CONTROLLING THE BASS

by NOEL BONAVIA-HUNT

Wireless Magazine

1/-

FEBRUARY 1935

Whether you are on A.C. or D.C. this Set will bring you the Foreigners

The "W.M." . . . . A.C./D.C. Super Four

All About . . . . . Multi-grid Valves

The £5. 5s. . . . . Battery Four-valver

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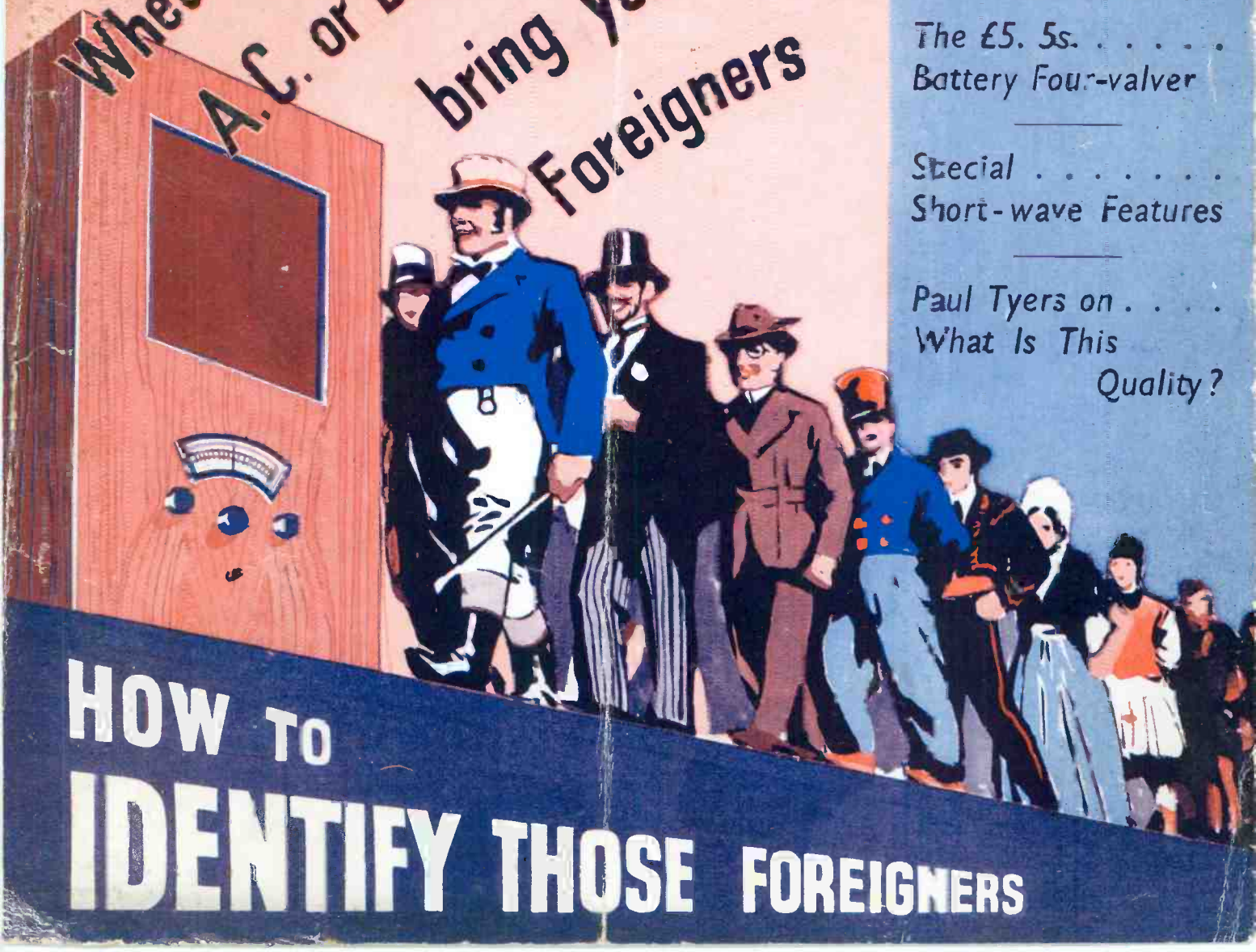
Paul Tyers on . . . . What Is This Quality?



HOW TO IDENTIFY THOSE FOREIGNERS

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What is This Quality?

FRANKLY, I do not know where to begin my "show-window" notes this month. "What is this Quality?" asks Paul D. Tyers, and what is this quality, I may be allowed to ask, that fills this issue of "Wireless Magazine" with articles of value to every serious reader? That sounds like a fanfare on my own trumpet. Perhaps it is. But please do turn over the pages for yourselves and taste that quality.

Look at Bonavia-Hunt's article, "Controlling the Bass Notes." He gives eight circuits, the last one representing a special method of his own which he claims to be the best he has ever tried.

Godchaux Abrahams tells us how to identify the foreigners and illustrates in his article how interval signals and station calls have changed during the past year. Further, he gives a practical method of identifying Continental stations which any reader lacking knowledge of foreign languages can easily follow.

Captain E. H. Robinson has built the "10-watt Amplifier," described in his article in this issue, for the sum of £12. It is a small sum for such a fine job and the reader needing a high-quality amplifier for gramophone and public-address work will find this the very thing.

Morton Barr comes to the aid of the worried reader who is lost in the maze of valves—hexodes, octodes, pentagrids, double-diode-triodes, etc., etc. He explains a number of modern types of valves available and shows how these valves function in circuits.

Then, for the beginner, is an article by L. O. Sparks, explaining the principles of automatic grid bias in both mains and battery sets. More and more it is the fashion to use automatic bias in battery sets—it is used in the £5 5s. Battery Four in this issue—and the article explains the fundamentals of the circuits used.

Freak ideas in loud-speakers come in for comment in the Paul D. Tyers' article "What is this Quality?" to which I made an opening reference. Mr. Tyers very cleverly handles a difficult subject.

Less for beginners than for the more experienced reader is J. D. Huffington's article "Directional Properties of Loud-speakers," dealing with the sound radiation effect of loud-speakers and particularly that of a new German two-diaphragm loud-speaker which radiates an equal proportion of sound in every direction. The article is illustrated with drawings and photographs showing how the new Telefunken loud-speaker is made and works.

H. Corbishley gives some useful hints in receiving television transmissions and mentions the common faults, correct scanning speed, etc., etc., while our friend Percy Harris continues his experiments which the constructor can carry out at home to find out how his set works. He is dealing with coils this time.

We present the final stage in our series of building up a set stage by stage. Last month we added a low-frequency stage to a two-valver described in a still earlier issue; now, we add the high-frequency amplification, the original two-valver now becoming the £5 5s. Battery Four.

Our Constructional Staff has given a lot of time to a set which sees the light in this issue, the A.C./D.C. Super Four, which represents the last word in universal design. The designers set out for quality and they've got it.

The most interesting technical point about the "W.M." A.C./D.C. Super Four is that, although a super-het, it does not make use of an intermediate-frequency amplifying valve.

By the way, on page 78 is a special note on the addressing of correspondence to "Wireless Magazine" from now on. Make a note of the new address. B. E. J.

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World's Broadcast Wavelengths

Stations best received in the British Isles are indicated in bold type. This 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	Pittsburgh 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. WIXAL (WEEI)		United States
19.67	Tashkent (Rim)		U.S.S.R.
19.68	**Radio Colonial FYA**		France
19.72	**Saxonburg W8XK (KDKA)**		United States
19.74	**Zeesen DJB**		Germany
19.82	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	Boston 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
31.55	**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	Guatemala City		S. America
45.02	Guayaquil HC2RL		Ecuador
45.38	Moscow RW72		U.S.S.R.
46.53	Barranquilla (HJIABB)		Colombia
46.69	Boundbrook W3XL (WJZ)		United States
46.7	Boston WIXAL		United States
47	Cali HJ5ABB		Colombia
47.5	S. Domingo HIZ		Dominican R.
47.8	Domingo HIAA		Dominican R.
48.75	Winnipeg CJRO		Canada
48.78	Caracas YV3BC		Venezuela
48.86	**Saxonburg (Pa.) W8XK (KDKA)**		United States
48.86	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
49.18	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 WIXAL (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 4.)

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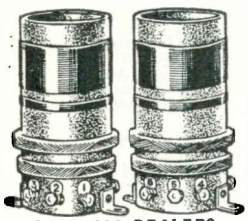
B.T.S. DROITWICH BAND CONTROL **COILS**



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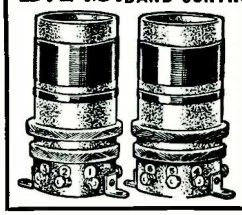

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EST. 1919

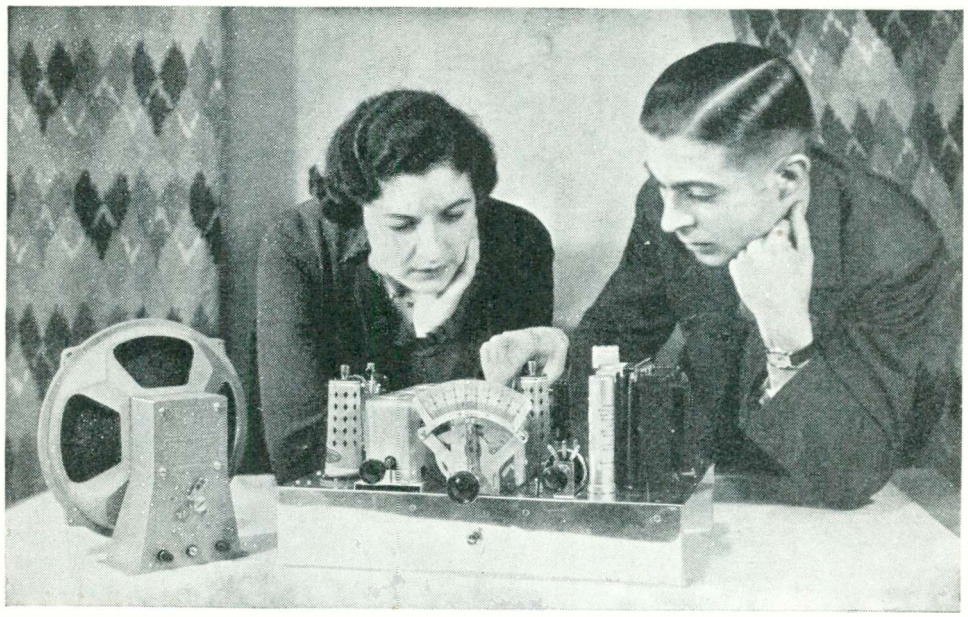
It helps us if you mention "Wireless Magazine"

WORLD'S BROADCAST WAVELENGTHS

Continued from page 2

Wavelength	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 CTICT		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
259.1	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
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
492.6	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
	Ostersund		Sweden
765	Boden		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
	Ankara		Turkey
1,339	Warsaw		Poland
1,354	Motala		Sweden
1,395	Eiffel Tower		France
1,442	Minsk		U.S.S.R.
1,500	Droitwich National		Great Britain
1,571	Deutschlandsender		Germany
1,600	Istanbul		Turkey
1,648	Radio Paris		France
1,724	Moscow No. 1		U.S.S.R.
1,807	Lahti		Finland
	Kootwijk		Holland
1,875	Huizen		Holland
	Brasov		Roumania
1,935	Kaunas		Lithuania

The "W.M." A.C./D.C. Super Four



Designed by the "Wireless Magazine" Technical Staff . . . .

THE most popular sets in the commercial world at the present time are undoubtedly four-valvers, usually called five-valvers because the rectifier is included; and the most recent advance in valve development is the range of universal or A.C./D.C. types now available.

We present to our readers this month the most recent advance in home-built receiver design, which is a five-valve combination (including rectifying valve) employing A.C./D.C valves. The valve combination is (1) pre high-frequency, (2) combined detector/oscillator, (3) second detector, (4) output, and (5) mains rectifier. Note that there is no intermediate-frequency stage.

About the Valves

The high-frequency valve is of the variable-mu pentode type and is the one of the Marconi Catkin range. The combined detector/oscillator is a heptode having a high conversion conductance. Another variable-mu high-frequency pentode is used as the second detector. The output pentode is also of the Catkin type, and is capable of giving an output of about 2 watts undistorted.

Let us refer to the circuit diagram and run through the various features of the receiver.

The grid circuit of the high-frequency valve is tuned by a coil and condenser in parallel. You will see that the aerial is connected to a switch which changes the position of tapping on medium and long waves. The effect of tapping down the aerial on the coil is to increase the selectivity.

The anode circuit of this high-frequency valve is coupled to the heptode frequency-changer by a tuned high-frequency transformer. By this means a saving in price of anode-circuit components is effected. The anode circuit of the frequency-changer consists of the primary of the one intermediate-frequency transformer and a decoupling resistance and condenser. This decoupling is common to the tuned transformer of the preceding valve, and consists of a 100,000-ohm resistance and a .5-microfarad condenser.

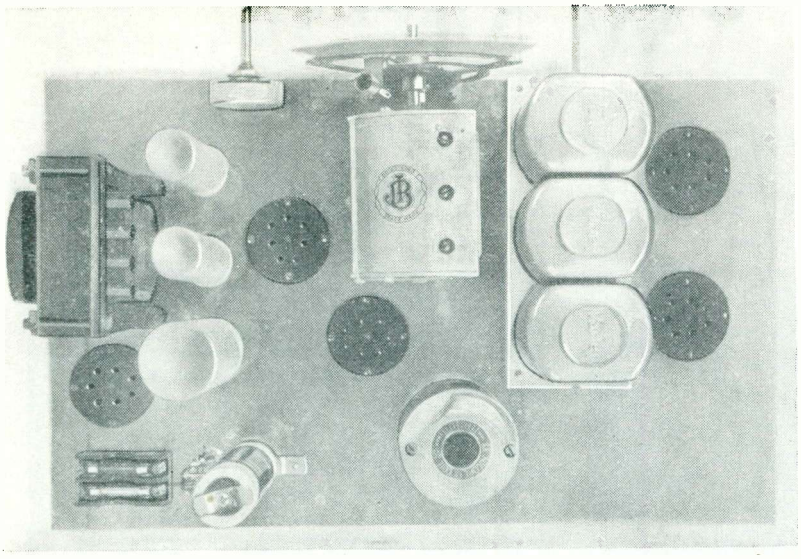
The oscillator grid and anode are, of course, tuned by a third coil and condenser. It will be noticed that the earth return of the oscillator grid winding is in series with a .002-microfarad pre-set condenser. The latter is used only on the higher waveband, being shorted out by a switch in the coil assembly when the set is used for medium-wave reception.

Padding Condenser

The action of this series condenser is to bring the oscillator section of the tuning arrangement into step on the long waves, without altering the ganging on medium waves or making it necessary to effect a compromise between the two.

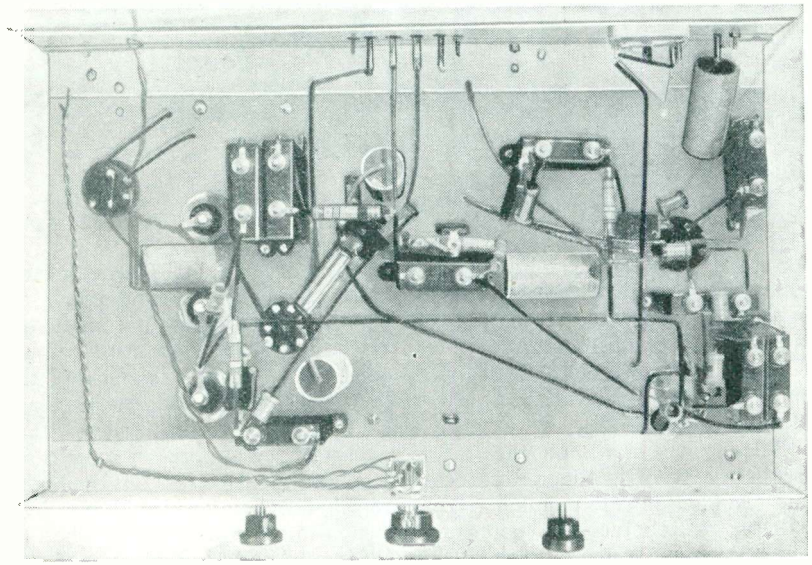
The plates of the oscillator tuning condenser are specially shaped in order that the necessary frequency difference between the received signal and the local oscillations is obtained. It is essential that this type of condenser shall be used.

A Super-het without an I.F. Amplifying Stage



PLAN VIEW OF TOP OF CHASSIS

It will be seen from this photograph that the chassis of the A.C. D.C. Super Four is very clean in appearance. Note the single intermediate-frequency coil behind the gang condenser



UNDERNEATH VIEW OF THE CHASSIS

All the small components needed for the circuit are accommodated on the underside of the aluminium chassis. The wiring is not very complicated

The three tuning condensers are ganged and a full-vision dial has been used. The dial pilot light is mounted on the actual pointer so that the light is always where it is wanted: that is, directly behind the pointer.

The three coils are mounted on one base and the switches are controlled by a single rod. All the coils, including the intermediate-frequency transformer, are of the iron-core type and, moreover, are the most suitable types for the job that we have yet tested.

The intermediate-frequency transformer deserves some comment. It has a variable selectivity device which is adjustable from zero to a 10-kilocycle peak separation by a half-turn of the slotted ebonite knob at the top of the coil can. This adjustment is easily made by inserting a coin in the slot and turning to the required selectivity, which is marked in ten divisions on the top of the can.

Both primary and secondary windings are adjustable by means of small trimming condensers, the latter being operated by turning ebonite rods protruding through the can. The tops of these rods are slotted so that the adjustment can easily be carried out with the aid of a screwdriver.

The secondary of this intermediate-transformer is centre-tapped and from this point the second detector grid is supplied through a .00005-microfarad condenser. This value of condenser, in conjunction with a 100,000-ohm grid resistance, gives maximum selectivity combined with good quality.

No I.F. Stage

You will notice that no intermediate-frequency stage has been incorporated. The reason for this is that a minimum of background noise was desired. The loss in amplification has been made up in the pre-detector high-frequency and second-detector stages. For this reason high-frequency pentodes have been utilised. The additional amplification obtainable from the second-detector stage alone has been found to make up for at least one stage of intermediate-frequency amplification.

No H.F. Choke

In the anode circuit of the second detector you will see that we have used, in place of the usual high-frequency choke, a fixed resistance. This serves the same purpose, that is of preventing high-frequency currents straying into the low-frequency side of the receiver. The resistance is less likely to induce hum than a choke, and is much cheaper.

On the anode side it is by-passed by a .0005-microfarad condenser, and on the high-tension side by a .0003-microfarad condenser.

This stage is resistance-capacity coupled to the output pentode, the grid resistance being a variable potentiometer. By this means the input to the grid can be reduced and the potentiometer therefore forms an efficient low-frequency volume control.

Low-voltage Electrolytics

The by-pass condensers for both second detector and output valves are of the low-voltage high-capacity electrolytic type; the bass response is thus well cared for.

Now let us take a glance at the high-tension supply circuit. The valve used is the Marconi U30. This can actually be used as a voltage-doubler or as a half-wave rectifier. In this receiver it is used as a half-

wave rectifier, when used on alternating-current mains.

When used on direct-current mains the rectifier operates only as a limiting resistance and a voltage drop of 10 to 15 volts only is obtained.

The two anodes and also the two cathodes of the rectifying valve have been connected in parallel in order to obtain the necessary current supply.

Twin Smoothing Choke

The voltage from the rectifying valve is passed on to a twin choke. This is virtually two chokes wound on a common core; the smoothing effect is greater than that of a single choke of similar dimensions, and the component is cheaper than two chokes.

The two sections have been joined in series so that we have in effect a centre-tapped choke; on the valve-side it is by-passed by an 8-microfarad, and the centre-tap and output end are by-passed by two 4-microfarad electrolytic condensers.

Electrolytic Condensers

There is only one connection to make to each electrolytic condenser, for the metal case is the second electrode, being automatically earthed through the metal chassis. The metal chassis is, of course, used for many of the earth returns as this simplifies and shortens the wiring of the receiver.

The construction presents little difficulty. If the chassis is obtained ready drilled the only tools required to assemble and wire the receiver are a screwdriver and a pair of long-nosed pliers.

If a soldering bit is used the actual wiring will be much easier and will "stay put" far longer than if the wires are merely clamped under the terminals; the earth wires can be soldered directly to the fixing bolts, which will be much quicker than unscrewing the nuts and then clamping the wires underneath them.

The chassis you can make yourself if the necessary tools are available. You will need a fretsaw or hacksaw to cut the aluminium plate and angle strip, and a brace and bits for the drilling operations; the bits you will require are a $1\frac{1}{4}$-in. centre bit for cutting the holes for the valve holders, a $\frac{3}{8}$-in. twist bit for drilling the holes for mounting components, and a $\frac{1}{8}$-in. twist bit for drilling the holes to take the No. 6 B.A. fixing bolts and the wires which pass through from top to bottom.

The chassis which we constructed consists of a plate 16 in. by 10 in., two strips 16 in. by 3 in., and two angle strips 16 in. long by 1 in. by 1 in. All of this metal is No. 16 gauge aluminium and was obtained from Stantons, of Shoe Lane, London, E.C.4, at a cost of 5s. 6d.

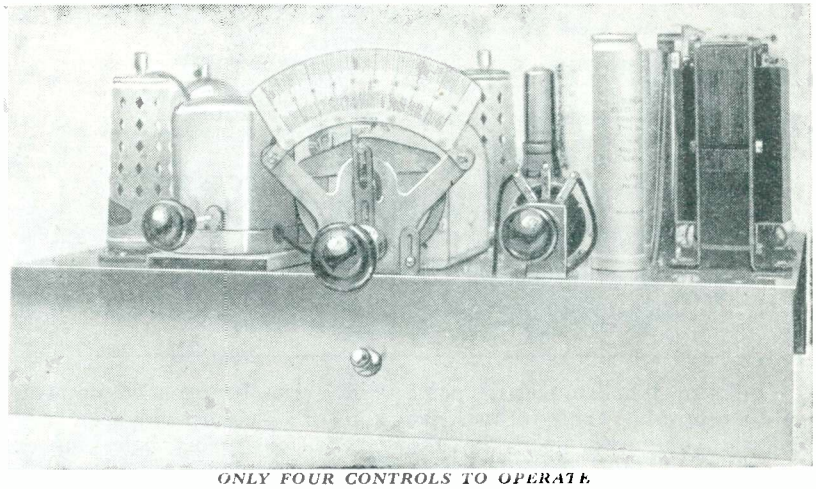
The aluminium plate is bought as a piece 16 in. square. From this are cut the two strips 16 in. by 3 in., leaving a piece 16 in. by 10 in. for the top plate. The cutting of this plate is quite easy if you use a fretsaw with a drop of oil on the blade. The rough edges on the aluminium can be smoothed with a knife, file, or a piece of sandpaper.

Making the Chassis

Eight bolts and nuts are used to hold each side strip in position; the holes for these should be drilled in this way: Drill four holes in the top plate as marked on the blueprint, then lay the angle strip on the plate so that the edges are level and mark the positions of the holes required in the strip.

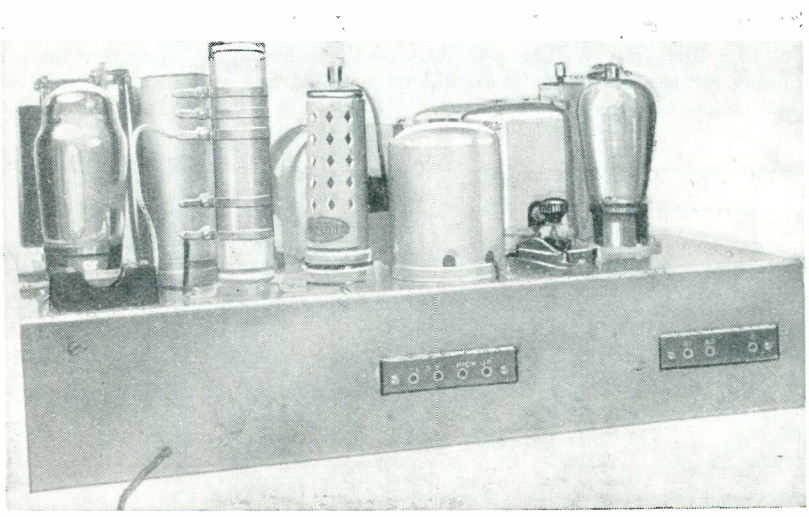
Now drill four holes in the supporting strip as marked on the blueprint and mark their positions on the angle strip. In this way you will not have the supporting strip too far one way and the angle strip too far the other way.

Having built the chassis the next job is to cut the holes for the valve holders. Mark the positions of the centres of the holes as indicated on the blueprint; if you have one of our full-size blueprints just lay the print of the baseplate on the chassis and mark through with a scriber.



ONLY FOUR CONTROLS TO OPERATE

From left to right can be seen the wave-change switch, the main tuning control and the volume control. Below the main tuning knob is the on-off switch



BACK VIEW OF THE ASSEMBLED SET

On the back of the chassis can be seen the sockets for aerial, earth, pick-up and loud-speaker connections. Note the two Catkin valves

COMPONENTS for "W.M." THE A.C./D.C. SUPER FOUR

	£ s. d.
CHASSIS	
1—Aluminium 16 in. by 10 in. by 3 in. (Peto Scott) ...	8 6
CHOKE, LOW-FREQUENCY	
1—Heayberd, type 753	1 1 0
CONDENSERS, FIXED	
1—.00005-microfarad, T.C.C., type M	8
1—.0001-microfarad, T.C.C., type Tubular	1 0
1—.0003-microfarad, T.C.C., type M	8
1—.0005-microfarad, T.C.C., type M	9
2—.001-microfarad, T.C.C., type M	2 0
6—.1-microfarad, T.C.C., type 50	11 0
3—.5-microfarad, Dubilier, type 4506	6 0
3—1-microfarad, T.C.C., type 50	7 6
1—8-microfarad, electrolytic, Dubilier, type 0281	5 6
2—4 - microfarad, electrolytic, Dubilier, type 0283	9 0
1—10-microfarad, electrolytic, Dubilier, type 401	2 6
1—20-microfarad, electrolytic, Dubilier, type 401	2 6
CONDENSERS, VARIABLE	
1—.0005-microfarad, three-gang Baby superhet type J.B. ...	16 0
1—.0003-microfarad, Radiophone	1 6
1—.002 - microfarad, preset, Goltone	1 0
COILS	
1—3-coil unit, Varley, type BP58	1 13 0
DIALS, SLOW-MOTION	
1—Arcuate drive, J.B. ...	5 9
HOLDERS, FUSE	
1—Twin, Bulgin type F11 ...	2 0
HOLDERS, VALVE	
5—Seven-pin, chassis mounting, Clix	3 9
METAL RECTIFIER	
1—Westinghouse, WM28 ...	10 0
PLUGS, TERMINALS, ETC.	
3—Clix anode connectors, type 21	4½
1—Clix aerial and earth strip, type 27	7
1—Clix loud-speaker and pick-up strip, type 26	8

	£ s. d.
RESISTANCES, FIXED	
1—200-ohm, type 1-watt, Franklin	6
2—250-ohm, type 1-watt, Franklin	1 0
1—5,000-ohm, type 1-watt, Franklin	6
2—10,000-ohm, type 1-watt, Franklin	1 0
1—20,000-ohm, type 1-watt, Franklin	6
1—25,000-ohm, type 1-watt, Franklin	6
4—50,000-ohm, type 1-watt, Franklin	2 6
3—100,000-ohm, type 1-watt, Franklin	2 3
2—¼-megohm, type ½-watt, Franklin	1 6
1—1-megohm, type ½-watt, Franklin	9
1—2-megohm, type ½-watt, Franklin	9
1—Series filament, Bulgin, type MR48	3 6
RESISTANCE, VARIABLE	
1—.5-megohm, Erie	3 6
SUNDRIES	
Connecting wire and sleeving (Goltone), say, ...	1 3
2-ft. screened sleeving (Goltone) say	6
1—1½-in. metal mounting bracket, say	3
4—Clix top-cap connectors ...	6
4—Doz. 6 B.A. ½ in. bolts and nuts	1 4
SWITCH	
1—Bulgin double-pole on-off, type S88	2 6
TRANSFORMER, INTER-MEDIATE-FREQUENCY	
1—Varley 110-kilocycles, type BP42	11 6
ACCESSORIES	
LOUD-SPEAKER	
1—W.B. Stentorian Senior, type PMS1	2 2 0
VALVES	
2—W30 Marconi catkin ...	1 15 0
1—H30 Marconi	13 6
1—N30 Marconi	18 6
1—U30 Marconi	15 0

Drill a small hole to take the point of the centre bit; the ⅛-in. twist bit will do quite well. Now lay the chassis on a piece of wood so that the point of the centre bit does not pierce the table, and cut the aluminium to about half its thickness; then turn the chassis over and cut from the other side. In this way you will get a reasonably clean hole which can be trimmed up with a knife or a piece of sandpaper.

The four fixing holes for each valve holder must now be drilled, using the ⅛-in. bit. These bits, by the way, can be obtained with a square shank to fit a brace, so that you do not need two drills.

The positions of the other components should now be marked and the necessary holes drilled. Care must be taken when fitting the Arcuate drive to the variable condenser; see that the pilot light does not strike the bolt heads on the condenser. This pilot light travels with the hair-line indicator so that maximum lighting is obtained just where it is required.

If our blueprint is followed for the fixing position of this slow-motion drive no difficulty will be experienced in the fitting.

Dial and Condenser Fixing

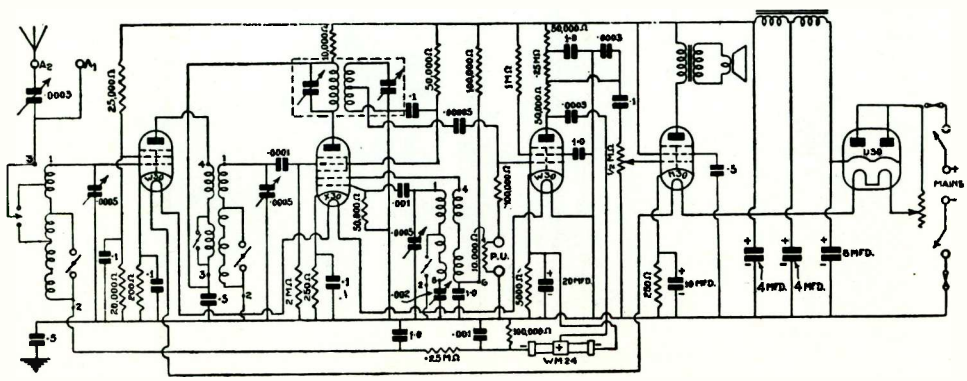
Make sure while you are fitting the condenser and dial that you have tightened up the screw that holds the condenser spindle to the dial bush. Some time was spent just recently with a set on which this little adjustment had been overlooked. The set oscillated, but when the *dial* was turned from 0 to 180 degrees the condenser vanes were not moving round at all.

When wiring up the coils you will find that it is much better to clamp the wire under the terminal than to use soldering tags and solder the connections. We find that the soldering tags are liable to short on the screening cans.

Small Points that Matter

Make quite sure that you leave sufficient wire to allow the coil can to fit over the wires, as if you have to strain the wires the oiled sleeving will wear through very quickly and a short-circuit will result. It is better to pay attention to these small points during construction than to spend time repairing the set when it is installed in the cabinet.

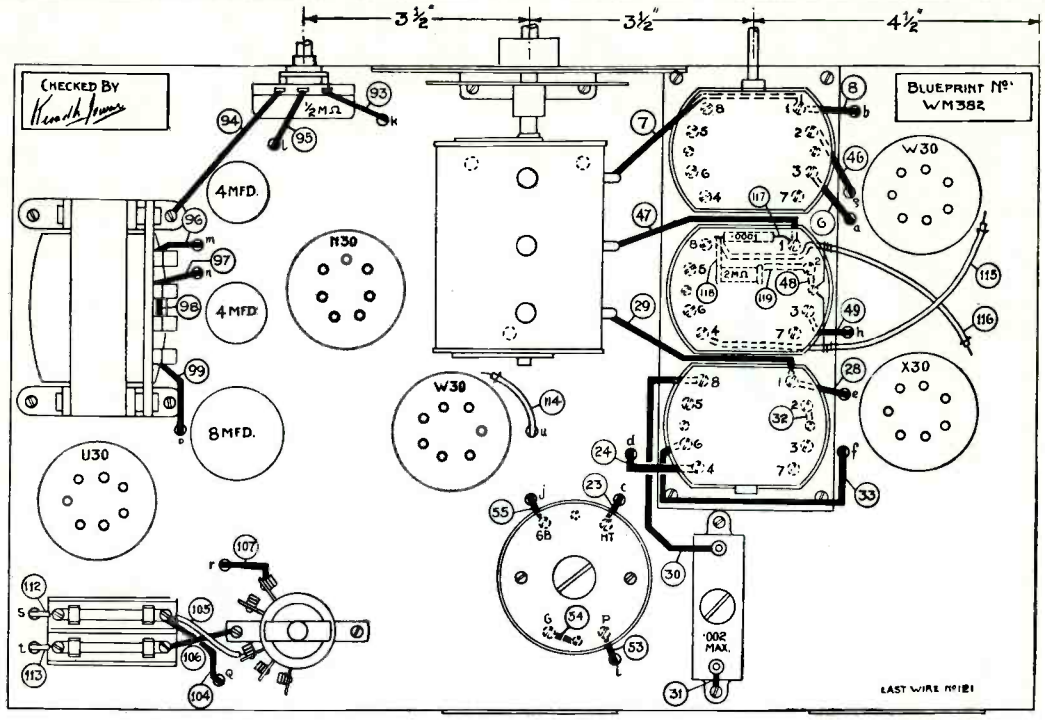
While we are on the question of the coil wiring it should be well to mention that the screened sleeving which is connected with the coils is not

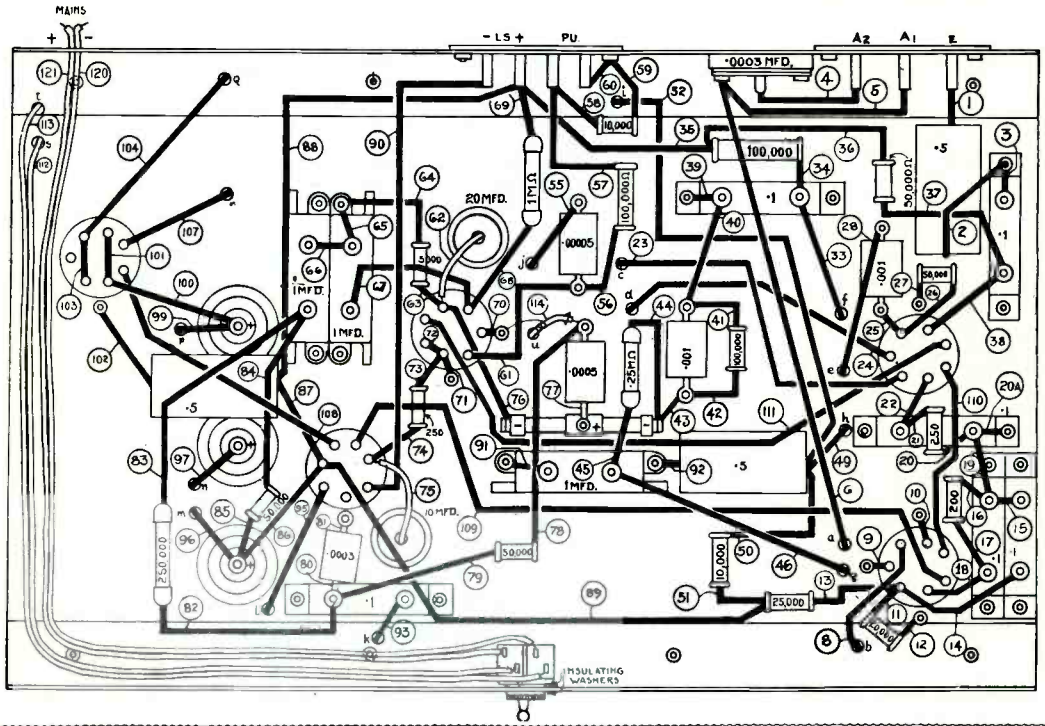


CIRCUIT OF THE A.C./D.C. SUPER FOUR

One of the most interesting features of this set is that there is no intermediate-frequency amplifier. The valve combination consists of a pre-high-frequency stage, detector-oscillator second detector and output pentode

Third-scale Layout and Wiring Guide





If desired a full-size blueprint of the set can be obtained for half price, that is 9d., post paid, on application to "Wireless Magazine" Blueprint Dept., 8-11 Southampton Street, Strand, W.C.2. The coupon on page 80 must be used and blueprint No. WM382 should be mentioned

continued for the whole length of the wires. It actually terminates at the point where the lead enters the coil can, otherwise the screening on the sleeving will short-circuit the coil terminals.

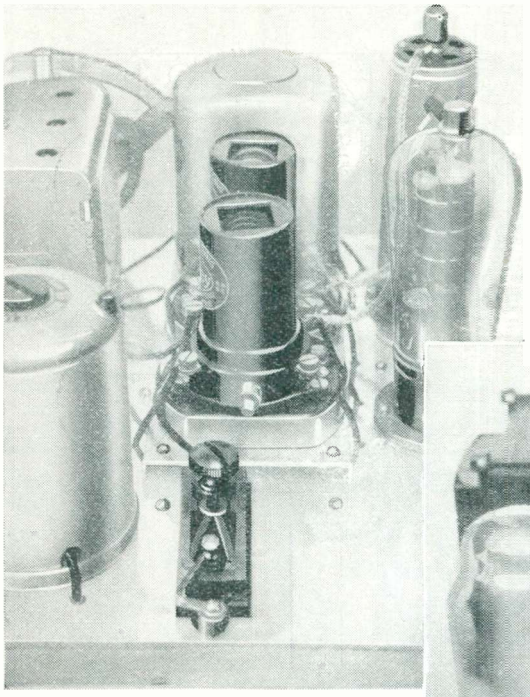
Another point about the screened sleeving is that it should not be allowed to touch the metal screening of the Catkin valves or it will short out the bias applied to them.

It is a good plan to run a little solder round the ends of the screening on these wires as this stops the ends from fraying out, but do not apply too much or the heat will burn through the oiled sleeving.

It is important that the mains on-off switch be insulated from the chassis, or when the set is switched on there will be a risk of a shock if the switch knob is touched while standing on an earthed conductor. If this switch is insulated from the chassis there will be no fear of a shock when the set has been placed in the cabinet.

Do not think that all these points are peculiar to this set—they are liable to crop up in the construction of any receiver.

Before leaving the construction of the receiver a hint on fitting it into



COIL ASSEMBLY "UNCANNED"
Iron-core coils are used throughout for the A.C./D.C. Super Four and there is, of course, only one wave-change switch

the cabinet will not be out of place. The ends of the control spindle should be covered with Chinese white or Blanco—ink can be used, but will not show up so clearly—and the receiver pushed into the cabinet. The foremost spindle will leave a mark on the front of the cabinet. Drill a hole large enough to clear this spindle and slide the receiver into the cabinet again.

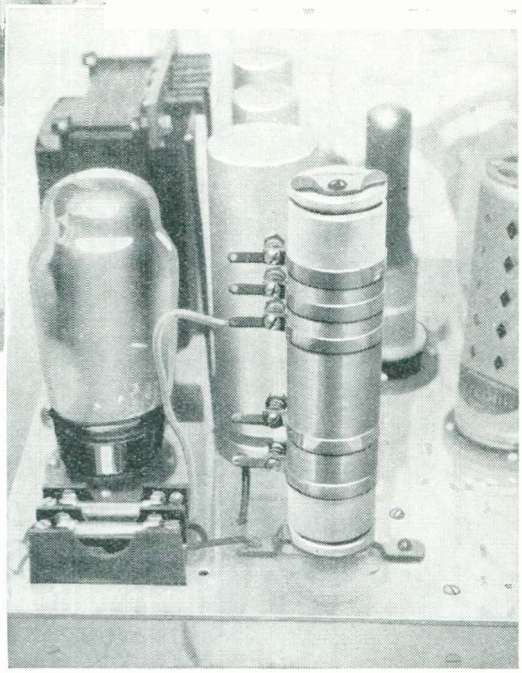
Drilling the Cabinet

This time the spindle which is next in length will leave a mark; drill another hole and repeat the process for the remaining spindles. In this way errors in marking out and in drilling are avoided.

Fitting the Escutcheon Plate

Now, using the drilling template for the escutcheon plate of the variable condenser, mark out the opening to be cut out. This should be done in the following way: Place the template on the front of the cabinet and centralise it with the hole that you have drilled for the slow-motion spindle. This will be easy if a light is placed inside the cabinet. Then prick through with a scriber the shape of the piece to be cut out.

To cut out the resulting pattern, drill a ⅜-in. hole and cut round the line with a keyhole saw: an alternative method is to drill round the line with the ½-in. bit so that the holes are almost touching. The unwanted piece of wood can then be knocked out and the edges of the hole trimmed with a file or knife and finished with a piece of sandpaper.



FOR D.C. VOLTAGE CONTROL
Here you see the breakdown resistance which is brought into use for controlling the voltage when the set is used on D.C. mains

Having completed the receiver, insert the valves in the appropriate sockets (the positions are shown on the blueprint) and adjust the mains resistance to the tapping corresponding to the voltage of your supply; this adjustment is the same whether your mains are A.C. or D.C.

Before Ganging

Disconnect wire number 1, which goes to the centre of the Westector, and so cut out the automatic volume control before starting to gang the set.

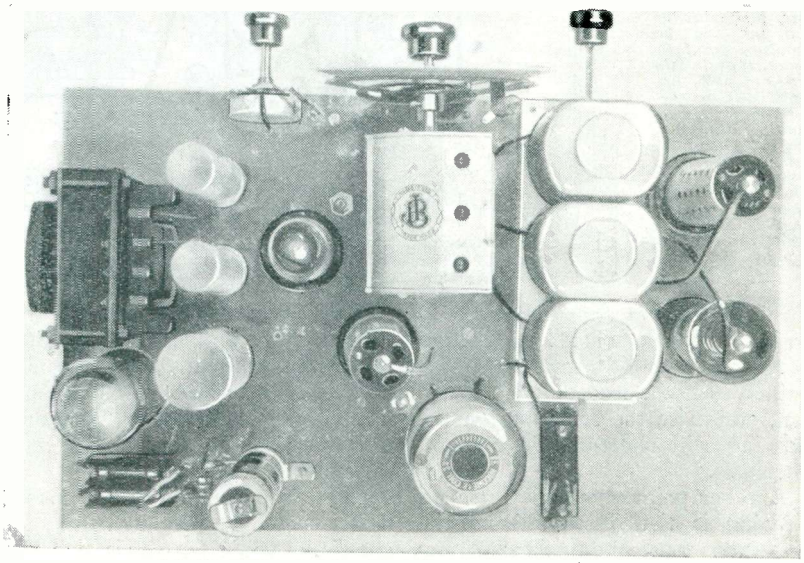
Having inserted the valves, adjusted the resistance and, of course, checked your wiring, plug in to the mains socket.

It is better to make the first test of the set before you place it in the cabinet, but take great care not to touch the chassis as it is connected to one side of the mains.

Switch on and allow about a minute for the valves to warm up, when you should hear some signal. If you are on D.C. mains and can get no signal, then the mains plug is in the wrong way round.

Connect the aerial, earth and loud-speaker.

Continued on page 79



COMPLETED CHASSIS WITH VALVES IN POSITION
Although only four valves are used, these are of such efficiency that the receiver is as good as most five-valve super-hets

All About Multi-grid Valves

A Comprehensive Survey of Modern Valves having from one to six grids

By MORTON BARR

These youngsters evidently think this huge transmitting valve is a big toy!

WHEN Lee de Forest put the grid into Fleming's two-electrode valve, he started a line of development which in due course produced first the four-electrode valve, and then the pentode.

Within the last year or so, the process of adding still more electrodes to the valve has been speeded up to such an extent that we are now faced with a four-grid or "fading-mixing" hexode, a five-grid heptode or pentagrid-converter, and a six-grid "octode" containing no less than eight electrodes, all of which take a hand in controlling the electron stream in its passage from cathode to anode.

The introduction of the first or control grid changed the early Fleming diode or rectifier into a sensitive relay. Because it is located close to the cathode a positively-biased grid assists the passage of the electron stream, first by breaking up the "space-charge", or crowd of electrons which tend to cluster around the heated cathode, and secondly by accelerating the flight of the free electrons towards the anode.

When negatively biased the grid checks the electron stream, and in the limit will stop it altogether.

The amplification factor of a valve is, in fact, a direct measure of the relative effect on the electron stream of 1 volt applied to the grid as compared with 1 volt applied to the anode. That is to say, a three-electrode valve with an amplification factor of 40 is that number of times more effective, as a relay or voltage-amplifier, than the original Fleming valve.

In the first two-grid valve, the extra grid was intended more particularly to cope with the space-charge formed by the crowd of electrons surrounding the heated filament.

When an electric current passes through a cold wire, the electrons flow inside the wire in much the same way as water flows through a

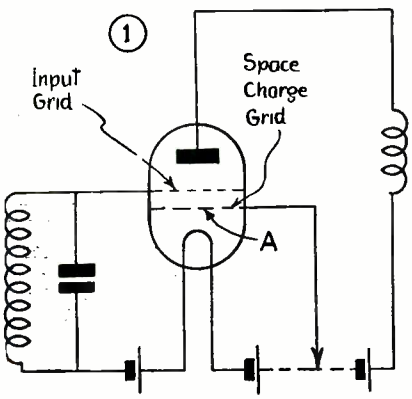


Fig. 1.—A four-electrode valve with space-charge grid

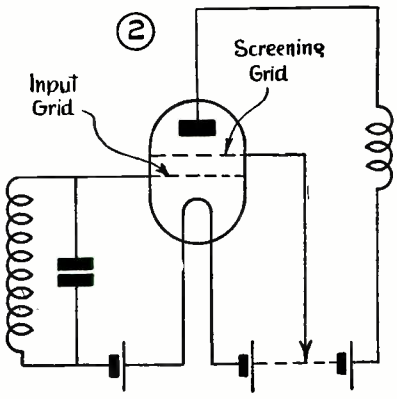


Fig. 2.—Showing the straightforward screen-grid valve

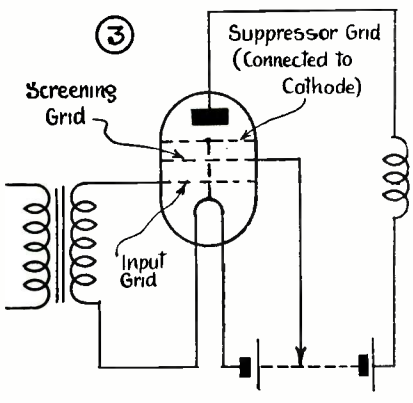


Fig. 3.—The arrangement of the three-grids of the pentode

hose pipe. On the other hand, a heated wire may be compared to a leaky hose-pipe, because it allows the electrons to spill over or spurt out under the pressure of the applied E.M.F.

A Wet Blanket

But once the initial velocity of the spurt is exhausted the emitted electrons tend to fall back and settle around the filament. Here they act as a wet blanket on others which are trying to leave the filament, and in this way tend to block the main electron stream through the valve.

The insertion of a grid A, Fig. 1, carrying a small fixed positive voltage and placed closer to the cathode than the ordinary control grid, serves to break up the cluster of electrons around the filament and so helps to foster a more copious emission thereby, of course, increasing the main electron stream. The space-charge grid also assists the "pull" of the plate voltage, and was largely used in the early days as a means of economising in high tension.

Its successor in the two-grid class is the well-known screen-grid valve in which the extra grid is located between the control grid and the plate as shown in Fig. 2.

It provided a simple cure for the troublesome instability of the ordinary three-electrode valve when used as a high-frequency amplifier. In spite of the small physical dimensions of the grid and plate electrodes, they are of sufficient size to form a coupling "link" between the input and output circuits inside the glass bulb, particularly when the valve is handling high-frequency currents.

The screening grid serves to intercept the lines of force which accompany the rise and fall of the high-frequency voltage on the plate and prevents them from reacting and transferring their energy to the control grid. It carries a fixed positive voltage in order to assist the main electron stream to reach the anode, but this does not prevent it from being effectively earthed so far as high-frequency currents are concerned.

The pentode—which introduces a third grid—was originally designed for the output stage on the low-frequency side of the set, where the valve is required to pass a comparatively heavy current in order to operate the loud-speaker. In these circumstances the effect of the highly-positive screening grid, located close to the plate, causes the mass of electrons to bombard the latter with such velocity that they produce "secondary" electrons in large numbers. These are then attracted back to the positively-charged grid and so form a reverse current which may completely mask the original signals.

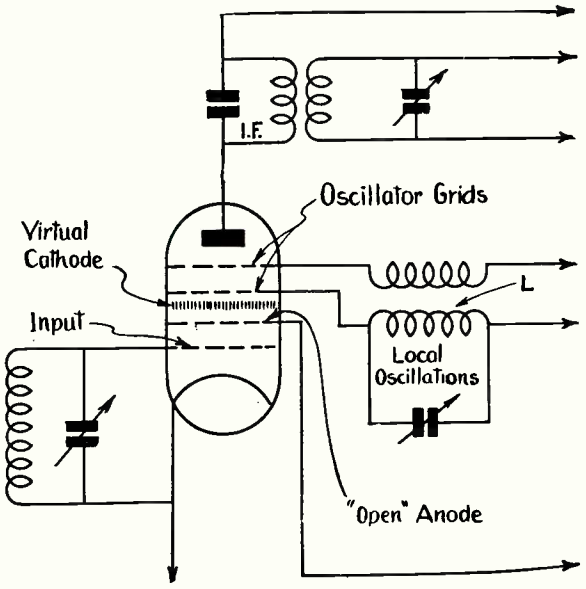


Fig. 4.—This circuit shows the electrode arrangement of the German hexode, or mixing valve

Pentode Suppressor Grid

To prevent this dynatron action the pentode is provided with a third or suppressor grid inserted between the screening grid and the plate, and is earthed by direct connection to the cathodes.

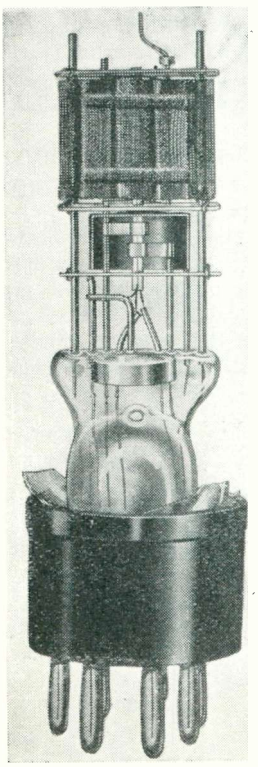
The outstanding merit of the low-frequency pentode is that it feeds a greater proportion of alternating or signal current to the loud-speaker—for a given drain on the high-tension battery—than any other type of valve.

H.F. Pentodes

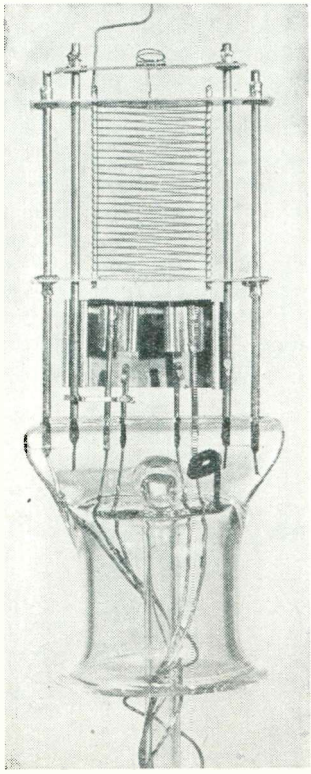
Before long, designers began to realise that the pentode could be just as useful on the high-frequency side as on the low-frequency side of the set. Here the third grid is not required to prevent dynatron action, but serves to perfect the shielding action of the ordinary screen grid.

At its best the latter is liable to let some of the electrostatic lines of force from the plate stray through its open windings and so reach the input grid. But the combined action of two earthed grids is completely effective in preventing any capacity coupling through the valve.

In practice the high-frequency



The arrangements of the electrodes in the Marconi double-diode-triode can be clearly seen here



Showing the electrode arrangement of the Mullard battery double-diode-triode: One of the most efficient valves of its type on the market

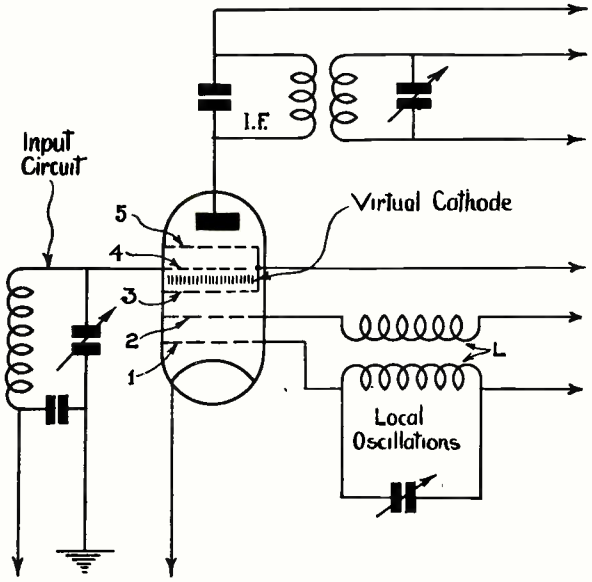


Fig. 5.—Showing the circuit arrangement of the heptode, or pentagrid converter. This valve has five grids

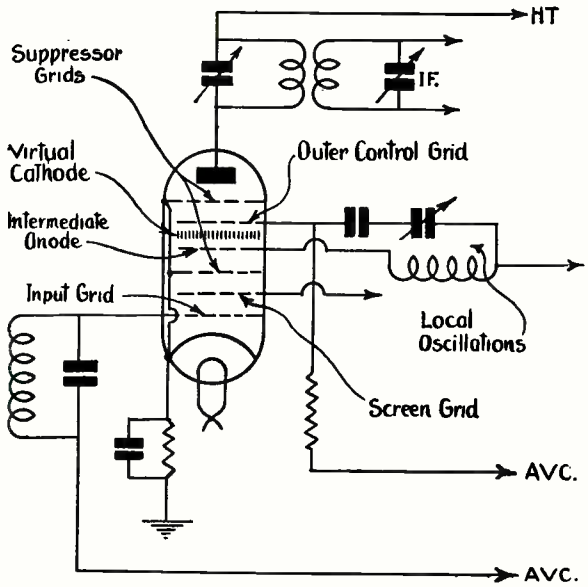


Fig. 6 shows the latest form of octode, a six-grid mixer valve used in up-to-date super-hets

pentode is beginning to replace the ordinary screen-grid valve, not only as a high-frequency amplifier and mixer, but also as a detector and in the intermediate-frequency stages of super-het receivers.

The universal popularity of the super-het circuit is in fact responsible for the appearance of the later and more complex form of multi-grid valve.

German Hexode

The German hexode or mixing valve is shown in Fig. 4. It contains four grids, one of which serves to create a special space-charge, indicated by the cross-hatched line, halfway along the main electron stream. This forms a reservoir of electrons or a virtual cathode from which the electrons required to produce the beat or intermediate frequency are drawn, as and when required.

The signal input is applied to the grid nearest the cathode. The second grid acts as an open anode which amplifies the signals and feeds the electron stream forward. Meanwhile the two upper grids are back-coupled at L to produce the local oscillations, which are then mixed with the amplified signals through the virtual cathode.

Pentagrid Converter

This method of electron coupling is perhaps more clearly seen in the five-grid valve, or pentagrid-converter, illustrated in Fig. 5. Here the cathode and the two grids nearest to it act as a local oscillator by virtue of the back-coupled coils L. Grid number two consists of two short rods so that it only intercepts a part of the electron stream, the rest moving forward through the valve.

Grid number three, which is made in two parts, 3 and 5, surrounds the input grid marked 4. The effect of the grid-electrode 3 is to create a reservoir or space-charge of electrons which acts as an artificial cathode for the upper part of the valve.

The signals are applied to grid number four and the resulting rise and fall in its voltage regulates the number of electrons which are drawn forward from the virtual cathode (shown cross-hatched) into the upper or amplifying part of the valve. In this way the signal and local oscillations are mixed together inside the valve, without being back-coupled through external circuits. The resulting intermediate-frequency oscillations are collected in the tuned intermediate-frequency circuit.

The chief merit of the pentagrid converter lies in the absence of any external coupling between the tuned input and local oscillator circuits. This makes it possible to gang these two circuits together without one reacting on the other. A second advantage is that the screening action of the grid, 3, 5, isolates the locally-generated oscillations from the aerial, and so prevents re-radiation.

In addition the valve has a variable-mu characteristic so that automatic volume control can be applied at the signal input, which is the most effective point in the receiver. Finally, it has a high-conversion factor, that is, it produces a high ratio of signal energy in the intermediate-frequency circuits.

Six-grid Octode

Fig. 6 shows the latest form of six-grid or octode valve. It is characterised by the use of a double-suppressor grid, the lower part of which is inserted between the first screen-grid and the intermediate anode; whilst the upper part is located next to the output anode. This grid is intended to prevent any tendency for the main electron stream to reverse or change direction at the two points in question.

Action of the Octode

The input signals are applied to the first grid as shown, and are amplified in the lower part of the valve, i.e., by the electrodes below the virtual cathode shown by the cross-hatched line. The upper set of electrodes generate the local oscillations, which are mixed with the signals by drawing upon the virtual cathode to form the intermediate-frequency oscillations in the final output circuit.

In this case, too, the mixing is performed by electron coupling, that is, by the interaction of the grids on the common electron stream flowing through the valve.

Fox photo

All the leaders in the dance-music world are here. Lew Stone is on the left playing the double bass, Mr. and Mrs. Christopher Stone occupy the centre position, while other "lads" include Harry Roy, Geraldo, Jack Hylton and Henry Hall

Are We Better Listeners Now?

By WHITAKER-WILSON

SURELY we must be? It stands to reason that twelve whole years—or, say, ten, to be on the safe side for many people—of taking in impressions through the ear alone must have seen some improvement in us. Also we have had thirty years of telephoning.

The fact that we are undoubtedly better listeners in 1935 than we were in 1925 seems to me to be reflected in the programmes which—I have noticed—are so much more specialised than they were only a few years ago—three or four at the most.

Every department of broadcasting is becoming divided, subdivided, and divided yet again. It is the only possible method by which British broadcasting can hope to reach British people. Abroad it must be very much easier because people's tastes are not so varying as here.

Nations devoted to opera-going are largely satisfied with operatic relays and music related to opera in the general sense. The Germans take their Beethoven and Wagner and Schumann and Mozart by the yard, so to speak. They will listen to prolonged transmissions of that type of music because it is in their blood. The Americans will not do that. Nor will we ourselves.

Our tastes seem to be so nicely contrasted that there are very few broadcasters who may really be said to be universally popular. Even men like Christopher Stone fail to please a certain class of listener. I know of quite a number who would never listen to him. Very much in the minority, of course; but the fact remains that not even he is universally popular.

I am not in a position to know whether other broadcasting corporations are in the habit of receiving as many letters in the course of a year as the B.B.C. Nor yet whether such broadcasting stations go by the concensus of opinion when they do get letters from their listeners.

I often wonder whether foreign nations take as much interest in broadcasting as we do. If they don't, I think the reason lies in the fact that the programmes as a whole are so much the same. Although I have heard delightful music from abroad, I have never been conscious of the same intimacy, the same homeliness I have noticed here. It may be impossible for me to forget the great distance lying between me and the source of the entertainment.

I suppose it is difficult to feel on the same terms of intimacy with Budapest, which must be a thousand air-miles away from my set, as with Brookmans Park, which is only five.

People are still saying the programmes are rubbish, but I doubt whether that is a fair thing to say. So much is broadcast which you and I and the next man dislike intensely that there is reason enough to be discontented, but the open view on the whole scheme of broadcasting must always be the understanding view—that the B.B.C. does make a sporting shot at pleasing a nation of widely differing individual tastes.

I have just been listening to the first of the new "Conversations in the Train" series, which was fairly popular last winter—certainly popular enough to merit a repeat this winter. The subject was one which would attract many, and repulse almost as many. Three people were supposed to be in the carriage. One of the men was a Communist. He was sitting face to face with a Fascist. There was also a woman present who had been imprisoned during the suffrage campaign.

These people began to argue the question of freedom. Was England a free country or not? Possibly they did not get very far in their argument because there was not time for one thing and, for another, it was impossible to reconcile their points of view in any case.

When the little scene was over I fell to thinking about it, but not for what it was worth as an argument. Indeed not. I could have flung in some acid remarks about all of them.

I really sided with the woman, but, even so, could not agree with more than two-thirds she said.

That was not the subject of my reflection at all. I debated in my own mind whether or not, as a piece of broadcasting, that little scene justified its place in a programme on a Saturday evening. I came to the conclusion that it did for the simple and excellent reason *that I had been definitely entertained for twenty minutes.* If I had been irritated I should have switched on to something else.

But I was sitting by the fire in an easy chair smoking a pipe and drinking coffee. Candidly, I admit to being a little intrigued by those three people. They definitely entertained me in a specialised way. Had anyone asked me earlier in the day whether I thought I should like to hear a discussion on such a subject between those three people I am not at all sure I should have said yes. The fact remains that I listened to it. With a pleasing result.

Surely, if an occasional broadcast takes any listener by surprise and definitely entertains him for twenty minutes, even though the rest of the programme is of no interest to him, he has got his farthing's worth of licence for that day?

As a matter of fact, later in the evening I settled down with a score of Tchaikovsky's piano concerto which I have heard more times than years I have lived. I did so because Moiseivitch was playing it and I knew I should enjoy his rendering, as I have done before so many times.

In between these two things I got on to St. George's Hall and heard a delicious piece of fooling by Claude Dampier, whom I considered very clever in his way. A xylophone was being played in that programme by Teddy Brown. Now, there is an instance. I admire Teddy Brown's technique on an instrument with which I have no real sympathy, but I did not pay him the compliment of listening because I did not want to spoil Moiseivitch and the concerto. He would understand my point of view.

I maintain that the more specialised the programmes become the better for us. Just for the sake of strengthening the argument, I instance another type of broadcast for which I have no personal use. I cannot listen to the St. Hilary miracle plays from Cornwall, at least, not with very great pleasure. Yet I have seen miracle plays I liked extremely. I may even be in the majority. You and most of your friends may not like those Cornish plays, but you cannot get away from the fact that they bring in hundreds of letters of appreciation from listeners who *do* like them. They are extremely popular.

It is useless for an atheist to bemoan the fact that eleven *more* million copies of the Bible were sold in 1934 than ever before—not eleven million, eleven *more* million! The figure is staggering. And it points to the necessity of broadcast religious services. The most popular broadcast of all is the Daily Service. I never hear it and possibly you do not either. On the other hand, both you and I have got to realise that thousands have heard and appreciated most of those services.

You may not like plays, but you must remember those who do. Quite a number of my friends will not listen to plays. They will do me the honour of listening to one of mine, but I take it as a poor sort of compliment *unless* they are really appreciative of radio drama.

The very fact that we are so critical of every kind of broadcast proves, to my way of thinking, that we are better listeners in 1935 than we were even in 1932 or 1933.

We still have those dear people with us who switch on in the morning and leave the set on all day, who hear a great deal and listen to nothing, but I am optimistic enough to think they are getting thinner in their ranks. Indeed, I sincerely hope so, because to them, if they but knew it, broadcasting is really a serious menace. It is all very well to "say it with music," but not to that extent.

Specialised programmes surely call for specialised listening. As a critic I have had often enough to listen to something which, in the ordinary way, I should have avoided. I remember complaining to the Drama Director one day about a play which had irritated me. I considered it pathetic drivel, and said so. He seemed amused. Then he said: "Every fifth play ought to annoy you like that."

Perhaps that was a good view of it. Every fifth play ought to annoy me because it was designed for listeners who are not keen on the sort of plays I am keen on. Yet are they any the worse for that? I think not. It simply means their minds run on different lines altogether. What I thought pathetic drivel

Cont. on page 18

H.M.V. photo

"Even men like Christopher Stone fail to pleased a certain class of listener. I know of quite a number who would never listen to him. Very much in the minority, of course."

The Quality-range Problem

By G. E. COATES

WITH the object of combining in one receiver the virtues both of range and quality, I have designed and built many sets of different types. All my efforts, however, have led me to conclude that in the same receiver a combination of range—that is, sensitivity—and quality is impossible.

The nearest approach to a satisfactory combination may be found in some of the largest commercial radiograms which embody variable selectivity.

With the idea that most of the distortion present in the average receiver was due to a non-linear detector, I built a six-valve super-het with diode detection, using a Westector resistance-capacity coupled to the low-frequency stages. Besides its sensitivity, the chief feature of a super-het is its high selectivity.

Narrow Frequency Band

High selectivity means the reception of only a narrow band of frequencies, say 8 kilocycles wide. Let us suppose that we are listening to Munich on 740 kilocycles; then let us find out what comes out of the loud-speaker, assuming a selectivity of 8 kilocycles—quite a moderate figure.

Eight-kilocycle selectivity means that we can only receive musical frequencies up to 4,000 cycles, that is, half the selectivity figure. Eight kilocycles thus effectually prevent the reception of any notes whose frequencies are greater than 4,000 cycles. What does this mean, and how much do we lose by this cut-off?

The most serious losses are of the harmonics of the violin, and, less important, of the flute, clarinet, and the piano. It is largely the presence of these harmonics, especially those due to the violin, that confers distinction upon a high-quality instrument. This explains why the super-het did not fulfil the requirements satisfactorily.

I turned to the straight receiver. Now, although marvellous results in the way of sensitivity are claimed for the high-frequency, detector-power type of receiver, these results are attained by the use of reaction, usually in conjunction with a leaky-grid detector. But both these arrangements tend to ruin the quality. What can we do about it?

After removing the leaky-grid detector and its reaction circuit we arrive at the combination, high-frequency, diode, low-frequency, power, usually making use of a double-diode-triode valve. This arrangement gives excellent quality, reproducing frequencies up to 12,000 cycles or more. But we find that our sensitivity is reduced so much that only the local station and one or two foreigners can be received at any strength. Addition of another high-frequency valve usually introduces some high-frequency distortion, and is not particularly satisfactory.

I have found that the best solution to the problem is to use two separate sets. One should be designed to give high-quality reception of the local station, and the other to receive any station it is possible to receive, paying no attention to quality.

The quality set I use is an all-mains high-frequency, diode, low-frequency, power type of receiver giving nearly perfect reproduction on the local station and good reception of one or two foreign broadcasters.

Ambitious "Super"

The other set I am using is an eight-valve super-het using a crystal-gate, and with the following type of circuit: pre-selector, first-detector, oscillator, two intermediate-frequency, detector, low-frequency, and power.

The selectivity is made variable by the introduction of a variable condenser shunting the crystal. The overall amplification is colossal, and the selectivity is variable from about 1 kilocycle to about 7 or 8 kilocycles. These two sets would suit almost anyone's needs.

ARE WE BETTER LISTENERS NOW?—Continued from page 17

may have appealed to them as romantic.

If our listening this year is to be really better than it was last we ought to become specialised listeners. I think we can all use the principle of trying anything once in order that our minds may become more open and receptive, but we should try in the long run to make our minds as *selective* as we like our sets to be!

It is not a bad idea to sum up our likes and dislikes. I can do so with mine fairly easily. I like symphony concerts, chamber music, drama. I also like good comedians because I like to laugh; dance music to a certain degree—I make a practice of listening to a good deal of it during the course of the year.

I avoid novelty quartets, accordion bands, indeed most of that class of broadcast, popular as it is. I hear a certain number of talks, but am very particular about the talker. If he proves merely a bad reader I am apt to switch him off.

I generally avoid musical comedy because I am not too keen on that sort of music, but if I hear *beforehand* that the music is likely to be good I give it a trial. I occasionally listen to a relay from a cathedral.

Can you put down what you are likely to want to hear? Can you glance through the programmes and detect at once what you want? And, if so, do you try to "keep an appointment" to listen, not merely to have the set on while you talk or eat a meal? That is what is going to make all of us better listeners in 1935.

There is nothing to be gained by reading a novel during the broadcast of a play, because the two sets of dialogue will not agree. To read a book and hear chamber music is not a bad plan. It is hardly fair to either but it can be done pleasurably. Indeed, to some it may be a means of coming to appreciate chamber music, one of the highest forms of art in the world.

My firm opinion is that the low-brow attitude is going to get you nowhere.

What You Should Know About Short-wave Design. No. 3.

Low-frequency Coupling Circuits

Here we present the final article of a series by KENNETH JOWERS in which he has dealt with the ins and outs of short-wave design. He describes here six methods of low-frequency coupling, pointing out their bearing on short-wave working. It should be remembered, however, that the circuits shown apply to ordinary broadcast-band receivers

IT is quite safe to say that the average short-wave receiver only makes use of one low-frequency stage. I might go further and say that the majority of people who are using two low-frequency stages would probably get the same gain from a properly designed single stage.

Unnecessary Gain

At the same time the increase we get by using two stages is not really necessary when using headphones. Commercial stations and static come in at tremendous strength and to have every other station "R99" makes headphone listening rather a strain.

Taking it for granted that there is only one low-frequency stage, it does narrow down the different methods of coupling and the types of valve to use; but even so, six totally different circuits still remain, and unless you have gone very thoroughly into each circuit you are likely to become muddled.

These six circuits are: resistance-capacity coupling, impedance coupling, transformer, push-pull, class-B, and the lesser-known direct coupling introduced by Loftin White some years ago.

I am not going to try and tell you which is the best circuit out of the six mentioned. So much depends on what you have in mind. Almost invariably a compromise has to be made. With one circuit you may perhaps get good quality and poor reaction. With another good reaction, good quality, slight reduction in volume, and so on.

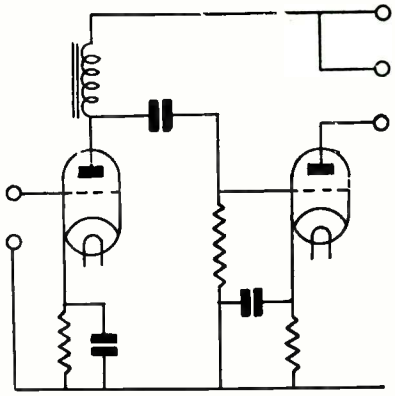


Fig. 2.—The impedance-coupled method, which ensures adequate voltage on the detector valve

Let me tell you just which points are coupled with these six different circuits and then you will be able to choose for yourself the type of low-frequency circuit you will employ in your next receiver.

The resistance-capacity coupled circuit is from an elementary point of view the simplest type of hook-up

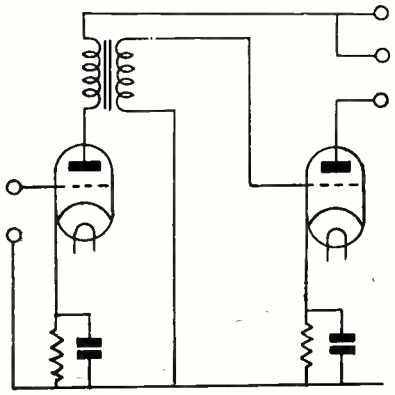


Fig. 3.—The most popular form of low-frequency coupling, the step-up transformer method

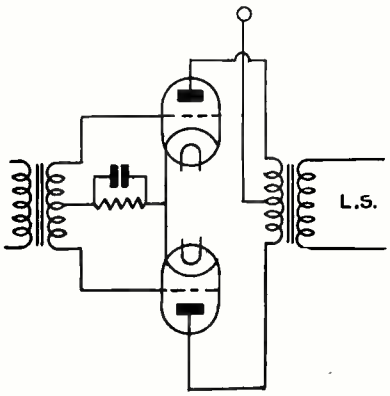


Fig. 4.—The push-pull method is rather an expensive low-frequency coupling for battery users

available. In a measure, the construction of such an amplifier is very simple; but if you want to get really the best results, it is not quite so simple as it looks.

Almost any values of resistance and condenser will give results, but it requires careful design if you are

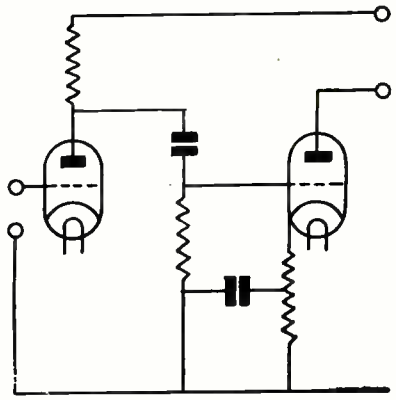


Fig. 1.—Showing the ordinary resistance-capacity method of low-frequency coupling. Careful design is needed

to obtain good quality plus a fair percentage of amplification.

If it is intended to use a triode valve with an average impedance of about 20,000 ohms, unless you use a high value of anode resistance the stage gain will drop. You will appreciate that immediately the anode resistance is increased above 75,000 or 100,000 ohms, the anode voltage will drop and so we get back to where we were at the beginning.

Screen-grid Detector

Again, with this method of coupling there is little scope for simple tone correction. In a way you can overcome the majority of these defects by using a screen-grid detector. Providing it is used on the anode-bend principle with a fractional anode current, you can use a high anode resistance without causing a voltage drop and so obtain quite a good step up. On the other hand, the conventional methods of obtaining regeneration cannot satisfactorily be used.

The impedance method is very similar to the resistance-capacity method, but it is more suitable for battery-operated receivers. In this type of circuit the anode impedance

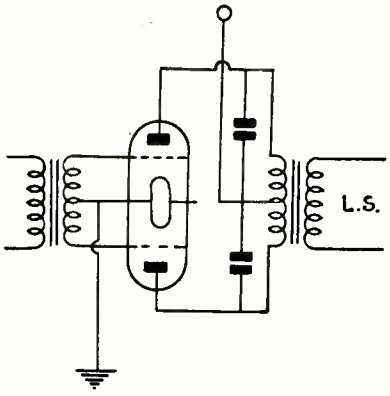


Fig. 5.—The class-B method lends itself particularly well to short-wave use

takes the form of a high-inductance low-current choke. About 50 per cent of the theoretical amplification factor of the valve is obtained, not so much because the anode impedance is correct, but owing to the fact that the D.C. resistance is low so that there is no appreciable voltage drop.

Small Voltage Drop

Normal regeneration circuits can be used so that this hook-up is worth considering. There is no doubt that the most popular low-frequency circuit uses the step-up transformer. With this type of circuit you get a very small voltage drop, a distinct step up of approximately 75 per cent of the theoretical amplification factor of the valve, plus a further two or three times through the low-frequency transformer.

A triode valve must be used to obtain satisfactory results owing to the fact that the external impedance is not high enough to match up with a multi-electrode valve of a screen-grid type.

It is possible to use a screen-grid valve with a low-frequency transformer by connecting a high resistance across the primary of the transformer. This is reasonably satisfactory, but as a general rule stick to resistance-coupling with a high-impedance valve.

A variation on this is the parallel-feed method, which is a combination of resistance and transformer coupling. With this type of circuit you can use a screen-grid or pentode detector having a resistance as an anode impedance with speech currents fed into a low-frequency transformer having one side of its primary connected to earth. In this way you will obtain the advantage of resistance coupling plus the step-up of transformer coupling.

With large receivers, such as super-hets having double-diode-triodes or wide grid base detectors, it is sometimes an advantage to use push-pull output. It has the same advantages as transformer coupling plus the advantage that by using two valves in the output circuit, considerably greater input can be handled without distortion, and at the same time the high-tension voltage available need not be particularly high.

Getting Smooth Reaction

One of the advantages of low-frequency transformer or push-pull couplings is that capacity reaction can be used and the user stands a level chance of obtaining smooth oscillation over all wavebands. Even

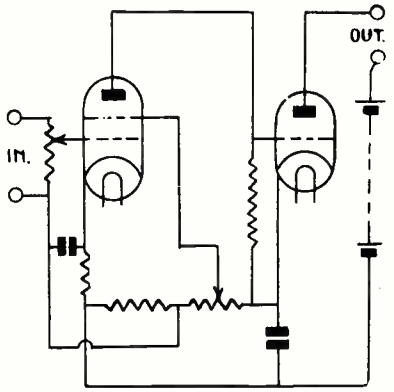


Fig. 6.—400 volts or more high tension is needed in this direct-coupled method if the best results are to be obtained

if there is a little grunt now and then, this can easily be overcome by using a few odd fixed capacities here and there, or perhaps grid stoppers.

Thinking more of the battery-operated receiver, push-pull is likely to make a distinct " hole " in a dry battery. As a general rule, judging from past experience, a high-tension battery in a push-pull circuit only lasts a month or so, consequently one cannot really expect push-pull to be over-popular.

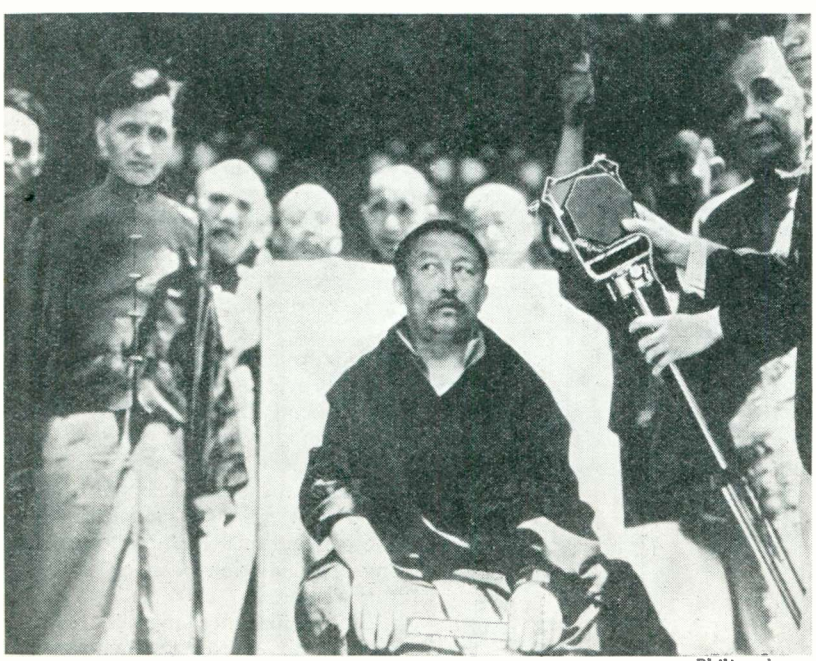
Class-B Amplification

If you are unfortunate enough to be tied to batteries, then remember that class-B amplification will probably solve your troubles. As you probably know, it uses two triode valves in one bulb, having a common filament.

With this type of circuit the anode current depends to a certain extent on the amount of output. While you are searching round looking for signals, the anode current will be almost negligible. Immediately a station is tuned-in, then the anode current will rise in proportion with the strength of the station.

This is almost an ideal arrangement, for half the time on short-wave working the signal strength does not cause the anode current to rise more than a milliampere or so.

Continued on page 79



Philips photo

THE PANCHEN LAMA BEFORE THE MICROPHONE

The Panchen Lama, one of the two supreme pontiffs of the Buddhist faith who rarely leave Lhassa—the forbidden city of Tibet—photographed before the mike when on a recent visit to Shanghai for a big religious gathering

Tests of New Apparatus

W.B. Midget Moving-coil Loud-speaker :: Graham-Farish Pick-up :: Tungsram Battery Heptode

W.B. MIDGET LOUD-SPEAKER

APPARATUS: Midget loud-speaker.
MAKERS: Whiteley Electrical Radio Co., Ltd.
PRICE: £1 2s. 6d.

THIS is one of the new loud-speakers embodying the magnesium alloy and which first made its public appearance at the Exhibition last year.

The effectiveness of this new material can be judged from the fact that the sensitivity of this loud-speaker is not noticeably less than the average 7 in. or 8 in. instrument. Yet the magnet system is only 2¼ in. by 2¼ in. by 1 in., with the other dimensions correspondingly reduced.

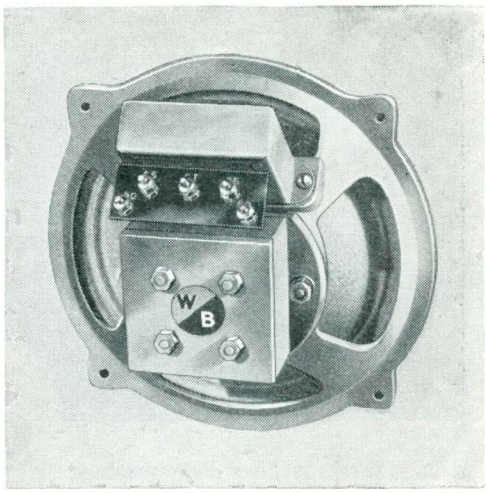
The diaphragm itself is a 5-in. cone of a flexible material, crimped at the outer edges to give the necessary movement. It is housed in a small casting, which also carries the output transformer having a variety of ratios and a centre tap.

Opinion as regards the reproduction will depend on the hearer. The bass is well in evidence, as also are the upper frequencies up to about 5,000 cycles, which is sufficient for most requirements.

Instead of the usual dip in the middle of the response curve there is actually a resonance around 1,500 cycles. This is not sharp, but spreads over an appreciable proportion of the middle frequencies and therefore is not of unpleasant incidence.

On the other hand, the attack seemed a little disappointing, possibly because of the material used for the diaphragm. Certain classes of music seemed a little dead.

For all that the component is a remarkable production, well in keeping with this firm's reputation.



The Midget Loud-speaker made by W.B. gives good volume and tone for its size

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GRAHAM FARISH PICK-UP

APPARATUS: Gramophone pick-up.
MAKERS: Graham Farish, Ltd.
PRICE: 14s. 6d.

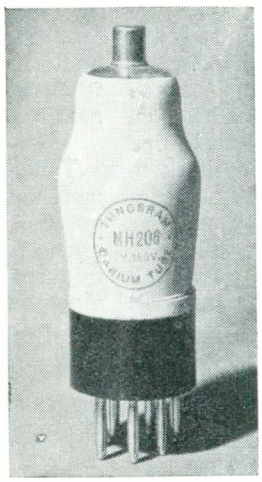
THE pick-up casing and tone-arm are one continuous moulding carried at the rear end on a small swivelling fitting. The tone-arm lifts right up in the vertical position and locks there for convenience in changing the needle.

The mechanism itself is of conventional construction, an armature pivoted in a magnetic field being surrounded by the coil in which the voice-frequency currents are generated.

We found that the damping was inclined to be rather stiff. This resulted in a bass resonance at around 150 cycles. Below 100 cycles, however, this output falls off rather rapidly.

Over the middle register the output is level and has a value of approximately .5 volt. There is a sharp rise at around 3,500 cycles followed by a sharp cut-off.

Considering the price this is a production which will find many buyers.



The new Tungsram MH206 has a metal cap and is of the seven-pin variety

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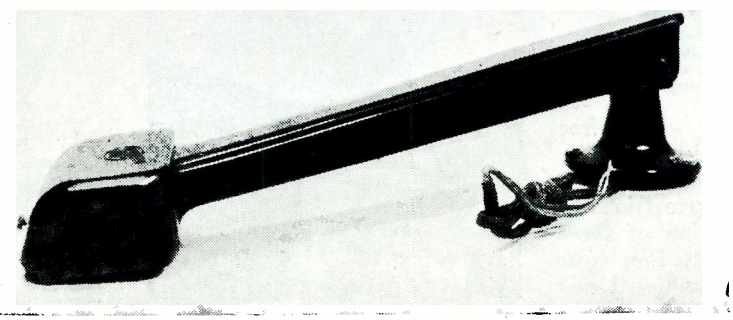
TUNGSRAM BATTERY HEPTODE

APPARATUS: Battery heptode.
MAKERS: Tungsram Electric Lamp Works (G.B.), Ltd.
PRICE: 15s.

A BATTERY-operated heptode which will run from a 2-volt accumulator and only consume .06-ampere filament current has just been announced by Tungsram. It is a great achievement and is a definite step towards bringing down the total filament consumption with multi-valve sets.

This new valve, designated the MH206, is of the metallised type with standard seven-pin base. The maximum anode voltage that can be applied to the *detector* anode is 150, and 130 to the *oscillator* anode. It also requires 22 volts negative bias and 75 volts on the auxillary screen.

We have tested this valve with standard super-hets and found that it oscillates quite freely over all wavebands.



For those who require a cheap and efficient pick-up, the new Graham Farish model is to be recommended

This fine photograph was taken in Billy Mayerl's home and shows the famous syncopated pianist rattling over the ivories with his wife. This pair recently recorded some outstanding duets for Columbia

PROGRAMME NOTES and NEWS

By T. F. HENN

ONE of my New Year resolutions was to listen in more frequently and more often. It was with this resolution in mind that I listened to the whole of Henry Hall's Guest Night programme on January 5. Another reason which made me listen was that little birds

A popular artist, Wyn Richmond is frequently heard in light shows from Broadcasting House

have been whispering about free advertisements creeping into these programmes.

I can hardly pen my reactions to Lew Leslie's presentation of short excerpts from his show, *Blackbirds of 1935*. You probably heard this show. Lew was obviously feeling very pleased about Henry Hall's pronouncement that he had the freedom of the microphone. He took Henry too literally. "If you want to hear Valaida at her best you cannot . . . etc."—or words to that effect—came as a terrific shock to me, knowing the B.B.C.'s stern attitude to the sponsored-programme question as a whole.

Personally I have no grouse at all against advertising programmes. In fact, my own view is that, provided the sponsors are kept under strict surveillance, we should immediately find a marked improvement in our programmes.

It seemed to me that something happened at Broadcasting House on that particular Saturday night. Maybe it was that something was said in the studio, for pronouncements were of a less pronounced character after that thrilling second or two. Anyway, praise where praise is due: Valaida was truly grand!

But, mark you, I am definitely against such free advertisements. If it is good for one, it is good for all. It all points to a distinct meanness on the part of the B.B.C. Only those who have free entertainment to offer get the freedom of the mike.

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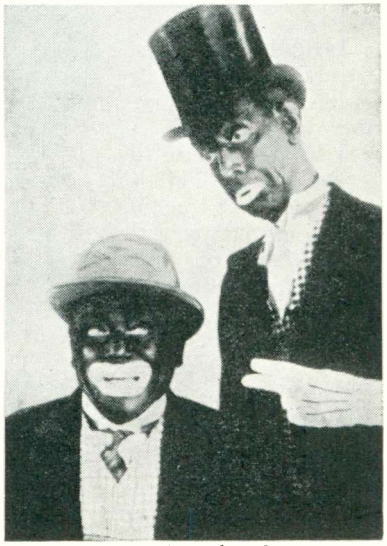
Talking about sponsored programmes, one is naturally led to the question of broadcasts of gramophone records. The B.B.C. makes frequent use of records, and in ninety-nine cases out of a hundred the name, number and make of

A newcomer to Hughie Green's gang, Ella Wilson is Scotland's champion piano accordianist



This pair have been heard in recent Kentucky Minstrel shows. They are Alexander and Mose

record are given. That is free publicity all right, but it does not end there.

I heard rumours that the company which looks after the rights of the gramophone companies is asking for a payment each time a record is broadcast. Seems fantastic, doesn't it ?

The figure mentioned does not really matter except that it is such that it might pay the B.B.C. to drop gramophone records altogether and put on real live artists instead.

Anyway, negotiations of a friendly nature are going on, and it looks as if everything will be settled quite amicably.

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Read an interesting paragraph in *Radio Pictorial* dated January 11. This paragraph said that Sheila Borrett—the one and only lady announcer to grace Broadcasting House—is returning to the mike as an announcer. The date was reported as a mystery, but the end of January was mentioned as a likely time. Whether Sheila Borrett is taking a permanent position I cannot say, although I have tried hard to find out.

My only comment is that I hope it is a permanency. Ideas change quickly, and perhaps those responsible for her exit have realised that a lady's charming voice does help to break programme monotony.

Her return must be to please the men, because I distinctly remember being told by an official at Broadcasting House that it was the women listeners who were not too pleased with her announcing. Jealousy, eh!

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First details are now available of a 1935 Music Festival, which the B.B.C. proposes to hold in Queen's Hall between May 10 and June 14.

Heard with Joe Loss' Kit Cat Band, Annette Keith is the lady who sings those charming vocal choruses

The gentleman on the right needs no introduction. It is Harry Roy at the Mayfair Hotel mike with one of his vocalists. Harry looks full of mischief, doesn't he ?

The concerts will be given on May 10, 17, 22, and 27, and June 3, 5, 12, and 14.

At the time of writing nothing definite has been fixed about the works to be performed except that the concert on Friday, May 10, is to commemorate the 250th anniversary of Bach's birth. On this date Adrian Boult is conducting a performance of Bach's B Minor Mass.

The other three concerts in May are to be conducted by Serge Koussevitzsky, who conducted at the 1934 Music Festival.

A fine tenor, Heddle Nash has delighted thousands of listeners with his singing in recent concerts

The great event of the festival is the four concerts which Arturo Toscanini is to conduct in June. Toscanni's visits to England are rare and memorable occasions. He is probably the world's greatest conductor, and we can look forward to some delightful renderings of great music.

An unusual feature is being adopted for the first time at these concerts. The major works in the programmes of June 3 and 12 are to be repeated in the concerts of June 5 and 14.

The B.B.C.'s reason may enlighten you. They say that the repeats are " not only for the benefit of listeners who cannot hear them on the first occasion, but for those who appreciate an opportunity of making a better acquaintance with music in such a way."

There are two B.B.C. Symphony Concerts at Queen's Hall during February. The first, on February 6, is notable for a performance of Holst's *Scherzo*, which is a part of a symphony he left unfinished at his death last year.

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London is the place for sensational reports on B.B.C. activities. The latest, at least at the time of writing, is that the Corporation has plans for building a theatre to which listeners would be admitted at a moderate charge. All wrong, of course!

The position is that in time Broadcasting House is to be extended along Portland Place. The extent of the enlargement will mean that Broadcasting House will be about

Two favourite duettists who still command as big an audience as ever, Layton and Johnstone

half again as large. In the extension it is probable that a small vaudeville theatre will be included, but even that plan is not definitely settled.

In the meantime the B.B.C. has St. George's Hall from which most of the vaudeville shows and a number of light orchestral concerts are broadcast. It has been proved, as you well know, that a small audience gives life to a show and helps the performers tremendously.

The B.B.C. has a lease on St. George's Hall until well into 1942, and the Corporation is perfectly satisfied with it. It is more than unlikely that any theatre will be built or rented by the B.B.C. until 1942, and then, in all probability, the lease on St. George's Hall will be renewed for a further period.

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February is to be the big month for winter programmes, especially for those of the lighter variety. As I mentioned some little while back, the B.B.C. has been busy improving and developing its organisation for this side of programme activities. February will see the fruit of its labours.

The plans are not fully matured yet, but how's this for a beginning? February 4 will see Geraldo giving another of his one-hour non-stop programmes. Too good to need comment! Also light on this day is an orchestral concert of light Spanish music with Pedro Morales as conductor.

On February 5, Leonard Henry keeps the ball rolling by presenting a concert-party show with himself, Harry Pepper and Doris Arnold at the pianos, those Dancing Daughters, and the Variety Orchestra.

John Watt is to present another of those anonymous variety shows on February 7 in which listeners guess the names of the artists taking part.

American variety fills the bill for February 8, while on the following day there will be the usual Saturday night Music Hall programme. Incidentally on this day there is a relay of a Ketelbey concert from the Kingsway Hall. Good stuff, this! Later on that night is a programme called "*Macabre*" *Ghost Programme*. Too thrilling for words!

It may be worth while to renew your licence after all!

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Maybe you were interested in the results of the Saar plebiscite and probably you tuned in your set on January 15 to hear the results. If you did you will remember that before the results were given we heard a number of gramophone records of a very brisk kind.

I have thought, and said so, for a number of years, that the B.B.C. is sadly neglecting its duty in the early morning.

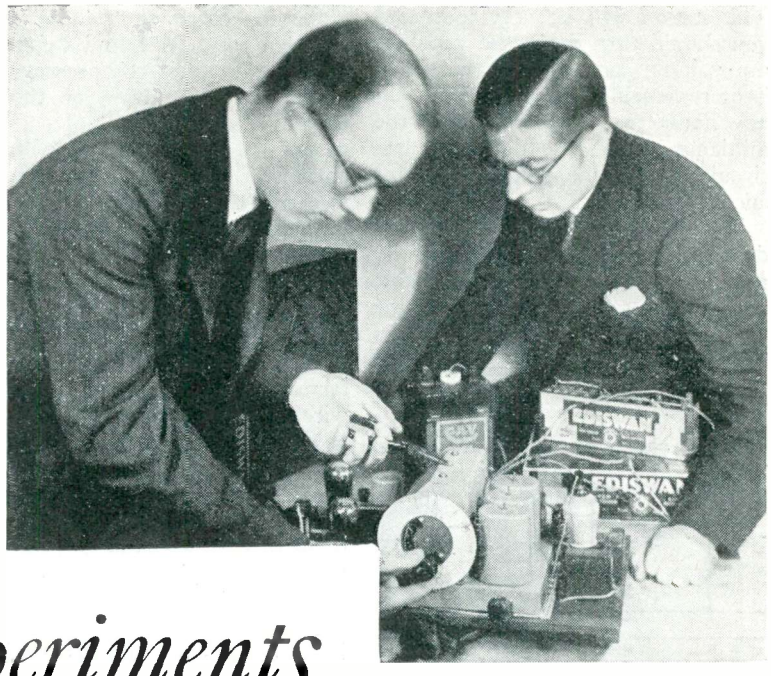
Can anything be more pleasing whilst having one's breakfast than a bright and cheery selection of gramophone records? It gives one an appetite for the day's work. All the worthwhile Continental stations do it. Why must the B.B.C. always be late; morning entertainment is bound to come.

The one and only Henry Hall. Henry is doing a deal to popularise good dance music in this country. His Saturday Guest Night shows provide plenty of amusement and are a pleasant change to the usual run of late-evening music

A popular tenor who is heard a deal in old music hall and light variety programmes, Denis O'Neil

Muriel George, heard singing old songs with Ernest Butcher, is undoubtedly one of radio's best entertainers

This is the third article of a series by Percy W. Harris in which are described simple experiments that can teach the enthusiastic constructor a deal about the basic principles of radio. The experiments are based around a simple test board which the author described in the December, 1934, issue of "W.M." Copies of this issue are still available, price 1s. 3d., post paid.



By closely following this useful series of articles, constructors will get a deal more pleasure from the great and fascinating hobby of radio

Coil Experiments With Our Test Set

By PERCY W. HARRIS, M.Inst. Rad.E.

NOT all experimenters wish to build a set merely by assembling what may be termed "composite components," which reduce the wiring to about half a dozen leads. The various units incorporating the whole of the tuning arrangements from aerial to detector certainly save time and trouble, but they rather sterilise one's experimental work and teach little.

They are, however, splendid devices for the man who knows exactly what he wants and who is, perhaps, building up a standard type of receiver incorporating his own ideas on the low-frequency side.

True Experimenting

I have frequently used them with great success for such experimental work, but to the true experimenter they are, to say the least, unexciting.

Standardisation in radio may have its advantages, but specialisation is much better. The true wireless enthusiast who experiments with coils and learns all about their strange ways is not only in a position to make samples to suit his particular circumstances, but can choose the finished product with much greater discrimination.

Our experimental bench gives just the opportunities required to start coil experimentation and I would like to suggest—if you have not already tried—that you should follow out the line of experiments indicated this month.

First of all, take the circuit for the high-frequency amplifier and detector, together with the low-frequency amplifier arrangement already described in the December number and reproduced again this month. Disconnect the coils to the left of the first variable condenser, but keep the earth connection to the lower side of the variable condenser.

Insert the milliammeter in the plate circuit of the detector valve as a resonance indicator and wind a simple coil consisting of forty-eight turns of wire on a paxolin tube 3 in. in diameter. Tappings should be made half-way down and three-quarters of the way down the coil respectively.

There are several ways of making these tappings, and perhaps the simplest is to wind the complete coil without tappings and then, by means of a sharp instrument such as a scriber, to prise up the middle turn and slip a match underneath it so as to isolate it from the remaining turns.

Three or Four Tappings

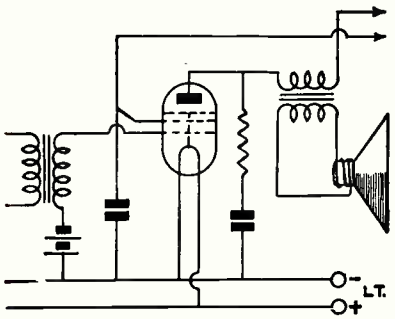
The insulation can then be scraped from the wire at this point and a lead soldered on. A similar procedure can be adopted three-quarters of the way down the coil. If you have the time, you may care to make two or three other tappings at various points.

Now take the lead from the aerial terminal and join it to one side of a small aerial compression condenser set at a low value. Join the other side to the top of the coil and tune in the local station. Tuning may be a little difficult, in view of the fact that you have two tuned circuits to consider here, but as you will have previously calibrated the detector-tuning condenser, you will know exactly where this should be set for your local station.

Set this first, then, and next adjust the first variable condenser with your

new coil until you get resonance. The station will be very loud and you should turn down the variable-mu volume control until the signal is of reasonable strength. You will now notice that there is a flick of the milliammeter in the detector plate circuit every time you pass resonance.

With the aerial compression condenser set at a small value, carefully note the reading of the first variable condenser for exact resonance on the



By combining this simple low-frequency circuit with the circuit at the foot of this page, constructors will get a simple three-valve circuit recommended by the author for simple experiments

local station. This will be indicated by the deepest dip of the milliammeter needle. Now vary the setting of the aerial condenser and re-tune for exact resonance, when you will find that the tuning position will not be the same at the new setting.

Ganging Difficulties

This will make it quite clear to you how, in a simple circuit of this kind, variations of aerial can completely upset any attempts to gang this circuit with another, for the aerial capacity is in parallel with the tuning capacity and any reduction in one calls for an increase in the other to get the station into resonance.

Now repeat the experiments on the middle tapping and the bottom tapping respectively, in each case taking careful note of the various readings. You will find that with the middle tapping variations of aerial capacity will make considerably less difference to the tuning and on the lower tapping quite large variations of aerial setting can be made without noticeable difference. Differences in sharpness of tuning will also be observed distinctly in favour of the lower tapping, other values remaining equal.

When you have found a good setting of the aerial compression condenser on the lower of the two tappings, get a bunch of soft iron wires—half a dozen or so will do—and insert them in the middle of the former. The tuning position will be immediately altered, appreciably less variable condenser capacity being required to tune to the local station than without the wires in position.

This is an indication that the inductance of the coil has been *increased* by the insertion of the wires, for iron is a magnetic material having a greater permeability to the lines of force than air. If we were to leave the variable condenser at the original setting and remove a few turns of wire we could get the same tuning effect with a smaller coil, and this immediately suggests that it will be preferable to use iron-core coils instead of air-core for radio work.

Why not, then, get the maximum of iron or magnetic effect into our core and use the minimum of wire? This was tried very early in the history of radio, but it was found that such coils were extremely inefficient owing to the great losses set up by the presence of the iron.

These losses are not of great importance in low frequencies such as in normal alternating current, but in the higher frequencies, such as are used in radio, they are so great as to rule out ordinary iron completely from the picture.

You notice I say "ordinary iron." In the last few years experiments have been done with special forms of iron dust in which the particles are so fine that the losses are reduced to a very much lower figure than was previously thought possible. One of the main troubles with ordinary iron is that, being a conductor, induced currents are set up in it causing heat losses.

I remember many years ago, when one of the first high-frequency alternators was set up in England—at Slough—an iron spanner was left on the tarred felt roof immediately above the machine. As soon as it started up the induced currents in the spanner above the machine became so great that the spanner grew red hot, burnt its way through the tarred felt, and dropped into the machine room below!

Strong Eddy Currents

In fact, any metal placed in a strong field of this kind will have eddy currents set up in it which, if strong enough, will produce considerable heat. Indeed, the valve makers deliberately apply this principle in the manufacture of valves.

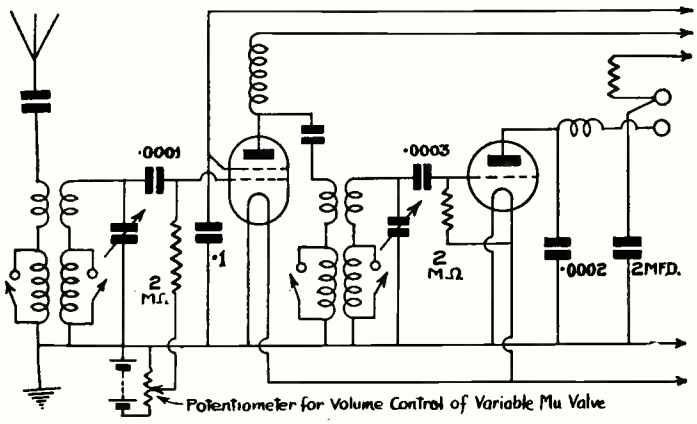
After the metal electrodes have been inserted in the bulb and the bulb evacuated, it is desirable to drive out of the metal any gases which may be trapped in its particles. So the new valve with its metal electrodes is placed inside a coil of wire through which a very strong high-frequency current is passed.

Bright Red Heat

All the metal parts within the valve are immediately raised to a bright red heat and at the same time the residual gas is driven out and absorbed by certain materials which have already been placed within the valve. If the current were still stronger or if the process were continued too long all the metal inside the valve would melt.

But to return to our coil experiments. By breaking up the iron into the smallest possible particles and insulating them from one another, the losses have been cut down and it is now possible to make radio-frequency coils with iron-dust cores having a very high efficiency.

In point of fact the efficiency can be made much higher than is necessary for commercial work, for it should be remembered that if individual circuits are particularly sharp in tuning it is very difficult to gang them.

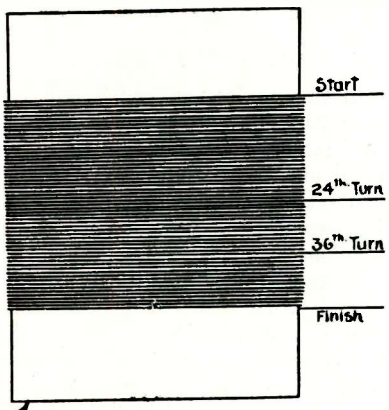


SIMPLE H.F. AND DETECTOR ARRANGEMENT
The experiments described by Percy W. Harris in this article are based on this simple high-frequency amplifier and detector arrangement

This is largely due to the fact that in quantity production certain tolerances in the variable condensers are allowed, and for the accurate ganging of very sharply tuned circuits a very high degree of precision of variable condenser is necessary. This high precision is not practicable in inexpensive receivers.

Coil Resistance

Now sharpness of tuning in a coil (assuming a high-grade variable condenser) is mainly dependent upon the losses in the coil itself. The resistance of a coil depends largely on the kind and size of wire, but as high-frequency currents travel only on the surface of the wire, penetrating to a very small extent, merely increasing the thickness does not necessarily reduce the high-frequency resistance in proportion.

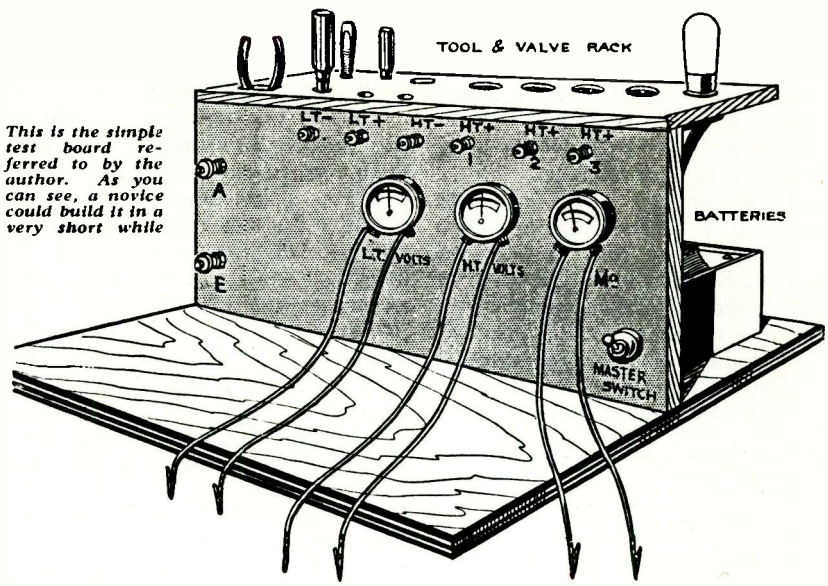


3" Dia. Paxolin Former Wound with 48 Turns No 24 D.C.C.. Tapped at 24th & 36th Turn

Giving the dimensions for the simple coil for the experiment described in this article

Stranded wire, known as Litz, of which the strands are wound in a particular way, gives the highest efficiency of all on the normal broadcast band, but in practice it will be found that No. 24 double-cotton-covered wire gives a reasonably high-efficiency coil in practical conditions.

The shape of the coil, too, is important, for the inductance is dependent upon the interaction of the turns, and the inductance of a certain length of wire formed into one gigantic turn tuned by the variable condenser is much less than the same length of wire wound as a compact coil. The proportions given in our experimental coil above are about right for the maximum inductance with the minimum of wire.



This is the simple test board referred to by the author. As you can see, a novice could build it in a very short while

Now wind a duplicate of the coil with which we have just been experimenting, leaving the first coil joined up to the variable condenser, but without any aerial connection. Get a second variable condenser and connect it to your new coil, this condenser also being joined to earth.

Set the new coil and condenser at the setting you have previously noticed as satisfactory for the local station with the other coil, and likewise put the variable condenser connected to the high-frequency valve at a similar setting, but a little higher.

If the new coil is placed anywhere near the first coil, you will find the local station comes in very well indeed, particularly after a little adjustment of tuning on the two circuits, and you will now be in a position to determine the big effect of one circuit on another, even at a considerable distance, when both are tuned.

I do not want to suggest too many experiments of this kind—I would rather you devised them yourself—but you will notice a variation of angle between the two coils will bring about a variation of signal strength.

A number of valuable lessons will be learned from these experiments, notably the paramount importance of proper screening between tuned circuits.

When the coils are well separated tuning will be very sharp indeed, as indicated by the milliammeter in the plate circuit of the detector valve. As you tighten the coupling or bring the two coils closer together, tuning will become flatter, and after a certain degree of coupling is reached you will find two distinct positions on either variable condenser at which the station will come in. This is called the "double-humped effect."

Double-humped Effect

If you were to plot a resonance curve showing strength of signal against condenser degrees, the double-humped effect would be very plainly marked. A practical application of this double-humped effect is in band-pass tuning, in which the sideband frequencies over the requisite range for quality are embraced between the two humps, a rapid falling off occurring on each side. In this way it is possible to receive only the wanted sideband frequencies and not the unwanted stations.

At first thought it would seem easy to adjust the coupling to give just the right effect, but unfortunately the degree of coupling to give the necessary width—no less and no more—varies with frequency and is *not* the same, in a simple circuit, at the top of the scale as at the bottom.

Variable Coupling

If a set is always to be tuned to one station, the coupling can be adjusted to give the best effect, but if we require to go from one station to another, as is always the case in practice, then the coupling which is right for, say, London National will not be the optimum coupling for London Regional.

What can we do? Special band-pass circuits have been devised with

combinations of different kinds of couplings. So far we have talked about inductive coupling in a circuit and there is another kind called "capacitative," which can be usefully combined with inductive so as to give more uniform effect.

When we are using inductive coupling, if we find the separation between the two coils on, say, the London National gives just what we want in the way of a resonance curve, then on the London Regional the coils would have to be closer together to give the same effect. If now we can find some kind of coupling which gets tighter as the wavelength goes up and could combine it with inductive coupling (which gets looser as the wavelength goes up), we could probably get what we require. Let us see what can be done in this matter.

Capacitative Coupling

Having found, with your loose coupling, the best tuning position for the local station with the new coil reasonably well separated from the high-frequency valve coil, separate the coils still further so that practically nothing is heard. Now take a wire and connect it to the top of the high-frequency valve coil and take another wire and connect it to the top of the new coil.

The wires should be insulated, and if they are laid alongside one another for a few inches so as to give a tiny capacity effect between them, you will find that signals come back again at considerable strength. If the two insulated wires are twisted together for an inch or two you will find that this capacity will be ample.

A Big Difference

In any case experiment and, if you like, make up a tiny little variable condenser to adjust the capacity between the two circuits.

This is called capacitative coupling and differs from inductive coupling in that it becomes weaker as we increase the wavelength or reduce the frequency.

In a future article we shall deal with practical forms of band-pass coupling and show you how the two kinds can be combined. I think by this time you will begin to realise that questions of coupling and coil design can be much more interesting than you at first thought.

You will notice that we have done nothing whatever with regard to long-wave coils and switching, and as this is quite a large subject, I do not propose to deal with it in this article, which is designed to give you an insight into the question of coil design.

The next important thing—tremendously important in multi-valve receivers—is the question of screening and its influence on coil design. Without more elaborate instruments than we have on our test bench, it is not possible to carry out a thorough study of screening, but there are a few illuminating experiments possible if you obtain a piece of copper or aluminium sheet sufficiently thick to be easily handled without bending.

First of all place the two coils side by side at such a distance that they are fairly tightly coupled together, giving a good signal. Now hold the sheet of copper or aluminium (it can conveniently measure about 8 in. by 6 in.) between the two coils and see what happens. Try it in all kinds of positions. You will probably find that you can vary the coupling somewhat, but it will not make a great deal of difference.

Now connect the metal sheet to earth and immediately you will find a powerful difference between results in different positions. Do not, however, be misled by any reduction of signal strength which is due to the proximity of the metal to the coil, for the presence of this sheet with its eddy currents will alter the inductance of the coil to some extent. In each position re-tune carefully before you draw any conclusions.

The sheet of metal forming an earthed conductor will prevent interaction between the two coils, or at least reduce it very considerably, but in your experiments you will already have come up against one of the problems of screening, which is its effect on the inductance and efficiency of the coil it is designed to protect.

Now a modern receiver has to be compact, but against this must be set the fact that very small coils have to be wound with very fine wire and, therefore, are usually less efficient than is really desirable. The best kind of screening in all practical circumstances is to enclose the coil in a sealed can of high conductivity metal, such as copper or silver, but aluminium is cheaper and can be made nearly as good.

If we place the screening very close to the coil, then very heavy eddy currents will be set up in the metal and a great deal of energy will be lost, while at the same time the total inductance of the coil will be reduced, making it necessary to increase the number of turns to get the same inductance as with an unscreened coil.

This for its part will increase the resistance and, therefore, still further lower the efficiency. It is much better to have a good space surrounding the coil, but here again this makes for added bulk and so the inevitable compromise is reached.

Low Coil Efficiency

In the modern screened coil the can encloses a very tiny coil so as to give reasonable space between the metal and the former, and the efficiency of the coil is definitely lower than we were accustomed to regard as advisable a few years ago.

Fortunately, however, the experimental work which has been done with iron-core coils has raised the efficiency somewhat, for the presence of an iron core restricts the spreading of the magnetic field and enables us to put the screening closer to the coil than would otherwise be the case without loss of efficiency.

One More Coil Experiment

Before we leave our coil experiments I would like to suggest you make one more test which shows the powerful influence of the screen position on the inductance of the coil. Tune in your local station with loose coupling between the two coils so that tuning is particularly sharp. Now take the earth screening sheet and gradually bring it closer to one end of the coil and you will notice the set will go right off tune and signals will disappear.

Keeping the screen in one position, readjust the tuning condenser and you will find you have to *increase* the capacity in order to bring the station back again. Now make the screen approach the coil still more closely and once more the signal will disappear, to be brought

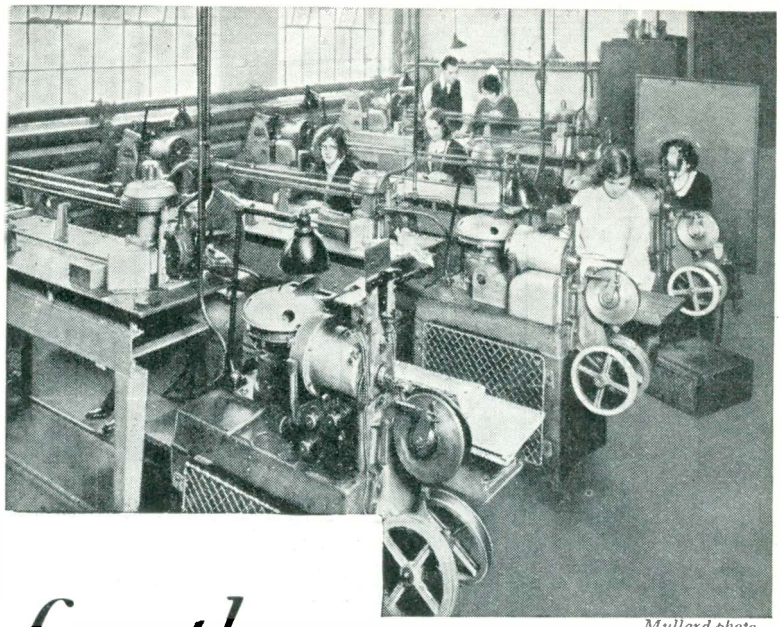
Continued on page 80

Searching for the Finest Results

By Capt. H. J. ROUND, M.I.E.E.

IN the last few articles I have been considering questions of non-linear distortion in amplifiers and other parts of broadcast receivers. Low-frequency distortion is very clearly indicated and exists in almost any receiver in which the power output is comparable with the maximum output of the valves.

This low-frequency distortion is not at all easy to cure without very considerable loss of power. Push-pull circuits, if very carefully and very elaborately set up, do give more power output than single-valve types, but in a normal working condition, with no meters to indicate what the valve currents are, and, what is more, no measuring instruments to indicate how our valves are behaving, there is a doubt whether the distortion that can be produced is not liable to be worse than when using only one valve.



Mullard photo

The very latest in up-to-date precision machinery for making the grids of valves is employed in the Mullard factory

Rectifier Troubles

I have indicated, also, how in receivers the rectifier can be a very serious source of trouble, particularly if the modulation of the carrier wave of the transmitter is high, and I have shown how in practice it is difficult to find a rectifier which will operate satisfactorily under practical conditions at a modulation of more than 65 per cent, although I have mentioned one particular form of diode—the pentode diode—which gives promise of producing linear results up to 90 or 95 per cent modulation.

Since writing the last article I have been seriously considering whether in order to produce the very finest results we have not got to drastically modify all our circuits with, of course, recognition of the fact that this modification is not one which will immediately be possible to carry into mass-production practice.

Our low-frequency amplifier circuit is subject to non-linear distortion of a considerable amount, and our rectifiers, if worked at small amplitudes, are equally troublesome. Is it not possible to consider the working of a radio set using such a rectifier as the pentode-diode directly on to the loud-speaker supplying sufficient power in a high-frequency form to give us the output we want?

This, of course, entails a high-frequency output valve capable of giving sufficient power for our purpose, and as this has not been catered for by the wireless manufacturers, we are in some difficulties.

The first question that occurred to me was what sort of distortion could occur in such conditions in the high-frequency circuit itself? If we assume that in an ordinary receiver the amplitudes in the high-frequency circuit are so small that distortion does not occur, in this new receiver, of course, the amplitude would have to be taken to the limit of power output of the valve, with a new condition arising which might easily lead to distortion.

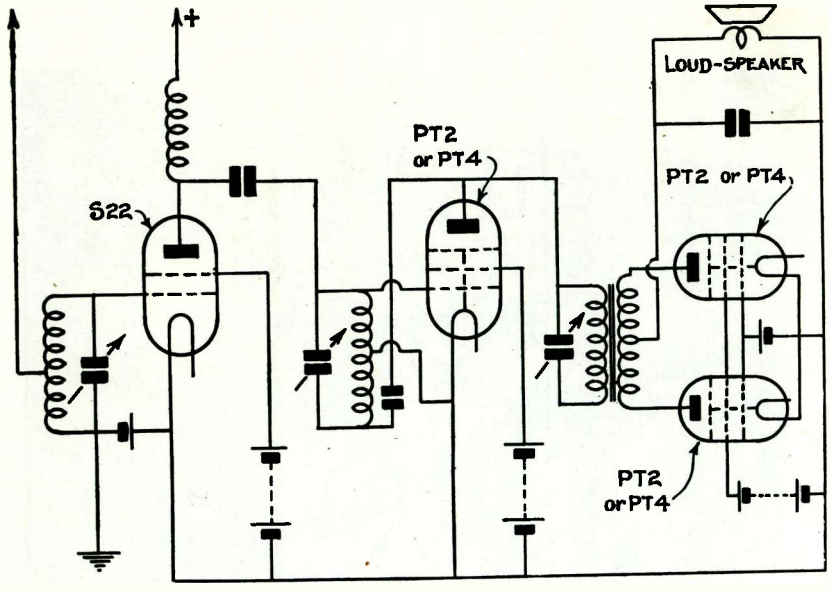
Careful Examination

I have examined this fairly carefully and have come to the conclusion that there is a general tendency in high-frequency amplification to balance out the type of distortion which will distort the final modulation, particularly if certain methods of operation are used.

Imagine we have a valve that we can use for high-frequency amplification, and the high frequency we are going to amplify has been modulated to 90 per cent and we try to visualise what is happening. There is a carrier wave which is swinging both sides of the zero, and this carrier wave is swinging with the modulation from practically no amplitude to double average amplitude.

One Side Only

It would obviously be sufficient in a linear rectifier to think of only one side of the wave and rectify that, and from the result obtain the modulation. But if we consider high-frequency amplification, how shall we go about it? Shall we consider



CAPTAIN ROUND'S HIGH-QUALITY CIRCUIT

A suggested high-quality circuit employing only one stage of high-frequency amplification and rectification by means of a pentode diode. Note that there is no low-frequency amplification

the valve that is doing the high-frequency amplification with sufficient grid bias, so that with no carrier-wave present there is practically no anode current and then with average carrier wave the anode current is carried to some point up the curve, such that in a rise and fall of modulation only one-half side of the modulation is treated ?

Or shall we arrange a setting where the carrier wave is such that modulation on both sides of the high-frequency zero line is handled ?

Less Distortion

General consideration shows that the latter method tends to give very much less distortion than the first method. The first gives a distortion similar to that in the low-frequency power valve in the ordinary equipment.

The second method gives a very much more linear result, in which the distortion is only of a secondary order. How to arrive at these settings and how to get the best arrangement out of such a combination I am not at all sure, but with the valves available I propose to set up a circuit such as that shown above, without any attempt at great range of reception at first, in order to check that the results I obtain are appreciably better than from a normal receiver.

The circuit I have shown only indicates the line of attack I shall follow. No doubt a number of modifications will have to be made as I go along.

I have indicated a double rectifier arrangement to the loud-speaker with a power pentode as the output valve, and on account of the possible instability of this I have indicated a neutralising method as being possibly very necessary, and I have preceded the whole arrangement with a high-frequency tetrode to give some range to the equipment.

Of course, it may be that as one is liable to splash out high frequency into the output circuit in this arrangement, some of it getting along the loud-speaker leads and then back by radiation to the aerial, considerably more care will have to be taken in shielding, but I really have in mind a further stage if this arrangement pans out at all successfully—a super-heterodyne combination with a power output on the intermediate frequency—and this arrangement would not be anything like so suitable.

Lonesome Radio Station

VIQ, Willis Islets Radio, a coastal radio telegraphy station installed on a coral island in the Pacific Ocean some 300 nautical miles from Queensland, is perhaps the most lonely spot in the world. The station is operated by two employees of the Amalgamated Wireless Company of Australia. These operators were for fourteen months the sole inhabitants of the island.

Little would be known of Willis Island but for the fact that at regular periods the station broadcasts weather reports and messages relating to navigational dangers.

Moreover, the station has assumed considerable importance in view of the fact that it lies in the centre of a cyclonic region and is thus able to transmit warnings to shipping and the Australian mainland.

Normally the two operators are on duty for a period of twelve months, for which hardship their salary is doubled. As the islands are of a rocky character little food except fish can be drawn from them and, with the exception of wild sea birds which make periodical visits, all victuals and stores must be supplied from the mainland.

Without doubt, the most lonesome radio station in the whole world!

THE BROADCASTING HOUSE OF BANGKOK

This typically Eastern building houses the transmitting gear and studio of the radio station at Bangkok, Siam. The plain wooden mast, a contrast to our Western styles, is seen on the extreme right

Kite-Aerial Design

Hints for the Short-wave Experimenter :: By MALCOLM HARVEY

LAST month I attempted to tell you a few things about the design of aerials of the Hertz and Marconi types, leaving out the freak aerials such as the Windom inverted-V and other unusual types. But I do feel that a few notes on what amateurs are doing with kite aerials would not be amiss.

You will probably feel that an aerial on a kite is hardly a practical idea, but remember that in the very early days Marconi's famous S signals to Newfoundland were received with a kite aerial.

Original Types

Of course, the original type of kite, which was flown some 300 or 400 ft. above ground, would hardly be suitable for use on short waves. But it is possible to fly a kite to a height of about 80-ft. and series tune it without increasing the damping too much so that the detector circuit still oscillates.

The advantage of this aerial over a normal inverted L or T would not be worth the bother except for outdoor work on field days, when it would probably be quite useful.

I don't know very much about the actual kite-flying end of this business, but for my experiments a friend built me two kites, 6 ft. in diameter, which could be flown up to several hundred feet above the earth. That is all very well in a way, but it is a big job getting rid of the damping effect of the downlead, so we decided to build a complete doublet aerial and this worked out well.

Conventional Doublet

I set about constructing a doublet aerial of the conventional type, having approximately a quarter wavelength top and tuned downleads. I obtained some Lewcos frame-aerial wire, consisting of a multi-stranded cable about 1 mm. in diameter, very flexible and light in weight.

By using the formula I gave you last month, which was

$$\text{Length (in feet)} = \frac{468}{f\,(kc.)} = \frac{468}{f\,(mc.)} \text{ or}$$

$$\text{Length (in metres)} = \frac{142{,}500}{f\,(kc.)} = \frac{142.5}{f(mc.)}$$

you can determine for yourself the length of the aerial tops and the downleads.

The only snag that you are likely to come up against is the transmission blocks. The normal Steatite blocks I recommended last month will not do for they are too heavy, so you will probably have to do the same as I did and use wood of the very hard variety.

The aerial is never up for very long at a time, so if it absorbs moisture it does not matter very much.

By fixing the top part of the aerial to the centres of the two kites and flying them separately, I had no trouble at all in getting them up to quite a good height. First of all, I tried dispensing with string and using the actual downlead to anchor the aerial. This was not very satisfactory, the wire was far too heavy for that. Finally, twine was used; something after the style of the twine used in fishing lines.

The kites must be flown well apart. For example, if the aerial is 20 ft. in length, the kites must be at least 35 ft. apart.

With an aerial of this type on Dunstable Downs, which is perhaps better known for the activities of glider enthusiasts, I obtained some really good results on a simple two-valve receiver, the only trouble being slight variation in tuning owing to excessive movements in the aerial.

This trouble was later overcome by using an untuned high-frequency stage in front of the detector.

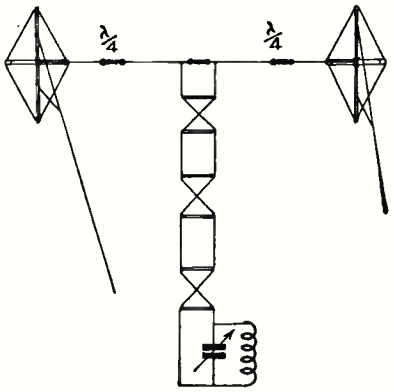


Fig. 1.—A doublet aerial with tuned feeder. Note the quarter-wavelength tops

This idea is not satisfactory below 20 metres and all experiments with kite aerials on 5 metres have been with the receiver actually on the kite or half-way down the feeder leads. Then the speech output via a choke-filter circuit is fed down to a pair of headphones.

With this arrangement there is no need to worry about the length of the downlead, except that if it is excessive you get bad top-note cut.

Reverting to ordinary medium-wave receivers, next time you are out in the open it is well worth trying a simple kite aerial of the single-wire type. Run the kite up to 200 or 300 ft., simply attaching to it some more of the Lewcos frame-aerial wire. With a small capacity in series with it, you can get some very good results indeed, particularly on long waves. For some reason or other, selectivity does not appear to suffer.

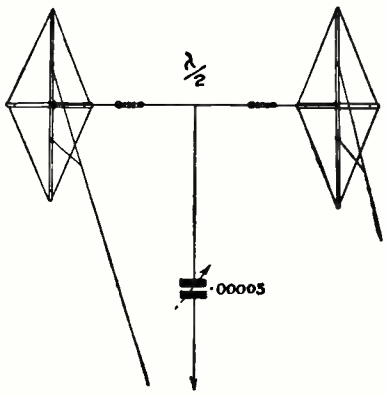


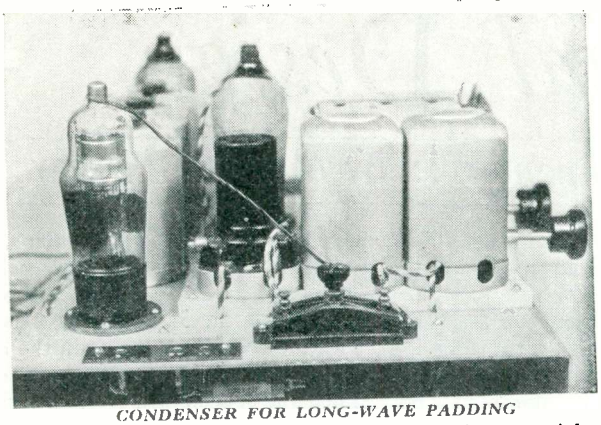
Fig. 2.—Half-wave T aerial, series tuned to reduce damping

Good Daylight Results

A simple three-valve receiver, which under normal circumstances will only bring in Continental stations after dark, does perform very creditably in daylight with a kite aerial.

There are several other ways in which you can experiment on these lines. For example, an inverted or a simple T aerial gives quite good results provided a small fixed capacity is always in series with the downlead.

More About the 1935 Super Five



CONDENSER FOR LONG-WAVE PADDING

This photograph shows the pre-set type of condenser used for padding the oscillator coil of the 1935 Super Five for long-wave reception. The condenser needs careful adjustment.

BEFORE giving details of reports we have received about the 1935 Super Five, we wish to draw readers' attention to one or two slight discrepancies between the theoretical circuit and the blueprint. We would also like to take this opportunity of apologising for any inconvenience which these errors may have caused.

To those of you who have wondered what value the condenser between wires Nos. 74 and 29 may be, we wish to state that this is .1 microfarad.

On examining the double-diode circuit it will be found that one side of the ½-megohm leak and .0001-microfarad condenser is taken to the positive low-tension, via wires Nos. 38 and 34. This should not be so.

It is necessary for wires Nos. 38 and 34 to be removed from the condenser and taken in a straight line between the two filament legs of the pentode and double-diode-triode.

It is now necessary to provide the earthing connection for the condenser-resistance combination and this is most easily done by extending wire No. 35 to the point where wire No. 67 is earthed. If the lead from G.B.—3 is traced on the theoretical diagram it will be seen that it passes through a 2-megohm leak which has the remote side earthed by means of a .0003-microfarad fixed condenser.

On the blueprint this has unfortunately been omitted. Therefore it is necessary to extend wire No. 48 to one side of a .0003-microfarad condenser, the other side of which is earthed at the most convenient point.

The low-potential side of the secondary of the third BP42 unit requires a slight alteration. On the blueprint the wire No. 49 is taken to one side of a .1-microfarad condenser. This should not be so. It is necessary to remove this connection and take it to the junction of wires Nos. 36 and 37.

So much for the faults, all of which have been corrected in current blueprints.

The outstanding feature of the reports received to date is undoubtedly the high degree of selectivity obtained, consistent with very fine frequency response.

Bearing in mind the crowded state of the ether, this is a very valuable asset and, when it is combined with good range capabilities, forms a most efficient combination.

The self-adjusting volume control does definitely carry out the work for which it is designed, and removes to a very great extent objectionable fading.

COMPONENTS NEEDED FOR THE 1935 SUPER FIVE

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 preset ... ... £ 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 Dublier) ... ... £ 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 economiser, 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

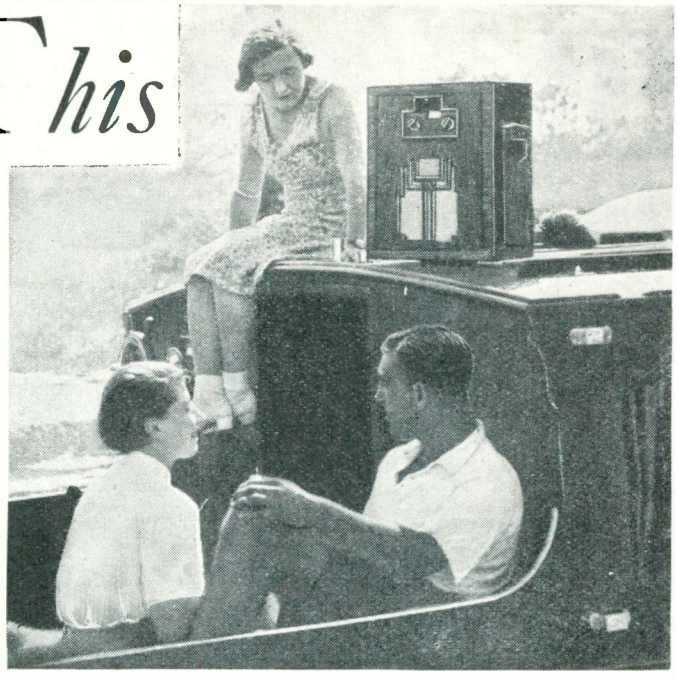
VALVES
1—Osram X21 ... ... £ 18 6
2—Osram VP21 (met.) ... ... £ 1 7 0
1—Mazda L2DD (met.) ... ... £ 9 0
1—Cossor 220PT ... ... £ 13 6

MAINS UNIT (in place of 120-volt battery)
1—Atlas, type T10/30 for A.C. mains ... ... £ 3 9 6

What Is This Quality?

By PAUL D. TYERS

This is the second and final part of an article which the author describes as "a simple basic analysis of quality reproduction—a subject which is perhaps the most controversial of all aspects of modern radio engineering." The first part appeared in the January issue



Marconiphone photo

Now is the time to think about the design for your 1935 portable

I HAVE already discussed the effect in an amplifier of capacity associated with a resistance, and I have pointed out that when a capacity is connected to an inductance totally different conditions arise owing to the production of resonant circuits. Before examining these in detail, it is well to consider how the effect of an inductance alone varies with frequency.

I have mentioned that the greater the frequency the greater will be the impedance of an inductance, whereas in the case of a capacity exactly the opposite effect is observed.

In actual practice a curve of the type shown in Fig. 5 is rarely obtained, because an inductance must have resistance owing to the ohmic resistance of the wire with which it is wound, and there is also the matter of self-capacity. Accordingly, we get very complicated networks of resistance, capacity, and inductance.

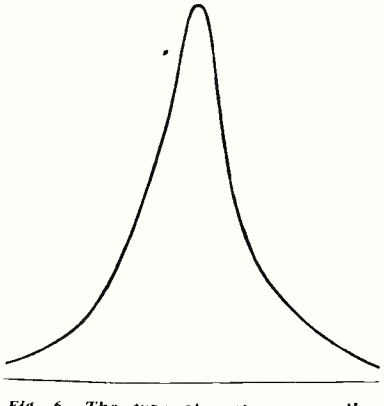


Fig. 6.—The type of response usually obtained from an ordinary tuned resonance circuit

Fig. 6 shows the type of response one obtains from an ordinary tuned resonant circuit, that is, a circuit comprising an inductance in shunt with a capacity. The maximum impedance is offered at the resonant frequency and the impedance falls away more or less equally on either side of the resonant frequency, producing the well-known resonance curve.

Now, the sharpness of this circuit depends on what is known as the decrement of the circuit and is controlled by the amount of resistance included in the tuned circuit.

If instead of connecting a condenser directly across a coil it is connected in series with a resistance, it follows that the height of the resonance curve will be much lower and the skirt, as it is called, will tend to spread.

By choosing suitable values of condensers and inductances, we can obtain circuits which offer varying impedances at any point we like in the audible frequency range.

It is actually possible by suitable design to produce a circuit which will accentuate or diminish the response of a receiver at almost a single frequency or over a narrow band or a wide band. All the so-called freak quality circuits are nothing other than combinations of resistances, capacities, and inductances, which have this effect upon the frequency response.

Without working out the actual values, it should be possible, even for a non-technical reader, to determine more or less accurately what will happen to the frequency response of any circuit. A very simple way of carrying out a rather elementary examination, which is a first approximation to real conditions, can be obtained by the following conception.

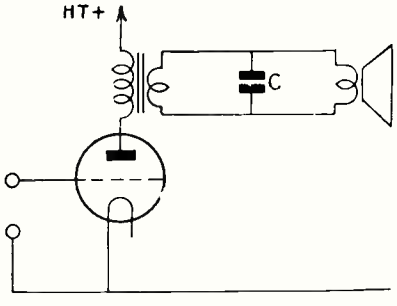


Fig. 7.—Showing a moving-coil loudspeaker connected by a transformer to the anode circuit of a valve. The transformer secondary is shunted by the condenser C

First of all, a capacity must be regarded as something which

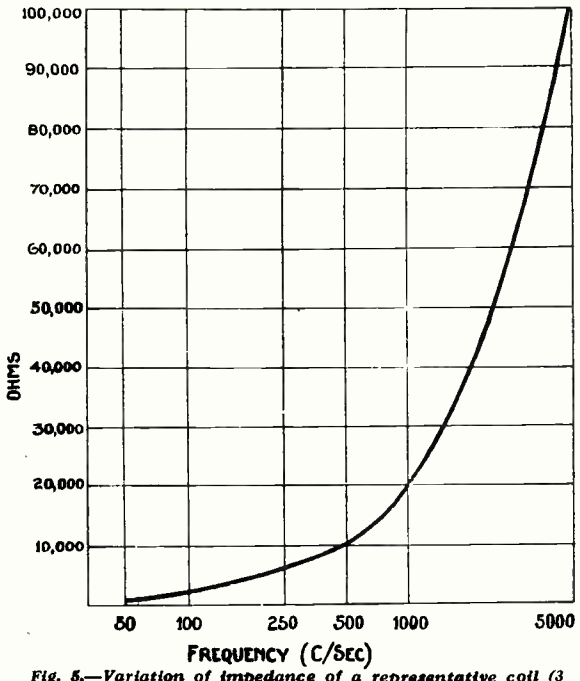


Fig. 5.—Variation of impedance of a representative coil (3 henries) with frequency. In actual practice this curve is rarely obtained

decreases in effective resistance or impedance as the frequency rises, while an inductance *increases* as the frequency rises. A resistance will deal equally with all frequencies.

A capacity and a resistance forming a resonant circuit will offer the maximum impedance at the resonant frequency, the peak becoming less marked as resistance is inserted in the resonant circuit.

There is one further important notion which must be fully appreciated before the analysis is complete. This concerns the position in which the various electrical quantities occur in the circuit.

Two-position Conception

This is briefly summarised by a two-position conception, namely, a series arrangement or a parallel arrangement. Fig. 7 should help to make this clear. This shows a moving-coil loud-speaker connected by means of a transformer to the anode circuit of a valve. Here the secondary has shunted across it a condenser c.

Voltages will be produced across the secondary circuit, and we can assume that they are of relative magnitude over the entire audio-frequency scale, but we know, however, that the impedance of this condenser is going to fall with frequency, and the effect will obviously be that of a low resistance tending to short-circuit the coil at the higher frequencies. In other words, this condenser will tend to cut the top response because it is in parallel with the reproducing device, that is, the moving-coil reproducer.

In Fig. 8 the same condenser is shown in *series* with the transformer secondary and the moving-coil loud-speaker. Now, the condenser will behave in exactly the same manner as it does in Fig. 7 in so far as its frequency characteristic is concerned. Its effect on the actual reproduction, however, will be totally different.

We know that at the higher frequencies its impedance will be very low and accordingly it acts more or less purely as a connecting lead between the moving-coil speaker and the secondary of the transformer.

As the frequency falls, however, the impedance rises and it will tend to act as a resistance in series with the moving coil and accordingly it will cut down the power supplied to the coil at the lower frequencies. In other words, the same condenser has in the first case cut the top response and in the second it has cut the bass response.

If, instead of using the condenser, we had used an inductance of appropriate value, then just the opposite effect would have been obtained. The inductance when series connected would have had practically no effect on the low frequencies, but it would have offered very considerable impedance to the higher frequencies. When parallel connected the effect would have been exactly opposite.

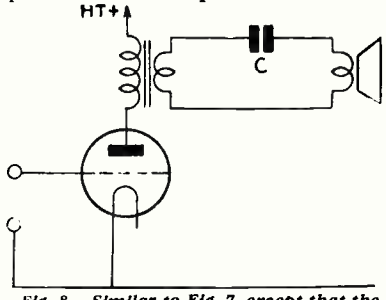


Fig. 8.—Similar to Fig. 7, except that the condenser is shown in series with the transformer secondary and the moving-coil reproducer

An inductance or a capacity, when used for the purpose of modifying the frequency response, is generally called a filter. Filters, however, in practical circuits almost invariably comprise complicated networks of inductances and capacities, and in many cases resistances are also included.

Pi-section Filter

One of the simplest forms of filter is the very familiar *pi*-section, consisting of an inductance in the form of a smoothing choke and two smoothing condensers. This, of course, is used in almost every mains receiver for smoothing the ripple on the high-tension supply. Filters are generally referred to as high pass or low pass. A whole arrangement of series and shunt impedances is generally called a network.

Unfortunately, it is impossible to explain here how to work out the effect of any network, because to do so involves some knowledge of the use of what is known as a *j* operator or some similar mathematical process. It is possible, however, that those who care to work out some simple square-root expressions would like to know the effective impedance of some of the more simple combinations of inductance, resistance, and capacity, which might be used for experimental work in tone correcting or adjusting the response of amplifiers.

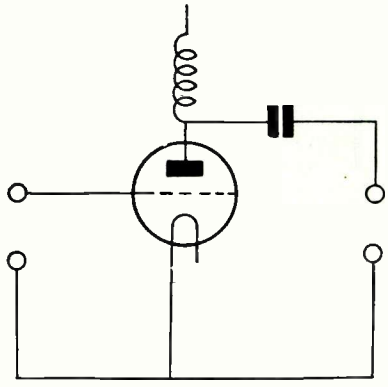


Fig. 9.—Output circuit with a single inductance having an impedance varying with frequency (see Fig. 5).

The effective impedances for a number of simple circuits are shown in the table on page 36 and these values can be worked out by simple arithmetic, since I have not made use of the *j*-operator method. If these various impedances are plotted against frequency in the form of a

simple curve, it will be quite possible to see how they will affect the frequency response in any amplifier.

In a modern receiver in which considerable sideband cutting occurs owing to the sharpness of the tuned circuits in the input stage, it is common practice to resort to tone correction; this system, for example,

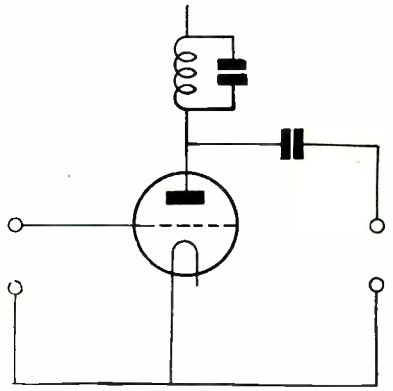


Fig. 10.—A peaked coupling circuit which gives greatest amplification at the resonant frequency

being employed in the Stenode receivers recently described in these pages.

One of the simplest forms of tone correction is obviously to use as a coupling impedance a circuit which offers a greater impedance to the higher frequencies than the low frequencies. That is quite obvious.

One can take the simple case shown in Fig. 9 of a single inductance having an impedance varying with frequency on the lines of Fig. 5. This, however, would gradually increase the amplification of all the frequencies.

Stenode Arrangement

Now, in a receiver such as a Stenode we actually require very little amplification in the lower and middle ranges and considerable amplification in the higher ranges. It is obvious, therefore, that if we shunt an inductance with a capacity we can obtain a circuit which resonates somewhere in the upper registers, perhaps at about 5,000 cycles.

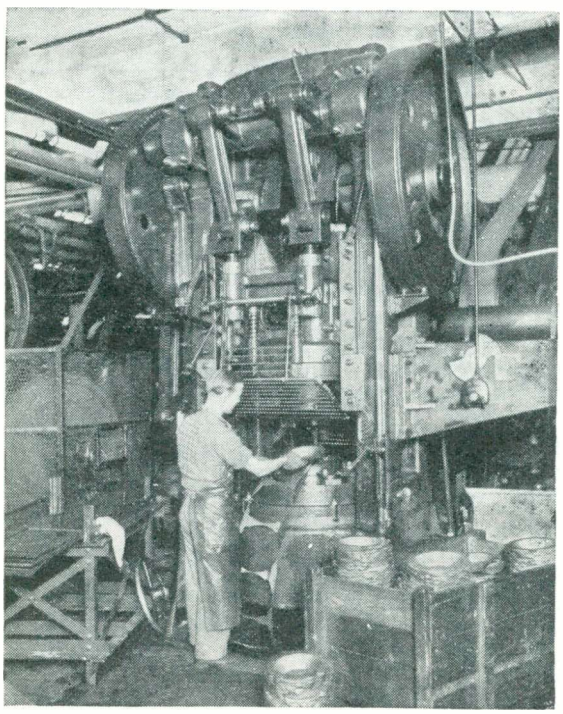
If we used this alone, however, and if the circuit were fairly sharp, it would offer practically no impedance to the lower and middle registers, and accordingly we should obtain no amplification whatever. It is general, therefore, to use a combination of a resistance in series with a tuned circuit.

In the table the effective impedance of a tuned circuit of the type used occurs at the bottom of the list, and it is quite possible from this expression to find what would be the impedance of this tuned circuit at any frequency.

Now this impedance can be made directly proportional to the amplification simply by including it in the anode circuit of a valve. The amplification obtained depends entirely upon the impedance of the valve and the impedance of the anode load, which, of course, is the variable impedance due to the tuned circuit.

It is actually given by the expression $\frac{\mu \, Eg \, Z.}{Z+Ra}$ Since the amplification factor of the valve is a physical property which remains substantially constant, the amplification is then simply proportional to the expression $\frac{Z}{Z+Ra.}$

By using this very simple formula and the standard forms shown in the table, readers should be able to determine exactly what happens to the frequency response of any so-called quality circuit in which they are interested in any way.



Rigidity is an essential feature of a loud-speaker chassis. H.M.V. use a 200-ton press for making the chassis of their reproducers

It is admittedly difficult to explain in practically non-technical language the manner in which electrical networks function, but the few simple fundamental principles which have been briefly explained should help to remove any mystery or doubt which may surround the freak quality circuit.

About Loud-speakers

It would not be fair to dismiss the subject of quality reproduction without saying a little about the matter of loud-speakers.

I indicated last month that good quality reproduction is actually nothing other than an aural illusion. It is very obvious that unless our reproducing mechanism is capable of dealing with the frequencies which exist in the original there is a strong possibility that the illusion will be far from perfect.

The efficiency and fidelity of the modern loud-speaker is tending to increase, but it is possible that finality is not only really distant, but is not even in sight.

"Freak" ideas are found from time to time in all types of loud-speakers, whether they are moving-coil, moving-iron, electrostatic, or piezo-electric.

There are a few elementary rules underlying the design of a moving-coil loud-speaker which appear to be beyond argument, but frequently one finds that what appears to be the fundamental basis of construction is completely set aside.

Diaphragm Problems

It is obvious, for example, that a loud-speaker diaphragm which has a very large mass has so great an inertia that it obviously cannot vibrate at extremely high frequencies. Low frequencies demand comparatively large amplitudes and accordingly a loud-speaker in which the diaphragm is restricted is not likely to radiate very much at the lower frequencies.

There are almost a thousand and one minor problems in loud-speaker design, such as the acoustic "breaking up" of the diaphragm at various frequencies, but perhaps the most important point of all is the

My First Television Experience

DO you remember the thrill you experienced when you received your first radio signal? I often think of the excitement of my first crystal set, and of the hours I used to devote to station logging when I had reached the valve-detector stage.

One gets rather hardened and blasé about the whole thing after dabbling in the science for more years than one cares to remember, therefore, I feel very bucked, as I have found a method of creating as much excitement and interest as probing the old crystal used to provide.

I have joined the happy band of television enthusiasts.

How the Germs Took Root

It all came about through a certain friend of mine who is absolutely full of the idea. He often tells me of his experiences, but it was not until last week that the germs took root in my radio system. I am glad to say that the germs had a most violent effect on my activities, and the result was a raid on my sorely tried exchequer.

Needless to say I managed, by a tidy spot of wangling and a few odd swops, to secure the necessary bits and pieces and become the owner of a televisor. I was agreeably surprised at this stage to find how few components were actually required. Of course, I only kicked off with one of the most simple disc outfits, and for that I only needed a disc, an electric motor to drive it round, a mains resistance to drop the supply voltage, a 6d. magnifying glass, and a neon lamp to supply the modulated light source.

Building of the whole outfit did not take any time, while the connections are so few and simple that no brain fag was caused.

The next thing was to connect the contraption to an efficient receiver, which would reproduce the vision transmission from the medium-wave London National station at sufficient strength to operate the neon tube.

My set happens to be of the screen-grid high-frequency, detector, low-frequency and two small power valves in parallel type, and while the filaments are heated from an accumulator, the high-tension is supplied from a generous power pack. This seemed all O.K. so I connected the neon tube straight in the anode circuits of the output valves in place of the usual output transformer.

The tube glowed quite nicely, and I was very tickled. The next point was to see if a signal would modulate it, or, in other words, cause fluctuations to take place in its intensity. Tuning in the local had the desired effect, so it now only remained to wait impatiently for a proper television transmission.

Oh! by the way, I hooked up a little standby three-valver on another aerial to receive the sound broadcast.

The great night arrived, and I don't mind confessing that I was as excited as a kid with a new toy.

Excitement at the First Picture

Well, the transmission started and after a few seconds something appeared behind the magnifying glass. To say I was excited is to put it mildly, especially as the rest of the household were almost yelling in chorus, "There's something. Look. . . . look!"

By getting just the right speed with my finger on the motor spindle, pictures appeared and remained fairly constant. It was quite easy to recognise the various artists and follow their actions, while the sound transmission completed the effect and made it a most eventful episode.

The thrill I experienced when the picture formed made me realise that there was a new field of interest and experimenting open to me.—*L. O. Sparks.*

WHAT IS THIS QUALITY?

Continued from page 35

behaviour of the loud-speaker under transient conditions.

Simple loud-speaker analysis is carried out by measuring the response under sustained conditions. The loud-speaker is energised with a sinusoidal input and the output is measured as amplified microphone voltage. Such a system does not take into account the waveform produced by the diaphragm; neither does it give the slightest indication of what happens under transient conditions.

The transient examination of loud-speaker response is not an insoluble problem, but it is certainly a difficult one, and it is definitely known that in many respects modern reproducers do not behave altogether as their designers would wish.

It is very important, therefore, when making bold statements concerning quality to remember that in the chain there are several weak links.

Most important is it to remember that we are not reproducing in our room the exact acoustic conditions prevailing in front of the microphone; we are simply producing a clever illusion.

CIRCUIT	IMPEDANCE
C	$\frac{1}{\omega C}$
L	ωL
L R C	$\sqrt{R^2 + \left(\omega L - \frac{1}{\omega C}\right)^2}$
L R, R_1	$R_1 \sqrt{\frac{R^2 + \omega^2 L^2}{(R+R_1)^2 + \omega^2 L^2}}$
L R, C	$\sqrt{\frac{R^2 + \omega^2 L^2}{(1-\omega^2 CL)^2 + \omega^2 C^2 R^2}}$

When $\omega = 2\pi f$
$= 6.28$ Frequency (Approx.)

Table of Effective Impedances

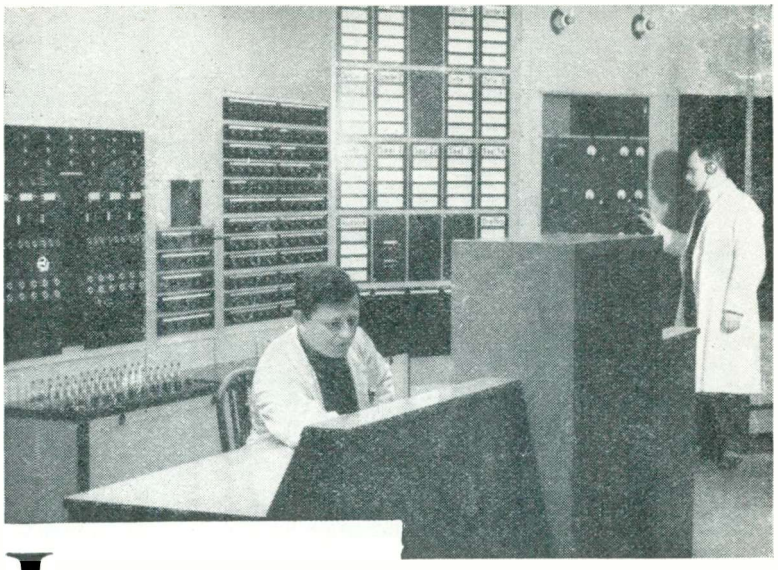
How to Identify Those Foreigners

By J. GODCHAUX ABRAHAMS

WHEN the home stations are found lacking in the particular kind of entertainment you wish to enjoy, doubtless you turn to Continental stations in the hope of finding a programme that fits in with your mood.

Now and again luck will be with you, and you will pick up surprise items, interesting relays of outside broadcasts or musical entertainments of a style seldom heard in the British Isles.

Equipped with a modern receiver, you cannot twirl the tuning dial without logging a fair number of foreign broadcasts. Many sets are fitted with dials bearing a host of station names and, in theory, all that is needed is to turn the pointer to the marking coinciding with the wavelength or frequency of the desired transmitter. In practice, however, it does not always work out as planned. I do not mean to infer that the scales of receivers are carelessly calibrated, but that in view of the number of powerful stations now working in Europe it is impossible to include them all on the dial.



Gulliland photo

The main control room at the Berlin Broadcasting House. On the extreme left is the output switching panel, where programmes are switched to other transmitters in the country

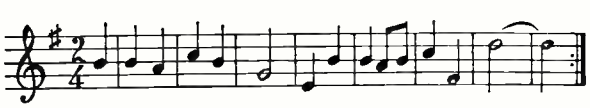
Difficulties of Tuning

Unless a dial is of large dimensions and gives a wide separation between the names, it is evident that the slightest deviation of the pointer will mean the tuning-in of a broadcast on a channel adjacent to the one to which the listener thinks he has set the condenser.

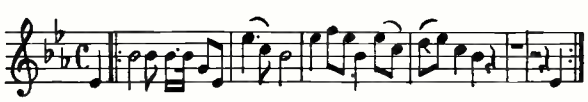
The broadcasting wavebands are so congested—there are now about 250 transmitters in Europe alone—that to separate transmissions it is necessary to tune to a hair's breadth.

Where so-called clock dials are used and in other instances where only wavelengths or degrees are indicated, it is obvious that the problem of identifying broadcasts becomes very difficult.

However, the matter is not so difficult as might appear at first sight, even if the listener possesses no knowledge of any other language than his mother tongue. The ear quickly becomes accustomed to strange foreign sounds and most listeners who tune-in foreign stations regularly, although not perhaps capable of understanding actual words or sentences, are quickly able to gather whether a particular broadcast is made in a Latin, Teutonic or Slavonic tongue. This rough classification, at the start, tends to simplify matters.



The musical interval signal of Brussels No. 2



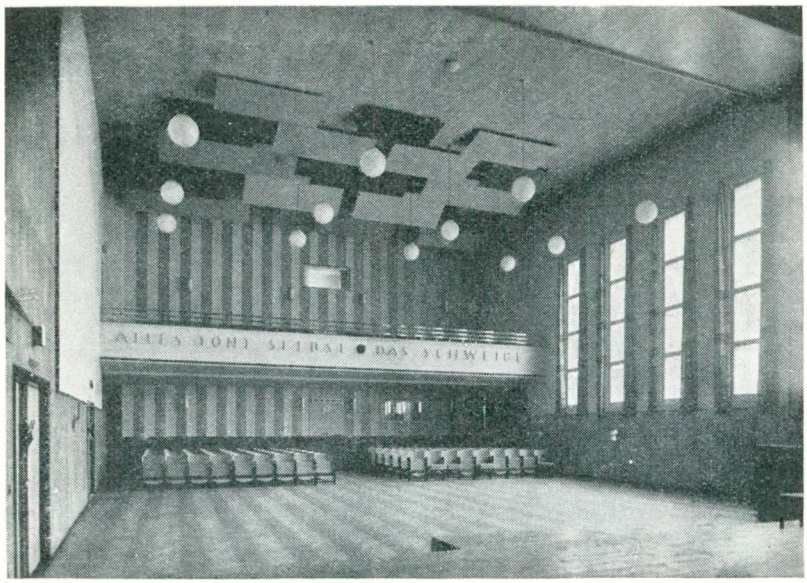
Interval signal of Kaunas, Lithuania

Methods of Identification

For recognising the identity of studios, therefore, we have several means at our disposal. We may, in the first instance, ascertain the wavelength or frequency of the transmission, but the method is not very reliable, inasmuch as some channels are shared by transmitters in two different countries. If we can label the broadcast in respect to nationality we get considerable assistance, as this narrows the possibilities.

Call or Interval Signal

Our next step is to try and hear a call, or better still an interval signal, as this information, even if it does not actually give us the name of the transmitter, at least tells us in which group or network the station is working. We may be hearing a capital broadcast through one of the relays, in which case we pick up the interval signal from the main studio, but an estimate of the wavelength should show us at once on which channel it is being picked up.



Gulliland photo

Our photo shows the main concert studio in the new Broadcasting House at Konigsberg. The wording on the front of the balcony is very true of broadcasting studios: "Everything is Sound—Even Silence"

A quick glance at a list of stations in order of wavelength or frequency will tell us to which station of that network we have tuned our receiver.

Individual Methods

With but few exceptions Continental studios possess a distinctive interval signal. After having passed through the simple metronome, gong and bell stage in the last few years, stations have adopted more individual methods of making themselves known to the foreign listener.

Where bells are used in the form of carillons or chimes, or where electrical devices have been devised to produce musical tones, in every case some little melody has been composed or adapted to permit identification. Many studios, such as the German, Belgian and Scandinavian, reproduce by different means tiny excerpts of some folk or popular song; others use a small combination of notes, but whatever they may be, if heard frequently they are easily memorised.

Tiny Chimes

As an example, when you turn to Budapest in the evening hours, to Munich, to Stuttgart or to Copenhagen, you will hear tiny chimes which, frequently repeated, impress themselves upon your memory. When you happen to pick them up again you recall the tune immediately and without hesitation put a name to the broadcast.

As already stated, the majority of these signals are short and are usually made up of from three to nine notes, but there are exceptions. To facilitate their easy recognition, I have given the musical notation of the principal ones.

Fortunately, today European announcers are now more conscientious in giving their calls and repeat them at frequent intervals as the studios realise that with the advent of high-power transmitters the broadcasts are heard far beyond the boundaries of their respective countries.

If you pick up a double-barrelled *Allo-allo*, followed by the word *Ici* (ee-cee), put the call down as emanating from a Frenchman. Brussels (No. 1) and Sottens, although using the same language, do not announce in the same manner.

With the exception of Radio Paris, which is known as the *Poste National*, all stations belonging to the French State include in their call the letters P.T.T. (*pay-tay-tay*), standing for *Poste Telegraphes* (*et*) *Telephones*, thus showing that they form part of the official broadcasting network.

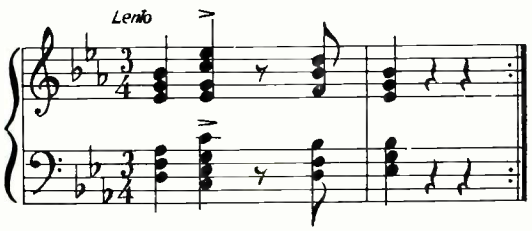
The French private transmitters, such as Radio Toulouse, Poste Parisien, Radio Lyons, Radio LL, Beziers, and so on, merely give out their names, but exception is made by Vitus (Paris) which styles itself *Poste Ile de France*, and Juan-les-Pins, which announces itself as *Nice-Cannes-Juan-les-Pins*. Fécamp, or Radio Normandy, is too well known to require any special mention.

German Network

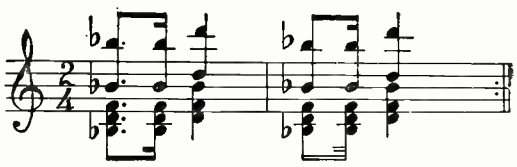
Where German stations are concerned, it is seldom you will pick up a local broadcast from a relay, and consequently the call heard will be that of the main studio feeding the group, or alternately a transmission from the capital simultaneously broadcast by all stations. When this occurs it is referred to as *Reichssendung* and in the same way all main stations are termed *Reichssender*.

Such names as Langenberg, Mühlacker and Heilsberg have been abandoned; they are the names of the actual transmitters. In their place we hear the names of the cities from which the programme emanates, i.e., Cologne (Koeln), Stuttgart and Königsberg.

Similarly, that jaw-breaker Königswusterhausen is now known as the *Deutschlandsender*. Practically every station—even the relays—has its individual interval signal.



The short distinctive signal of Prague



Another simple interval signal, Riga

For instance, Berlin (356.7 metres) now fills programme gaps with short musical improvisations.

Musical Morse

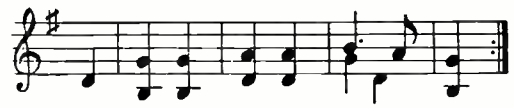
When the broadcast is also taken by other transmitters the letter *B* in morse (— . . .) is given repeatedly. In order that this sound may be of use to orchestras for the adjustment of instruments, it is tuned to a normal A. Hamburg's HA morse signal has been revived.

When you hear a German relay you can identify the origin by the letters used. BMN represents Bremen; FL, Flensburg; HR,

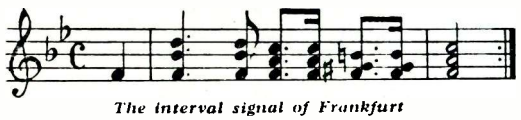
Hanover, and KL, Kiel. Stuttgart has retained its curious gong-like notes (C, D, G), and Leipzig spells out in German musical terms the name of its famous composer, Bach. This is represented by our four notes B flat, A, C, B.

From Switzerland

If we turn to Switzerland, we must bear in mind that we may hear three different languages—German from Beromuenster (usually announced as *Schweizerischer Landessender*); French from Söttens and Italian from Monte Ceneri, known as *Radio Svizzera Italiana*, the name of the town being seldom mentioned.



Berlin uses a simple march tune



The interval signal of Frankfurt

Switzerland possesses many studios and according to the melody used during intervals—if we listen to Beromuenster or Söttens—we can tell whether the programme is given respectively by Basle, Berne, Zurich or by Geneva or Lausanne.

Two Italian Groups

Our next move is to Italy. Here some little attention is needed in view of the fact that all transmitters have been brought into two groups, with the exception of Palermo. The Northern stations—Milan, Trieste, Genoa, Florence and Turin—effect an interchange of programmes and, consequently, whichever is responsible for the entertainment will be first in the list when any announcement is made.

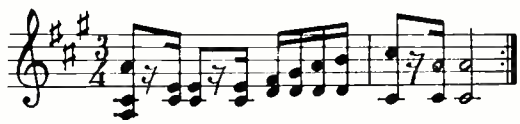
In the same way, Rome has its affiliated network, and the call on most nights may be *Eh-yah* (representing the initials E.I.A.R.) *Radio Roma-Napoli* (Naples), *Bari*, *Torino* (Turin) *secondo e* (and) *Milano* (Milan) *secondo*. This indicates that the small relays at Turin and Milan are taking the broadcast from Rome and thus provide in those two cities an alternative programme for their local listeners.

The Austrian stations present no particular characteristics and, as a matter of fact, although there are many, it is more than probable that you will only hear Vienna. All broadcasts are in German, but the word *Achtung* as used by the Germans does not precede the Austrian call.

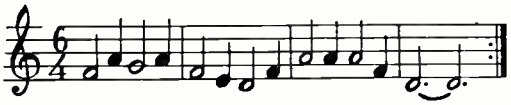
The Czechoslovak studios for the greater part of their programmes rely on Prague, and it is the call from there as well as the short musical interval signal you will pick up. Radio Praha (Prague) is usually followed by the full list of transmitters and as strung out by the announcer is quite a mouthful. This list habitually ends with *Kos-ee-tsay, Moravska-Ost-rav-va.*

Brno, for its local programmes or when relaying to the others, advertises its presence on the ether by four morse letters B-R-N-O (— . . . . — . — . — — — — — —). Some difficulty at the outset may be experienced in differentiating between a Polish and a Czecho broadcast: the two languages are not alike but to an untrained ear they may possess some similarity.

Polish is full of "ski's," whereas Czech is redundant in Z's, A's, B's and rolling R's. Russian, by the way, also contains quantities of labials and is difficult to distinguish from Polish, but as the majority of transmissions tuned-in from the land of the Soviets are on the long wave-band there is less chance of confusion.



Chopin's "Polonaise" is used at Warsaw



Copenhagen's signal is easy to recognise

Warsaw's Distinctive Signal

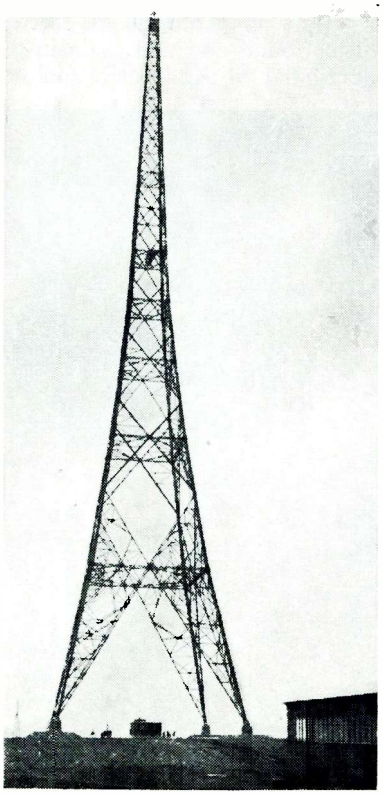
Warsaw you will know by its attractive signal, the first bars of the popular Chopin *Polonaise*, and also by the fact that the lady presiding in the studio clearly enunciates every syllable of the call: *Radio Polskie Warszawa* (Varsch-avva) and all the other stations in the network.

The pronunciation of these names, however, differs greatly from the way they are spelt. Lwow becomes *Lvoof*; Lodz, *Woodsch*; Wilno, *Weelno*; Katowice, *Kat-owe-vee-tsee*. In the case of Wilno, if you get this station direct you will notice that the conventional *Hallo* is replaced by the word *Uwaga* (*Oo-var-ga*), its local equivalent.

Calls from Budapest

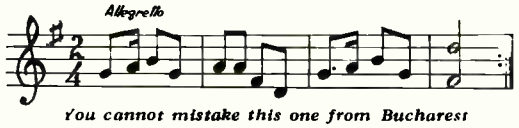
Hallo itt Radio Booda-pescht is the way in which you will hear the Magyar studio at Budapest, or, for that matter, through its relay Nyiregyhaza. Fortunately, the call is given at frequent intervals in German and French, sometimes also in English. Moreover, almost every evening you will pick up gipsy music from this powerful station. The wailing sounds of the leader's violin and the characteristic tones of the marimba must now be familiar to everybody.

In Belgium we find two different languages, Flemish and French; the former sounding a cross between English and German. Brussels (No. 1) will present itself as: *Ici Bru-sale Ee-en-air*, and No. 2 as *Hier Brewsell*; both have adopted distinctive interval signals.

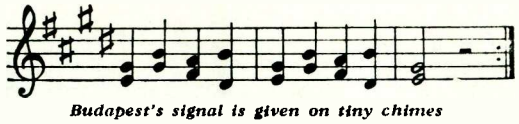


Gidliland photo

Europe's highest wooden aerial mast is that at the 100-kilowatt Stuttgart (Mühlacker). The mast supports an anti-fading aerial and is 623 ft. high



You cannot mistake this one from Bucharest



Budapest's signal is given on tiny chimes

The mention of Flemish naturally brings me to the Dutch transmitters Hilversum and Huizen (Hoyzen), but as their calls are given repeatedly I do not think that the listener need ever have any doubts regarding their identity.

A Tricky Job

It is not an easy task to define the differences between the Swedish, Norwegian and the Danish languages, as they possess many similarities. Swedish, perhaps, appears to be softer than the others and the announcer indulges in a sing-song intonation. We have no interval signal to guide us, but if in doubt must wait until you hear : *Stockholm-Mott-talla.*

Oslo, on the other hand, has opening and closing signature tunes of a carillon character; also it is pronounced: O*u-zlo.* Most of the relays, even Trondelag (Trondheim) take their entertainments from the capital. It is seldom one picks up an individual call.

Twelfth Century Tunes

There can be very little doubt regarding the Danes, as here again we have oft repeated announcements of : *Kalundborg - Kobenhavn og Danmarks Kortbolge-sender,* by which the three stations are mentioned. The tinkly tune one hears between broadcasts, a melody, by the way, which dates back to the twelfth century, is not easily forgotten.

Spain, today, gives us fewer opportunities of listening to her programmes; her stations still at comparatively low power are lost amidst the louder voices of the new European stentors. But from time to time it may be your luck to tune-in San Sebastian (EAJ8), Madrid (EAJ7), or Barcelona (EAJ1). All give out their calls *in extenso* with the letters and number, but in Spanish only.

The first named is heard as: *San-say-bas-tee-yarn,* and EAJ8 as: *Eh-ah-hota ocho*; Barcelona in Catalan is lisped, namely, *Barthell-owe-na,* and the capital studio EAJ7 gives you to understand every time that it is the " key " of the Union Radio network. Not one of these studios has a distinctive signal, but occasionally a melody is played at the opening of the broadcasts.

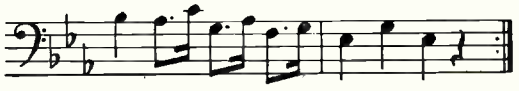
Portugal possesses two stations, and although the State transmitter at Barcarena works on 476.9 metres, a channel shared with Trondheim (Norway), as the latter usually closes down early the Lisbon programme may be captured in the later evening hours.

Portuguese is rather akin to Spanish, but sounds somewhat " roughish."

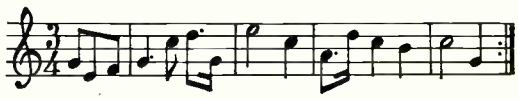
As a new station it announces frequently, namely: *Emissora Nacional, Radio Lisboa,* but, unfortunately, so far has no interval signal. Parede, its private competitor on 291 metres, will be found now and again in the background of Königsberg; in announcements it makes a constant reference to the *Radio Club of Costa do Sol.*

In the space allotted to me for this article, it is impossible to include the calls of every European nation possessing a broadcasting system, but if the listener, when making up a log, is capable of identifying the *main* stations, either by means of calls, interval signals, wavelength used or language heard, it is evident that other captures made at later dates, although not corresponding with channels already noted, will be found easier to classify.

Accurate identification is *only* possible when a log has been compiled in order of wavelengths or frequencies, or alternately if the listener is capable of understanding a number of languages and thus able to state immediately the nationality of the broadcast tuned-in.



The interval signal of Monte Ceneri



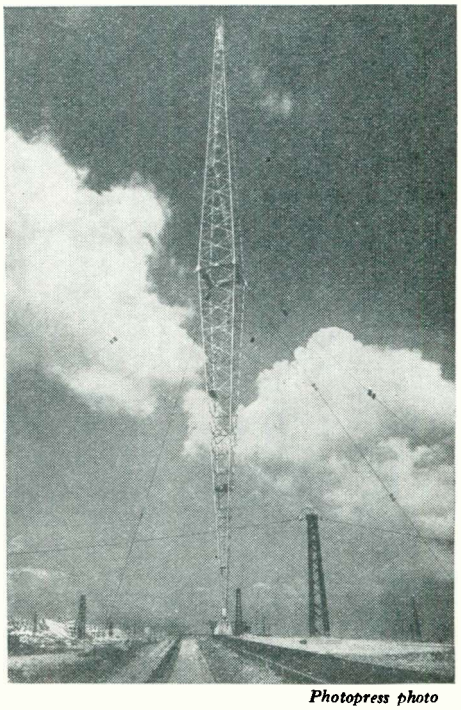
Lahti's signal—not often logged

Easy to Make a Log

The making of a log is an easy matter if you care to tune-in a powerful main transmitter and, after consulting the programmes, ascertain the names of the stations acting as relays in the same network. It is obvious that if a programme is captured from, say, Prague, and the dial readings jotted down, and then, if when slowly twirling the condenser the same radio entertainment is heard on other degrees, it is a simple matter by comparison to establish the readings which correspond with the relays.

Accurate tuning, however, is essential, but the listener, gradually gaining experience, will soon be able to distinguish the difference in language of two neighbouring transmitters. He will be able to state in full confidence " that is not Rome but Stockholm," or, " Why, of course, this is Hamburg, not Toulouse."

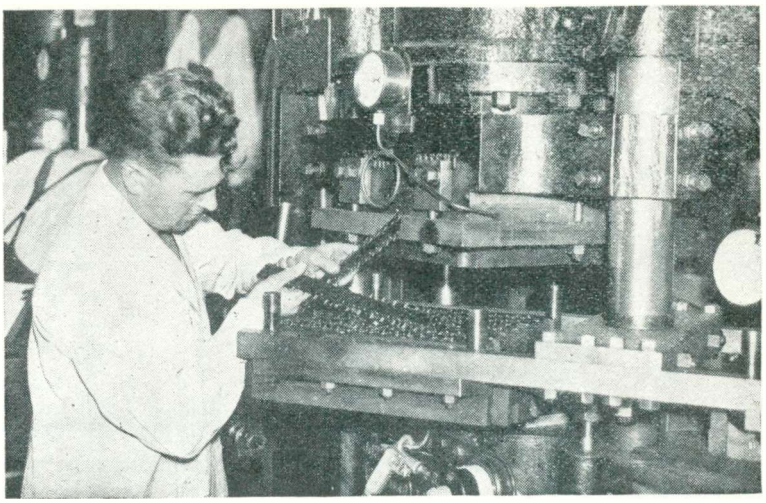
The sound of the foreign tongues will become familiar, and although he may not understand the sentences, without hesitation he will recognise the nationality of the transmitter.



Photopress photo

One of the huge anti-fading masts at the Bisamberg transmitter in Austria. This mast is about 500 ft. high—200 ft. shorter than those of the new Droitwich transmitter

The A.C. voltage across a component may, if desired, often be increased by putting a suitable condenser in series with it, and this less familiar method of increasing the voltage sometimes has advantages over the usual one of using a transformer or an auto-transformer. In the application, which is described in this article, use is made of the "resonance" properties of simple series circuits containing resistance, inductance, and capacity



H.M.V. photo

This huge eighty-ton press stamps out the cases for ninety fixed condensers in one operation

Condensers for Voltage Step-up Purposes

By E. C. WADLOW, Ph.D., B.Sc.

THE method of obtaining an increase in voltage across a component by using a condenser in series with it depends for its working on certain properties of simple series circuits, and these will first of all be briefly considered.

Apparatus used for sound reproduction often has a lagging power-factor or, in other words, may be considered as consisting of a resistance and an inductance in series. If a voltage E is applied to such a component, as in Fig. 1, the total current I taken will be given by the equation

$$I = \frac{E}{\sqrt{R^2 + (\omega L)^2}} = \frac{E}{\sqrt{R^2 + X^2}} = \frac{E}{Z} \quad (1)$$

Here R is the resistance of the component, measured in ohms, L its inductance in henries, and ω is the supply frequency in cycles per second. X is the reactance of the component, in ohms, and the impedance of the component Z (ohms) is given by $Z = \sqrt{R^2 + X^2}$.

If a condenser of capacity C farads is placed in series with the component the circuit becomes as shown in Fig. 2. The current I_1 for the same applied voltage E will now be given by

$$I_1 = \frac{E}{\sqrt{R^2 + (\omega L - \frac{1}{\omega C})^2}} = \frac{E}{\sqrt{R^2 + X_1^2}} = \frac{E}{Z_1} \quad (2)$$

The current in this circuit may evidently be changed by altering only the value of C. It will obviously have a maximum value when

$$\omega L - \frac{1}{\omega C} = 0$$

and will then be given by $I_1 = \frac{E}{R}$

When this state of affairs is obtained the circuit is said to be at "resonance."

The voltage across any section of the series circuit is given by the product of the impedance of the section and of the current passing. Thus the voltage across the component consisting of R and L in Fig. 2 is given by

$$E_{R+L} = I_1 \sqrt{R^2 + (\omega L)^2}.$$

If I_1 for Fig. 2 is greater than I for Fig. 1—E, R, and L being identical in both cases—it will be obvious that the voltage, E_{R+L}, across the component in the second circuit will be greater than the voltage E across the same component in the first circuit.

The variation in the total impedance of the circuit may alterna-

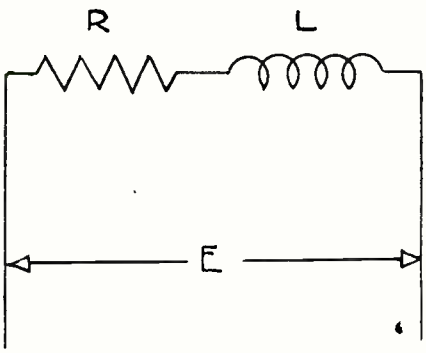


Fig. 1.—Simple series circuit associated with a lagging power factor

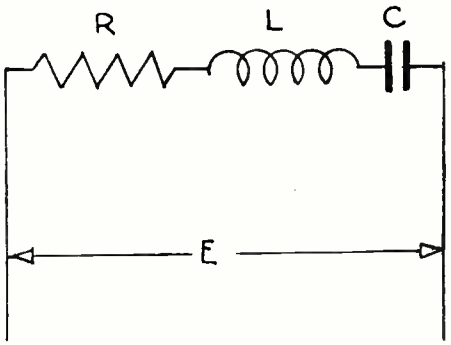


Fig. 2.—Similar to Fig. 1, but with the addition of capacity in series. The current in this circuit is varied by the value of C

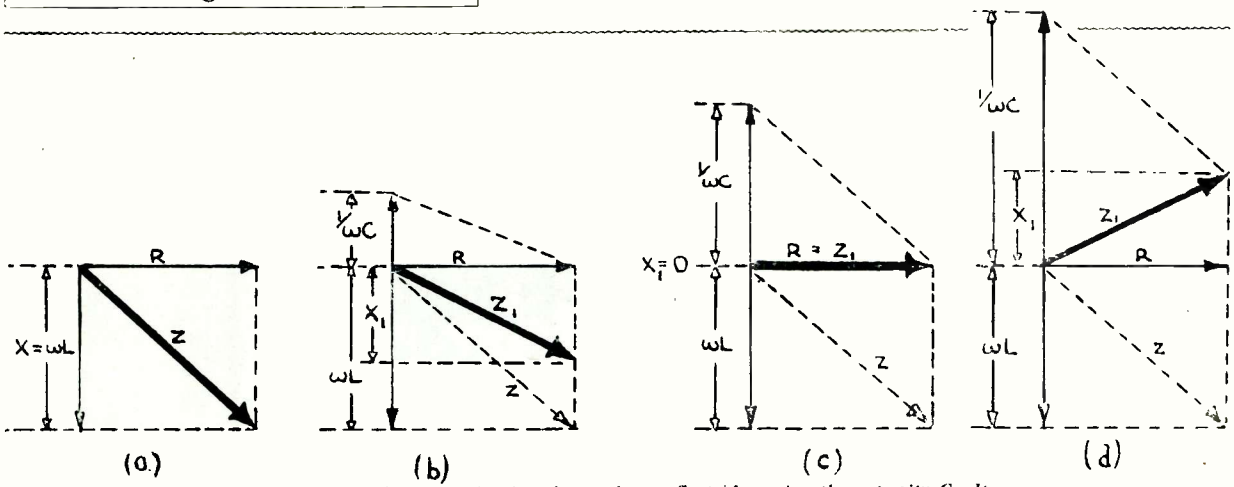


Fig. 3.—Vector diagrams showing the resultant effect of varying the capacity C. It will be seen in C that R=Z, therefore the current is at its maximum value

tively be considered by reference to vector diagrams. In Fig. 3, *a* illustrates the case of Fig. 1 where the condenser is absent. When a large condenser is introduced, as at *b*, the total impedance z_1 will be less than z, the impedance of the component alone, and the current taken by the circuit, I_1, is increased. *c* illustrates the case where $1/wC = wL$. z_1 then equals R, its minimum value, and hence the current is a maximum.

Circuit Reactance

As the value of C is reduced below this figure, it will be seen from *d* that z_1 begins to increase again, and hence the current falls. The reactance of the circuit as a whole, x_1, is given by the projection of the z_1 impedance vector on the ordinate axis, and is indicated in the four cases illustrated.

Fig. 4 shows the results obtained when this method of voltage step-up was applied to a gramophone motor. This may be taken as a typical component which may, in certain circumstances, require an increased operating voltage.

In this instance, the desirability of obtaining an increase may arise from the fact that motors are generally made to operate on a range of voltage from 200 to 250 without any alteration to the windings.

Torques Ratios

The ratio of the torques developed on 200 volts and 250 volts respectively is approximately as 200^2 is to 250^2, that is, as 1 : 1.56, and if the supply voltage is 200, an increase may be desirable and necessary for home recording experiments, or for driving an automatic gramophone.

The particular test illustrated was carried out with a supply voltage of 230 volts, though any other value may have been chosen, and would show the effect of the series condenser equally well.

It will be observed that as the value of the condenser is increased, the current, and hence also the voltage across condenser and motor respectively, increases very rapidly, and at resonance reaches values which may be high enough to cause considerable overheating of the motor, and perhaps breakdown of the insulation. In this particular instance, the maximum voltage across the motor was 345 volts at resonance.

The value of the condenser to give 200 volts across the motor was about .55 microfarad, while .75 microfarad gave 250 volts. Care must therefore be exercised in carrying out modifications of the nature described in this article, and it is necessary to measure the voltages developed in order to avoid trouble.

For this purpose an electrostatic voltmeter is essential if the voltmeter is to be subsequently removed. Other types which take current in their operation may give entirely fallacious results.

Series of Voltage Measurements

This is well illustrated by comparing Fig. 4 with Fig. 5. The latter shows a series of voltage measurements made on the same motor with a moving-iron type of voltmeter. The maximum voltage across the motor with the latter voltmeter in position was 266 volts with a condenser value of 2.6 microfarad.

On removal of the voltmeter from

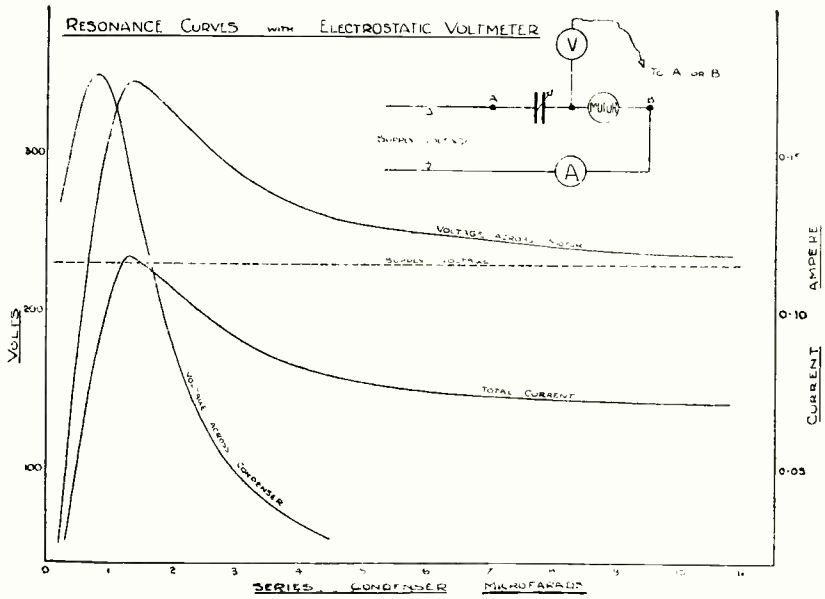


Fig. 4.—Showing the voltage step-up effect when the system was applied to an electric gramophone motor

the circuit, the voltage across the motor reverts to the figure given by Fig. 4 for 2.6 microfarads, namely, 295 volts. The value of the condenser to give resonance is also very much in error.

If an attempt is made to calculate the required capacity, it is necessary to observe that the value of R to be used in the above equations is not necessarily equal to the D.C. resistance of the component. In the case of the motor, additional power is required to supply the resistance losses in the rotor windings, which carry induced currents essential to the operation of the motor, and to supply certain iron losses.

Stator Windings

In the particular motor which provided the data for Fig. 4 the only accessible D.C. resistance was that of the stator windings, which had a resistance, when hot, of about 750 ohms. The effective resistance (R of Fig. 3) on 250 volts A.C. 50 cycles was about 2,160 ohms—a very considerable increase.

The value of the effective resistance, being determined by the general design of the motor, cannot easily be calculated, and bears no fixed ratio to the D.C. resistance of the stator windings. It may, however, readily be determined if the current and watts taken by the motor at a given voltage are known.

Thus, on 250 volts this particular motor took .0745 ampere and 11.9 watts. The total impedance was therefore

$$z = \frac{250}{.0745} = 3{,}350 \text{ ohms (approx.)}.$$

$$\text{Power Factor} = \frac{\text{Watts}}{\text{Volt-amps.}} = 0.64 = \cos \phi$$

Effective Resistance $= z \cos \phi = 3{,}350 \times 0.64 = 2{,}140$ ohms (approx.).

It should perhaps also be added that the effective resistance may not be independent of the voltage across the component. For instance, the effective resistance of the above motor on 50 cycles was found to be as shown in the following table.

TABLE 1.

Volts across Motor	*Effective Resistance (Ohms)*
100	2,450
200	2,240
250	2,160

A study of this example, and of the vector diagrams of Fig. 3 will serve to indicate some of the limitations of this method of obtaining increased voltages.

For instance, its application is limited to circuits containing inductance. If the impedance of the component is entirely resistive, no voltage increase is possible with the series condenser method, which is here at a distinct disadvantage when compared with the use of a transformer.

This, however, is a particular case. It is easy to show that, in general, the ratio of the supply voltage to the maximum voltage obtainable across the component is equal to

$$\frac{R}{\sqrt{R^2 + (\omega L)^2}} = \text{Power Factor of the Component.}$$

The method is therefore most suitable for use with components of low power factor—the lower the power factor the higher the voltage obtainable for a given supply voltage.

Again, it will be seen from the condition which is satisfied at resonance, namely, $\omega L = 1/\omega C$, that a low inductance necessitates the use of a high value of capacity, and hence an expensive condenser.

The condenser method of increasing voltages is therefore mainly limited to use with small components of low power factor, and of high inductance. Under these circumstances it may be more economical in any case to use a condenser instead of a transformer.

From the point of view of the experimenter, however, the advantage of the method will probably lie in the fact that suitable small condensers may already be available, and, if not, they can readily be purchased in units to build up any value required. These considerations do not apply in the case of transformers.

In describing the experiments on the gramophone motor, considerable emphasis was placed on the necessity for careful measurement of the voltages resulting from the addition of the condensers. Precautions are necessary, of course, with any method of increasing the voltage, unless the change is carried out to specific and reliable information.

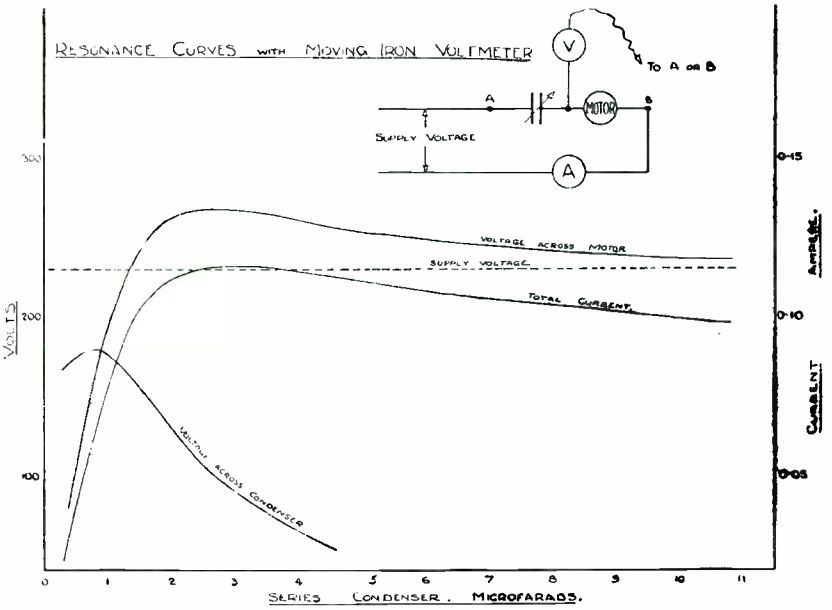
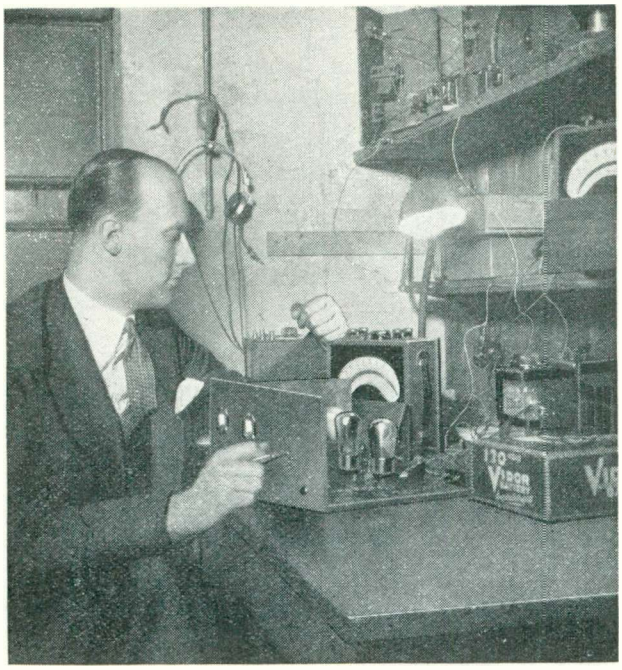


Fig. 5.—By comparison with Fig. 4, where the readings were obtained with an electrostatic voltmeter, it will be seen what fallacious results are obtained when the meter takes any current from the circuit

Components which may usefully be employed as above described will be designed for operation on a certain voltage range only, and the maximum figures given by the makers should generally not be exceeded.

However, there are several instances, particularly on 200-volt supplies, where a voltage increase is sometimes desirable, and where it can be carried out to give improved results without any risk of damage through overload.

Although, in this article, only the use of condensers to give a voltage increase has been discussed, it will be seen that under certain circumstances they may be used in a similar manner to cut down the voltage across a component. When this is being done, similar precautions to those already outlined should generally be observed.



The £5 5s. Battery Four

By the "W.M." Technical Staff

Last month, it will be remembered, we showed how to add a low-frequency stage to the simple two-valver described in the December issue of "W.M." Here we go one step further and add a stage of high-frequency amplification to the three-valver. New readers should note that this four-valver can be built for £5 5s.; this price including every accessory with the exception of the cabinet

THIS is a design that has graduated out of the two cheap and simple sets described in the December, 1934, and January, 1935, issues of "Wireless Magazine." First we showed how to built a two-valver, and afterwards we added a low-frequency stage: now we show how to build a four-valver.

Standard Components

Nearly all the parts used in the previous two sets can be made use of again in this month's design, but some additional parts will, of course, also be needed. As the components employed are quite standard productions there should be no difficulty in obtaining supplies.

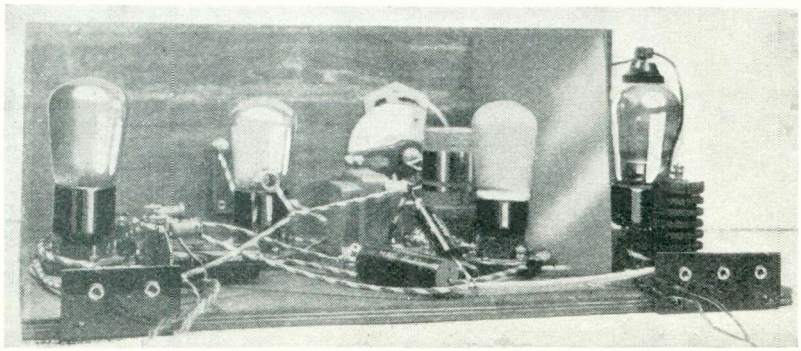
The valve combination used in the £5 5s. Battery Four is a screen-grid high-frequency stage, leaky-grid detector, transformer-coupled low-frequency stage and a resistance-coupled pentode (or triode) output valve. This is a combination that gives a reasonable degree of selectivity because of its two tuned circuits. It also gives adequate range and power.

But details are better than generalisations, so let us analyse the circuit so that we can understand just what is what.

In the first place it will be seen that the aerial is taken to the first coil through a .0001-microfarad fixed condenser; this, of course, is to increase the selectivity. Built into the tuning coil itself and thus forming an integral part of it is a further .00003-microfarad condenser; this is in circuit only when the set is used for long-wave reception.

In this way adequate selectivity is obtained where it is most required —and that is particularly true if you live anywhere near Droitwich.

As the high-frequency stage is a straight screen-grid type, there are no complications about this part of the circuit. The input is fed direct to the grid and to avoid the need for a potentiometer a separate tapping



SHOWING THE FOUR VALVES IN POSITION

A rear view of the completed set, showing the four valves. From left to right they are the pentode, first low-frequency amplifier, metallised detector, and the screen-grid high-frequency amplifier

is provided for supplying voltage to the screen; this is marked H.T.+1.

It will further be noted that this part of the circuit is decoupled by means of a .25-microfarad condenser.

In the anode circuit of the screen-grid valve there is a high-frequency choke, which should be of an efficient type so that the maximum signal strength is passed on to the detector valve, which is coupled to the first by the tuned-grid method.

Tuning Circuit

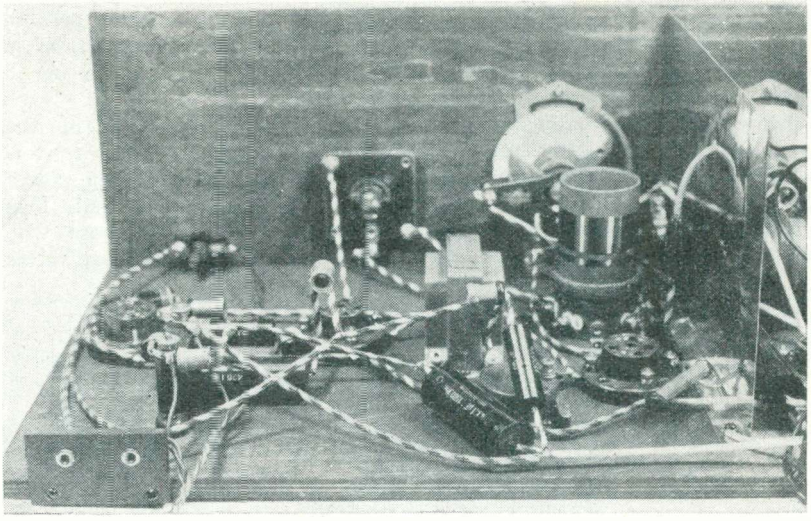
Between these two valves there is a coupling condenser of .0001 microfarad, immediately followed by the grid coil, which is tuned (as is the aerial coil) by a .0005-microfarad condenser. Separate tuning has been employed for both tuned circuits so that those who have a couple of spare condensers by them can make use of them without going to the expense of buying new ones.

The detector grid leak and condenser have the usual values of 2 megohms and .0003 microfarad. Reaction, it will be seen, is arranged on the differential principle. That is, the reaction condenser has two sets of fixed plates and the action is such that there is always the same by-pass capacity across the anode and filament of the detector valve.

Not so Efficient

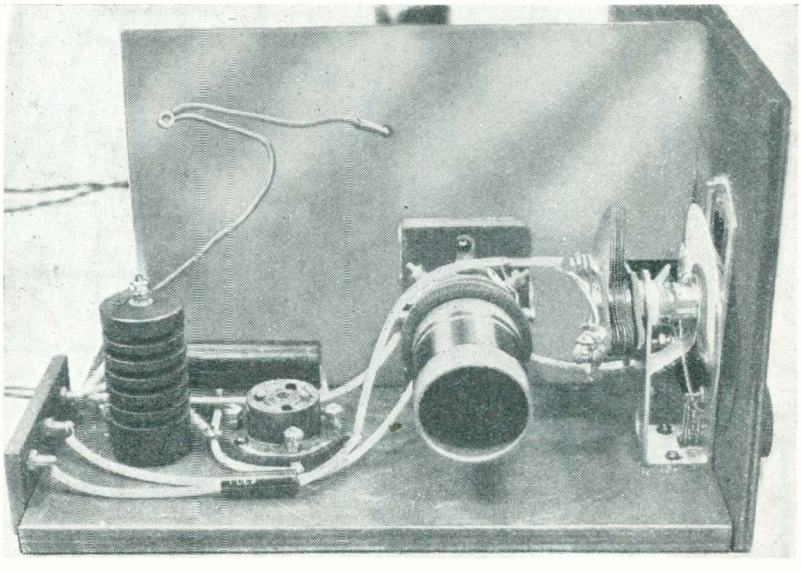
A second high-frequency choke is used in the detector anode circuit, but this need not be of quite such an efficient type as that employed in the anode circuit of the high-frequency valve.

There is nothing unusual about the connections of the low-frequency transformer. Remember, though, that should the set fail to give good results it is worth while to try reversing the connections either to the primary or to the secondary.



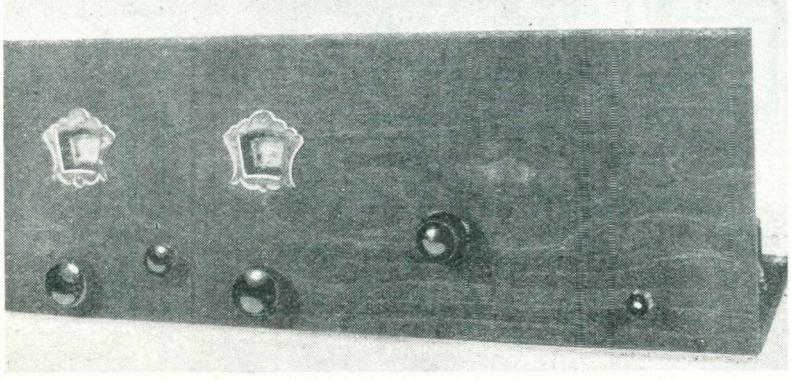
CLOSE-UP OF THE LOW-FREQUENCY SIDE

There is no need for us to emphasise the simple baseboard construction adopted for this set. Note the position of the low-frequency transformer—in the first low-frequency stage, not the second



SHOWING THE HIGH-FREQUENCY STAGE

There are but few components in the high-frequency stage. The aerial coil is mounted on a small piece of wood close to the aerial-tuning condenser



RATHER AN UNUSUAL PANEL LAYOUT

The panel layout of the £5 5s. Battery Four does not follow the usual symmetrical lines; efficiency being more desirable than appearance in this set

The intermediate low-frequency stage is resistance coupled to the output valve. A 30,000-ohm resistance and a .1-microfarad coupling condenser are used for this purpose. The two 5,000-ohm resistances and the .05- and .25-microfarad fixed condensers are for decoupling the detector and low-frequency stages respectively.

Associated with the output valve are further resistances and condensers. The two resistances of 350 and 150 ohms are for providing the output valve and the intermediate

low-frequency stage with automatic grid bias.

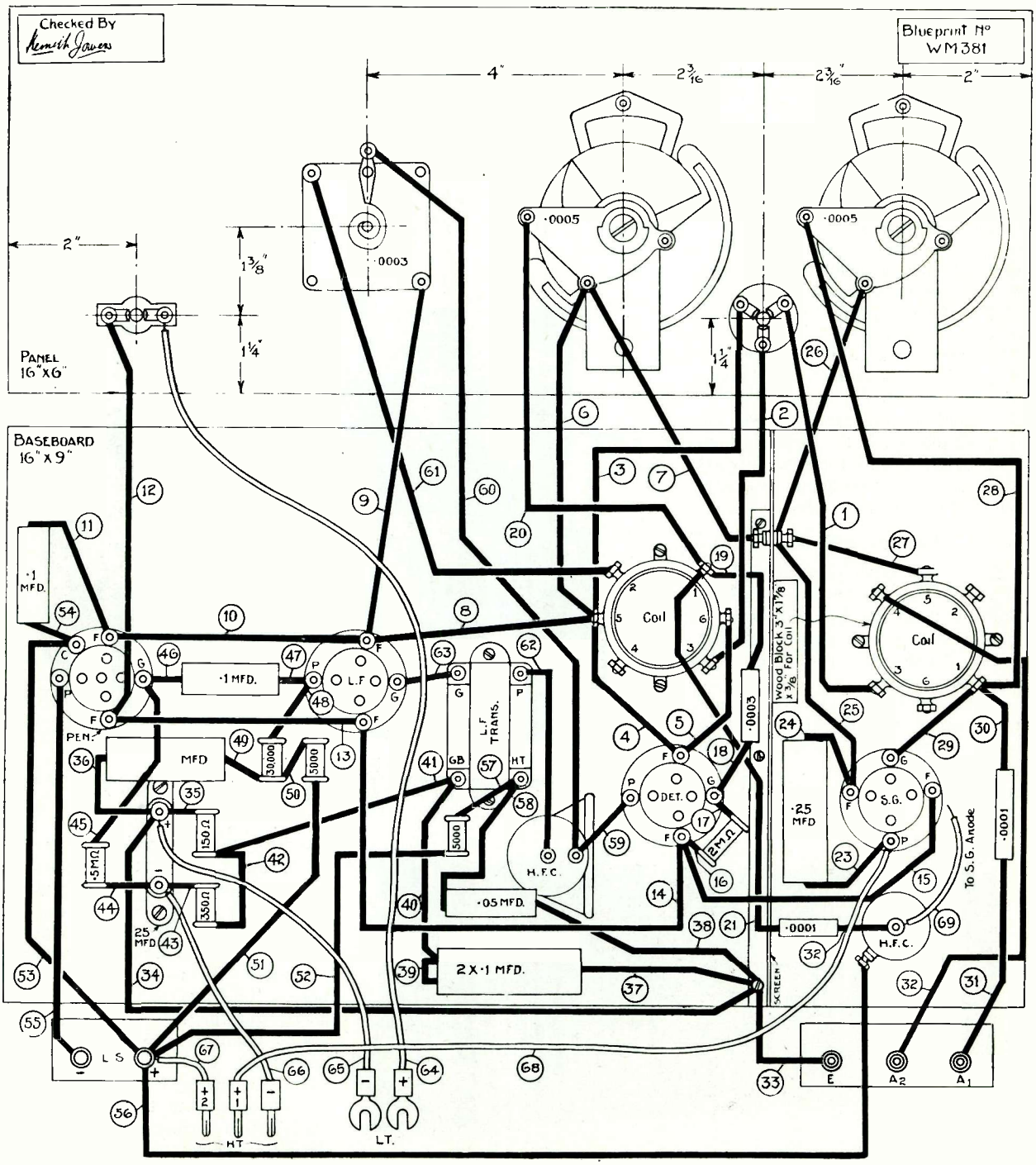
The 150-ohm resistance is by-passed by a condenser of .2 microfarads, while the two are by-passed by an electrolytic condenser of 25 microfarads. The latter must be connected up with due regard to the proper polarity.

Note that the screen of the pentode is supplied with the same voltage as the anode; this is in accordance with the makers' recommendations. The screen circuit is by-passed by a condenser of .1 microfarad.

Without any alteration of the circuit or the set in any way it is possible to substitute a triode power valve for the pentode if desired. This course may appeal to those who already have one or two spare valves or who can get them from their friends.

That covers the main features of the design, which on test has proved to do everything that can be expected of a set of the type. Range is adequate and the volume of reproduction from thirty or forty foreign stations leaves nothing to be desired.

Whilst full constructional details in the way of photographs and



If desired, a full-size blueprint of the £5 5s. Battery Four can be obtained for half-price (that is, 9d., post free), if the coupon to be found on the last page is used before February 28. Address your application to the "Wireless Magazine" Blueprint Department

drawings appear in these pages it should be remembered that a full-size blueprint is available to readers at half price, that is 9d., post paid, if the coupon on the last page is used by February 28.

When it comes to actual construction there is little that need be said, for everything is very simple and straightforward. Although for the sake of simplicity the aerial coil has been shown in the blueprint in a vertical position it is actually mounted horizontally, as will be clear from the photographs. This is to avoid interaction between the aerial coil and the tuned-grid coil.

Capacity Shield

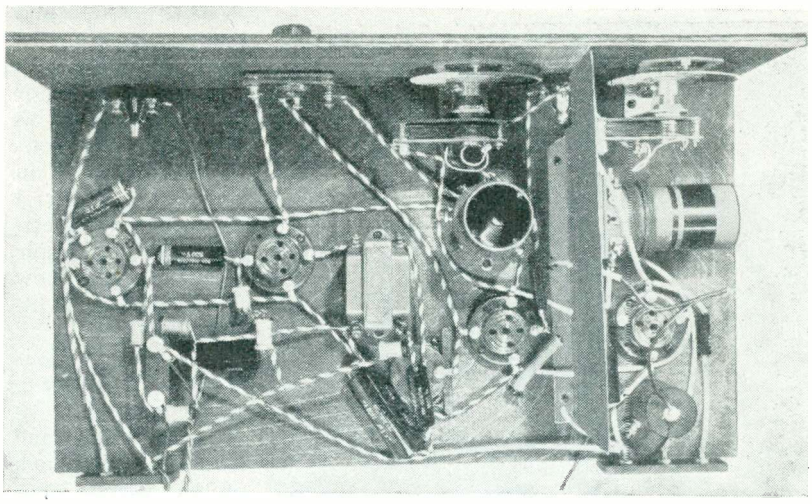
There is also a vertical partition screen between the aerial-tuning side of the set and the tuned-grid side; this screen acts rather as a capacity shield between the wires than as a magnetic screen between the coils, which is why the latter are mounted with their axes at right angles.

One other point to note is that the .2 microfarad condenser used as a grid-bias by-pass is composed of a .1+.1 microfarad condenser; this is used because it was employed in the previous designs. Those who are starting this set from scratch, as it were, can use an ordinary .2-microfarad type.

Five Controls

Apart from these special points there is nothing that the beginner will not be able to understand from the diagram on page 46 or the full-size blueprint.

There are five controls in all, three



PLAN VIEW OF THE £5 5s. BATTERY FOUR

This photograph will be found of extreme value if it is used in conjunction with the scale reproduction of the blueprint on the opposite page. All the wiring is on one side of the baseboard only so making construction particularly easy

condensers and two switches. The condensers, from left to right, are for aerial tuning, grid tuning, and reaction; the switch on the left is for wave-changing and that on the right for putting the set on and off.

There will be very little difficulty about the operation of the two tuning condensers as their readings will remain practically the same at all wavelengths.

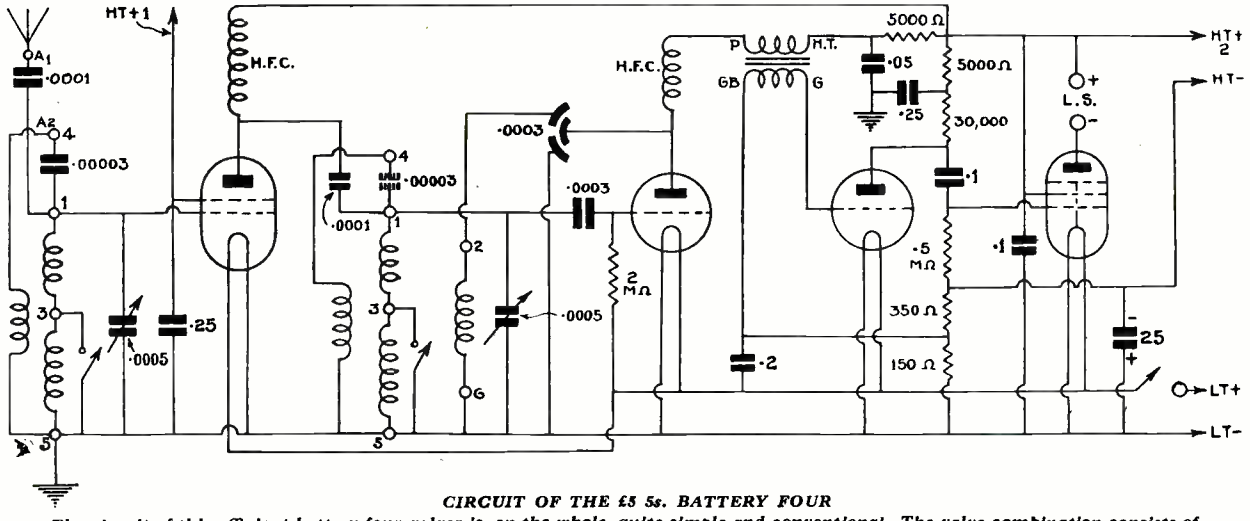
When the set is first put into operation it is important to adjust the anode voltages properly. The battery should be of 120 volts as some of this will be lost anyway because of the incorporation of automatic grid bias. This is not a great disadvantage, though, when the convenience of the system is taken into consideration.

Quite apart from the saving of connecting leads, the grid bias will automatically fall as the voltage of the battery decreases so that the grid bias will always be in more or less correct proportion to the applied anode voltages and quality will not suffer as the battery runs down.

Suitable Voltages

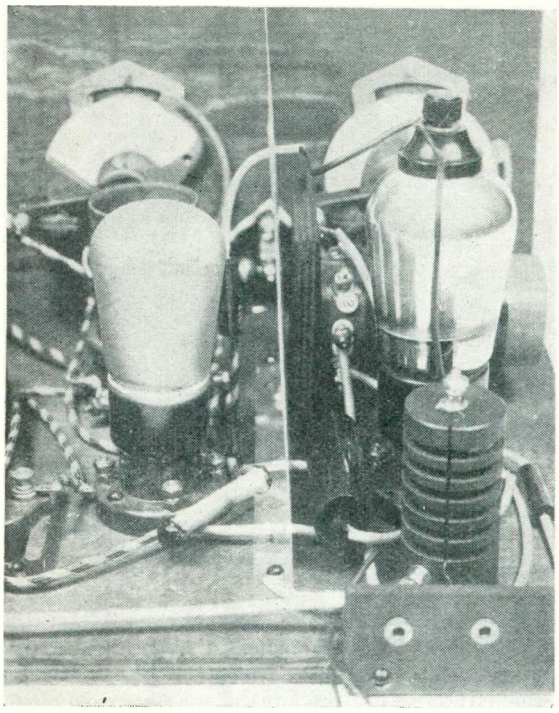
H.T.+1, which supplies the screen of the high-frequency valve, should be plugged in at about 80 volts, while H.T.+2 should be plugged into the 120-volt tapping. There is, of course, no objection to the use of a 150-volt battery, in which H.T.+2 should be plugged into 150 volts.

It is best to start reception on the



CIRCUIT OF THE £5 5s. BATTERY FOUR

The circuit of this efficient battery four-valver is, on the whole, quite simple and conventional. The valve combination consists of an ordinary high-frequency amplifier, leaky-grid detector transformer coupled to the first low-frequency stage: this stage is then resistance-capacity coupled to the output pentode



HIGH-FREQUENCY END OF THE SET

A rather unusual close-up showing the screen dividing the high-frequency side from the rest of the set. Two aerial tappings and an earth socket are provided

medium waves as there are more stations working on that band and it is easier to pick up a selection of programmes. To adjust the set for this waveband, pull out the wave-change switch on the right (push it in for long waves) and, of course, pull out the right-hand knob to switch the set on.

Operating Hints

Adjust the reaction condenser to its minimum point (that is, turn the knob in an anti-clockwise direction as far as possible) and then slowly turn the two main tuning dials. Keep them more or less in step as far as the readings are concerned until a station is picked up. After a few minutes' experience it will be simple enough to see how far the dials are actually out of step.

For distant stations it will be necessary to apply a certain amount of reaction and to do this the knob of the reaction condenser is turned in a clockwise direction. Do not advance the reaction control too far or the set will burst into oscillation and the quality of reproduction will be spoiled.

When it is desired to use a pick-up this should be connected across the 150-ohm bias resistance associated with the intermediate low-frequency valve. Most modern pick-ups give an output of the order of .75 volt and the 362 HL2 valve will be well loaded.

On the other hand, if an older type of pick-up giving an output of the order of 1.5 volts is employed, then the HL2 valve is liable to be overloaded and it will be better to use the 363 L2 in the intermediate low-frequency stage.

Do You Ever...?

At this time of the year there are usually some signs in the household of the forthcoming activities which cause chaos and confusion under the name of "spring cleaning."

From the radio point of view—and, after all, that is all that we constructors are concerned with—it is not so good.

The poor old receiver gets no attention; another year's dust is allowed to accumulate with dire results to its efficiency.

Have you ever thought that, apart from messing about with the circuit, it would be a good plan to give the innards of the receiver a thorough spring-clean? It is quite possible that some of the weird results which you have been moaning about will vanish when you have completed the dry-cleaning process, as it is surprising what loss of efficiency a little dust will cause.

Turn your attention to the variable condensers and give the vanes a good clean out with the aid of pipe cleaners. Inspect all resistances and grid-leak holders, removing all dust and making quite sure that the contents are clean and free from any corrosion.

Examine the switch movements and make certain that the operation is still efficient and all current-carrying points clean. Valve holders should receive their share of your attention and all dust should be removed, as it is surprising what leakage can be produced by this, together with any dampness which may be in the atmosphere.

S.

COMPONENTS NEEDED FOR THE £5 5s. BATTERY FOUR

	s.	d.
BASEBOARD		
1—5-ply, 16 in. by 9 in. ... say	1	6
CHOKES, HIGH-FREQUENCY		
1—Graham Farish, type Snap ...	2	0
1—Graham Farish Ohmic... ...	2	6
COILS		
2 B.T.S., type Droitwich ...	7	0
CONDENSERS, FIXED		
2—Franklin .0001-microfarad ...	1	0
1—Franklin .0003-microfarad ...		6
1—Franklin .05-microfarad ...	1	0
2—Franklin .1-microfarad ...	2	0
1—Franklin-.1+.1-microfarad ...	1	6
2—Franklin .25-microfarad ...	2	8
1—T.C.C.25-microfarad electrolytic, type 511	2	6
CONDENSERS, VARIABLE		
2—Ormond .0005-microfarad, type R/503	4	6
1—Graham Farish .0003-microfarad differential reaction type ...	2	0
DIALS, SLOW-MOTION		
2—Ormond, type R/361	2	6

	s.	d.
HOLDERS, VALVE		
3—W.B. four-pin	1	6
1—W.B. five-pin		8
PLUGS, TERMINALS, ETC.		
4—Clix wander plugs, marked: H.T.+1, H.T.+2, H.T.—		4½
2—Clix spade terminals, marked: L.T.+, L.T.—		4
5—Clix metal sockets		5
RESISTANCES, FIXED		
1—Franklin 150-ohm, type ½-watt		6
1—Franklin 350-ohm, type ½-watt		6
2—Franklin 5,000-ohm, type ½-watt	1	0
1—Franklin 30,000-ohm, type ½-watt		6
1—Franklin ½-megohm, type ½-watt		6
1—Franklin 2-megohm, type ½-watt		6
SUNDRIES		
Ebonite strip 5 in. by 1 in. by $\frac{3}{16}$ in. say		3

	s.	d.
3 Doz. ½-in. wood screws say		6
Connecting wire and sleeving say		9
3 yds. thin flex		3
Aluminium for screen 6 in. by 9 in. say		6
Wood for panel 16 in. by 6 in. by $\frac{3}{16}$ in. ... ... say		9
SWITCHES		
1—Goltone two-point push-pull ...		7½
1—Goltone three-point push-pull		10½
TRANSFORMER- LOW-FREQUENCY		
1—Graham Farish, ratio 1:3.5, type Pip	6	9
ACCESSORIES		
BATTERIES		
1—Marconiphone 120-volt ...	11	0
1—Exide 2-volt accumulator, type DTG	4	6
LOUD-SPEAKER		
1—W.B., type Stentorian Baby ...	1	2 6
VALVES		
1—362 SG2	7	6
2—362 HL2 L2	7	0
1—362 ME2	10	0

"W.M." photo

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

Bad Deliveries

MY remarks about bad component deliveries in the December issue of "W.M." have brought forth two long letters from readers who have suffered in this way. For instance, Mr. F. G. Bannister, of Macclesfield, says:

"Despite my keenness about home construction, I am beginning to wonder if it is really worth while nowadays, for, after all, the old-fashioned style of circuit which one could 'tinker' with and adjust to one's delight (and sometimes disappointment) is a thing of the past, and in place we have more complicated 'supers' which, unless one is really well up in technical knowledge (and not all of us are fortunate in this respect), are better left as the designer gives them.

"Another drawback with which the constructor has to face is £ s. d. I built early this year the Merry-maker Super, using specified parts which cost £15 5s. without loud-speaker or cabinet.

"The results I have obtained are definitely disappointing and do not by any means equal those obtainable from a factory-built set costing £10 10s. or thereabouts.

"I do not mean to imply that the design is at fault, but I think I have been unlucky in receiving components which are not up to standard. I have had to return the coils; some resistances have been found faulty; and also I have had trouble with three of the valves, two of which are now back at the makers for test, and I am living in hopes that they may prove the source of my trouble and that when I receive them back I may look forward to results being obtained which are at least in accordance with those to be expected of this set.

"My observations above are not in form of a grumble, but to emphasise the necessity of lower-priced components to enable the constructor to 'compete' with the price of the manufactured set, for, after all, few of us are able to pay an extra 'fiver' without feeling some pinch somewhere.

"I also think manufacturers of components ought to put their 'house in order' to enable them to reply to queries in a straightforward manner, which I am sorry to say they do not at the present seem keen about."

Ekco photo

TWO DESIGNERS—FOR THE OUTSIDE AND THE INSIDE

Mr. Wells Coates (right), the well-known architectural and decorative designer, discusses with Mr. E.J. Wyborn, Ekco's chief engineer, one of the latest radio cabinets

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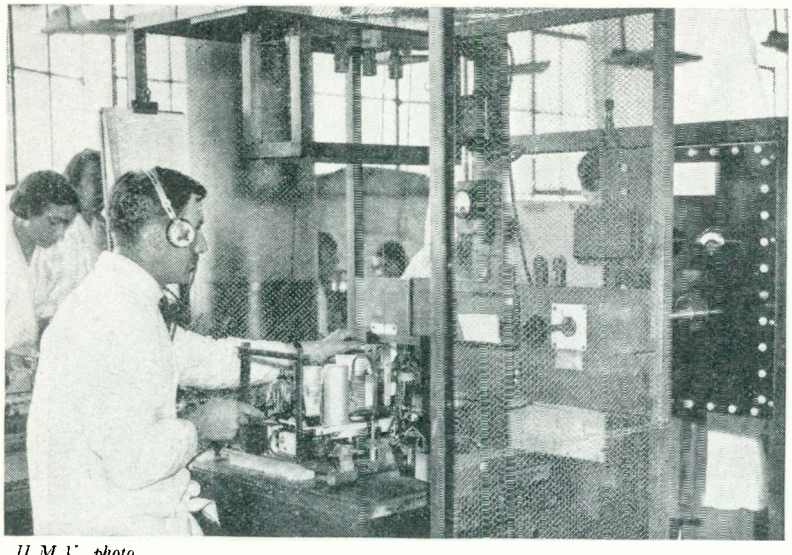
Still More Complaints

Well, that is that, but Mr. C. D. Smith, of Finchley, also has similar grouses. Here are some points from his letter:

"In the beginning of April last I obtained from one of the best kit suppliers known your Universal Merry-maker. I started to check over, and found some resistances were missing, and some I had but didn't want.



H.M.V. photo

MINIATURE TRANSMITTER FOR SET TESTING

Making use of a miniature transmitter to test a production set. Note the screened cage to decrease the amount of "mush" picked up from machines in the factory

"Went back to them with the surplus, and told them what I wanted. In spite of their advertisements they had not got them, and finally I had to go to the makers of the resistances myself.

"Then I started building the set, wired up and finally we were ready to test. But we hadn't really got going, for on trying to insert the valves, discovered that although continental valve holders are required, English type had been supplied.

"Down comes all the wiring and the valve holders returned for exchange. Three weeks later they arrived, and but for the fact that one of them was minus a hole in its leg, everything was looking rosy.

"Alas! along comes the news that 'W.M.' had slipped up and quoted the incorrect mains resistance. I thought it was curious that I got a 12s. 6d. resistance for 8s. That's not like these wireless people.

"Back it goes, and we settle down for another two weeks.

"It has come and is duly installed. Switch on! Terrific howl, getting more terrific when the volume control is turned up. More messing about—finally traced it to the coil unit switches.

"Out it comes and back it goes with dirty contacts. The nice neat wiring by this time looks like mother's wool after the cat's had a bit of fun. This time we only had to wait six weeks. I expect that the three or four reminders I sent made them sit up and take notice.

"Now we *are* ready. Switch on—pulls in the stations all right, but very bad hum. Must be our mains. Very well, we'll try it in the next district on A.C.—it's worse.

"Get aforesaid 'kit people' to test throughly to discover bad component or such like, and so we did.

"Finally had to go and collect it as they were too busy to dispatch it. Never mind, they only kept it a fortnight that time, and they said it was O.K. now.

"Arrived home and switched on, and it was just the same. Would you believe it? Still we went into the next district and tried it on A.C., and it was O.K. on A.C.

"But why should the hum be so loud on D.C.? (Even mercury-arc rectifier?)

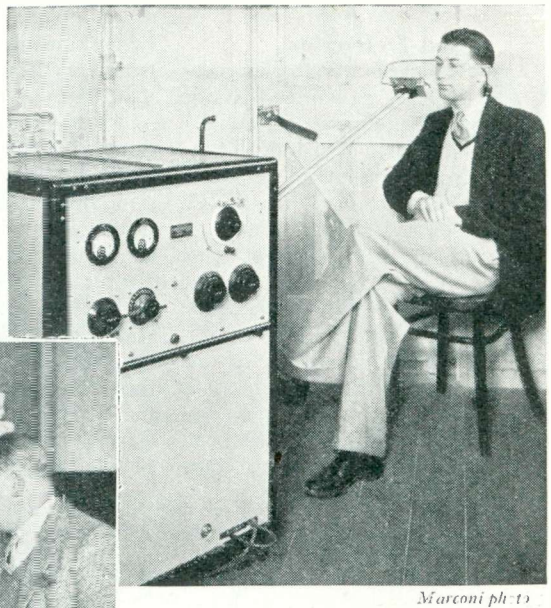
"After more messing about, making tests, inquiries, suggestions and getting every Tom, Dick and Harry's opinions, it was decided to fit an additional choke on the negative pole of the mains. This choke the aforementioned kit people would get and dispatch to me in two days. Waited patiently for a week, and then, on my reminding them that Christmas was drawing near, they discovered that it had come in that very morning.

"Put choke into circuit—nothing doing, more messing about, we're getting expert at messing about and found it was our old friend the coil unit—something wrong with his 'innards.'

Pye photo

NOT WHAT YOU THINK!

No—not another spot of bother! Just Clapham and Dwyer trying out their new portable set



Marconi photo

RADIO THERAPY

This apparatus generates high-frequency currents that have a definite therapeutic value; doctors are taking great interest in such forms of treatment

" Took it back to the makers, who will dispatch it in the morning, as there is not much the matter with it.

" But they didn't say which morning, and I forgot to ask them. However, I rang them up to-day, and they are still going to dispatch it in the morning. As a matter of fact, it was overlooked by the dispatching department. I suppose they found it 'kicking' about on the floor. Anyway, I eagerly await to see if they remember it this time.

" I've ordered my cabinet, for what is a wireless set without a cabinet (yes, and what is a cabinet without a wireless set?) and that is the reason that although the cabinet, promised in ten days, is about a week overdue, I am not hurrying them.

" I have the idea that there were one or two other little 'snags,' but I can't remember all of them. Eight months to build a wireless set, and not going yet (except backwards and forwards). Still, we live in hopes."

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Television Experiments

A friend of mine has had a lot of fun recently fitting up a disc television receiver. He is using only a small battery set to drive it, but is very enthusiastic about the results. He had never seen any television, by the way, until he got his own receiver going.

The first time he tried it out the picture was upside down and reversed: that is, what should have been black came out white, and vice versa. He altered the amplifier section and then got the picture the right way round, but still upside down.

At the third attempt he reversed the mounting of the motor, which put the picture " on its feet," as it were. Now he wants to graduate to a more ambitious system of reception, but the expense goes up rapidly when you want to change from a simple disc to a mirror drum.

There is no doubt that television will hold a great deal of interest for many experimenters when the position has really been sorted out and put on a proper basis.

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One-valve Short-wave Results

Just out of curiosity I have been trying out a one-valve short-waver. As a flat-dweller I am very restricted as regards aerial arrangements and the only convenient earth I can get, besides a copper plate under the carpet, is a gas pipe.

Nevertheless, even with an aerial only 12 ft. long I have had some remarkably interesting results. Quite early in the evening I have had several American stations coming through at really good phone strength. Which just shows what the short waves can do!

And isn't it strange to go back to headphones? It must be nearly eight years since I have used them, but they do give you the feeling that you are really doing something in radio. If I am not careful I shall find myself bitten by the short-wave bug.

At any rate, I have learned one or two useful things about short-wave reception by using this single valver. A really good slow-motion dial is absolutely essential—something of the 1:50 or 1:100 type is needed for tuning.

Moreover, it is just as necessary to have a very slow-motion control on the reaction condenser, for the setting of this is quite as critical as that of the aerial circuit.

BM/PRESS

London, W.C.1.

G.E.C. photo

WE COULDN'T DO WITHOUT THE MIKE NOW!

Public-address has become so much a part of our everyday lives that its use is nowadays taken for granted

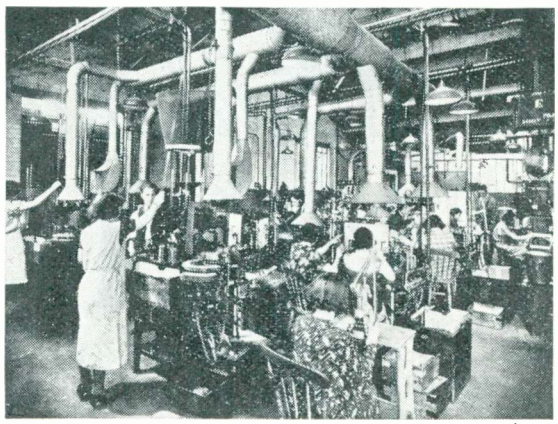
TEN YEARS OF THE BEST IN RADIO

THIS is the 121st issue of "Wireless Magazine," which means that we have completed ten years of existence.

Right from its inception "Wireless Magazine" has been recognised as the leader in its field; it has set itself a high standard—a standard that can be maintained only by the exercise of constant care and deliberation on the part of those responsible for its production.

During its first ten years "Wireless Magazine" has numbered among its contributors most of the important personalities in the radio world; we have been able to present our readers with articles by such men as J. Godchaux Abrahams, BM/PRESS, Noel Bonavia-Hunt, Arthur Burrows, Dr. Alfred Gradenwitz, Percy W. Harris, Baynham Honri, Alan Hunter, W. James, Kenneth Jowers, Marchese Marconi, D. Sisson Relph, J. H. Reyner, E. H. Robinson, Captain H. J. Round, Marcus G. Scroggie, P. K. Turner, Paul Tyers, Kenneth Ullyett and Whitaker-Wilson.

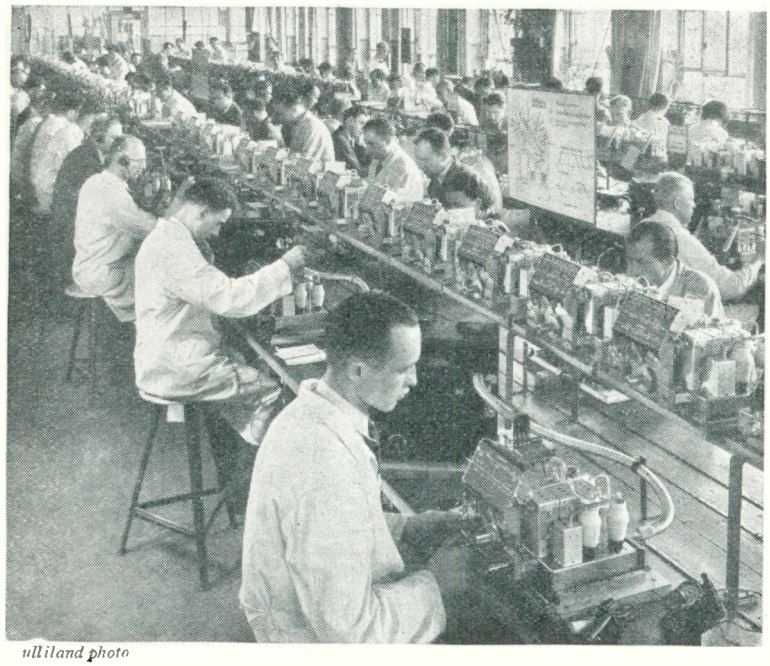
Indeed, no efforts have been spared to make "Wireless Magazine" what it now is—the best and most complete radio monthly in the world.



Cossor photo

A PEEP BEHIND THE SCENES

A corner of a mains valve assembly shop. Note the elaborate ventilating system—needed because many of the machines are gas heated



Every possible comfort is provided for workers in the testing-room of the Siemens' Berlin factory, even to flowers on the window-sills and curtained windows. Every German set has to undergo extensive tests before being sold

ullstein photo

Building a Two-valve 10-watt Amplifier

Here we present details of an A.C.-operated amplifier using only two valves and which gives an undistorted output of 10 watts —volume more than ample for an average hall. Although intended for gramophone work, the amplifier will be found ideal for connection to a radio unit

By Captain E. H. ROBINSON

TEN watts of undistorted output is far too much for an ordinary living-room, and is likely to be a nuisance to one's neighbours in flats and semi-detached houses.

The legitimate function of an output valve of this handling capacity is for *very* large rooms, for supplying gramophone dance music, and for public-address work generally.

Many who would like to build a really powerful amplifier have been kept off the adventure by the high cost which has become associated in the minds of most people with these instruments.

If one uses a triode output valve, which is supposed to be imperative for really high-class reproduction, something over £4 must be given for this valve alone, to say nothing of the fact that these triodes take a current of at least 120 milliamperes at 500 volts, with the resultant specially designed and expensive mains apparatus. In addition to this at least two valves have to precede the output stage.

The high-efficiency mains pentodes give an altogether different aspect to the problem. With the Marconi PT25 or the Mullard PM24D as the output valve, a two-valve amplifier will provide ample volume for dance music in quite a large hall, and since the combined anode and screen current for this class of valve is well within the capabilities of an ordinary 500-volt mains unit, design and construction are easy. The cost, too, is under £12, which is cheap considering the many uses to which the apparatus can be put.

In some initial experiments with such an amplifier, making use of a Catkin MH4 as the first valve and a Marconi PT25 as output, I imagined that transformer coupling would be necessary to load the output valve. I found that this supposition was erroneous, and that, with straight resistance-capacity coupling, using a loud needle and an efficient pick-up, the output valve could be nearly fully loaded on average records, and that on very loud records there were signs of overloading.

The circuit, together with the list of parts required, gives all the particulars necessary. As there are no iron circuits in the amplifier there is little danger of any interaction between the mains apparatus and the coupling circuits. Indeed, working without any earth connection, the amplifier, as I made it, is entirely free from any suspicion of hum.

Rectifying Circuit

The rectifier is on generous lines, and makes use of an indirectly-heated valve. The one I chose was the Osram U14, capable of delivering a smoothed supply of 500 volts 120 milliamperes. The actual current taken by the amplifier is just under 80 milliamperes, so that the mains apparatus is capable of feeding one or two more valves if it is desired to associate it with a radio unit.

With this end in view it is as well, when ordering the mains transformer, to get one with a 4-volt

2.5-ampere tapping for the rectifier, a 4-volt 2-ampere tapping for the directly-heated pentode, a 4-volt 1-ampere tapping for the first valve of the amplifier, and a 4-volt 2/3-ampere tapping for subsequent use on radio.

First Smoothing Choke

The first smoothing choke, which should be about 20 henries when passing 120 milliamperes, serves the output valve only. The field coil of the loud-speaker might be used in this position; but for public-address work it is often convenient to have the amplifier at some distance from the loud-speaker, and in such a case long leads carrying heavy current are liable to be a nuisance and may cause trouble from pick-up.

Anode-circuit Resistance

As the maximum anode voltage of the output valve is set by the makers at 400 volts, we must get rid of some excess, and a resistance of 1,000 to 1,500 ohms of 10-watt rating can be put into the anode circuit.

It should be pointed out, however, that the current taken by a pentode is largely governed by the screen voltage, and that some considerable excess of anode voltage makes little difference to the consumption of the valve or its life.

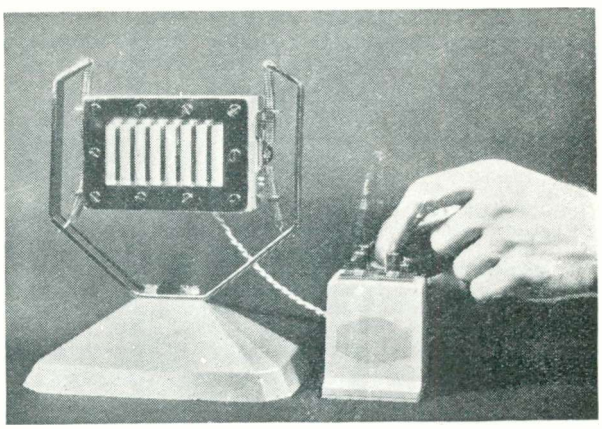
Across the primary of the output transformer is a filter circuit consisting of a 50,000-ohm variable resistance and a small condenser. This acts as a protection to the valve by preventing voltage peaks, and the variable resistance can be used to adjust the amount of high musical frequencies reproduced. The screen voltage is provided from the 500-volt circuit through a 30,000-ohm resistance of 5-watt rating. This is anchored to earth through a 1-microfarad condenser.

The first valve is fed from the 500-volt line through a 40-henry choke having a resistance of 700 ohms and then through a 5,000-ohm decoupling resistance rated at 1 watt and a 40,000-ohm anode resistance rated at 2 watts. These resistances reduce the voltage at the anode to 200.

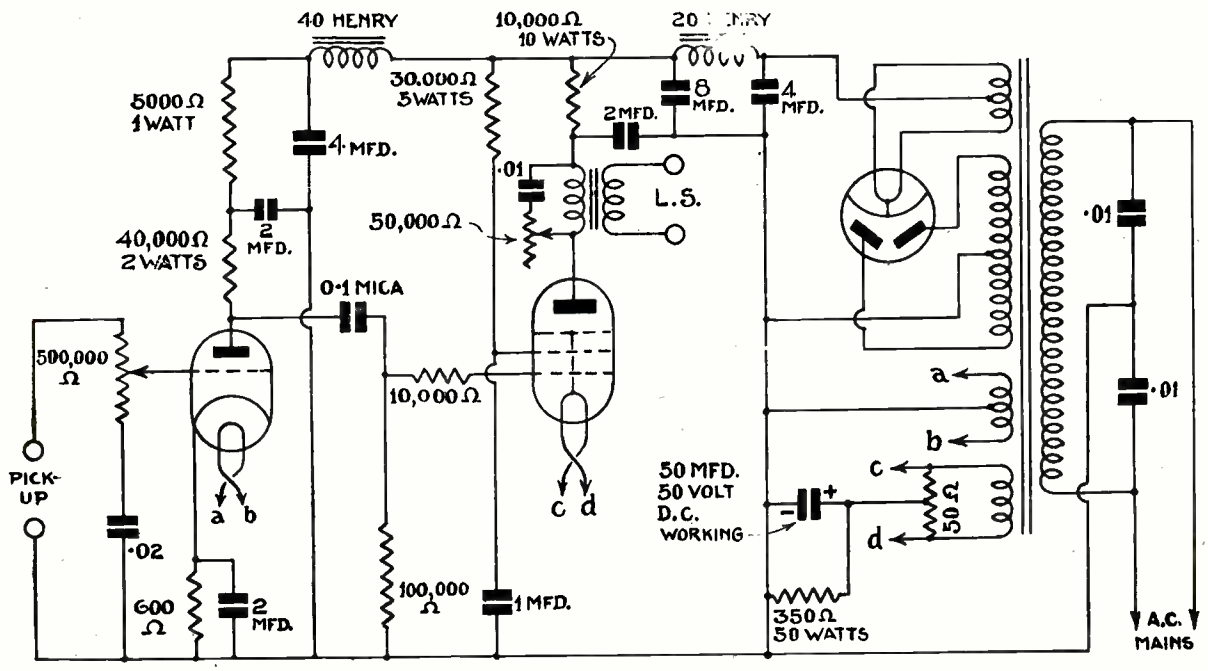
Coupling to the output is through a .1 microfarad mica condenser, a 100,000-ohm grid leak, and a 10,000-ohm resistance to suppress any liability to parasitic oscillation.

The automatic-bias circuits are extremely simple. That for the first valve is through a 600-ohm resistance decoupled by a 2-microfarad condenser, and that for the output valve consists of a 350-ohm resistance made up of two 700-ohm resistances of 25-watt rating connected in parallel and decoupled by a 50-microfarad dry electrolytic condenser for 50-volt D.C. working.

A hum-suppressing resistance of 50 ohms is placed across the output valve filament, and the bias resistance is connected to the centre point of this. If the hum suppressor is not considered necessary, the bias



For professional and amateur requirements the Parmeko junior microphone is ideal. It is mounted on a neat stand, the complete instrument costing only £3



CIRCUIT OF CAPTAIN ROBINSON'S 10-WATT GRAMOPHONE AMPLIFIER

Two valves and a rectifier form the basis of the circuit. The first is a triode, which is resistance-capacity coupled to a large pentode valve capable of delivering an undistorted output of 10 watts

COMPONENTS FOR THE 10-WATT AMPLIFIER

CHOKES, LOW-FREQUENCY
1—Parmeko 20-henry 120-milliampere.
1—Parmeko 40-henry 40-milliampere.

CONDENSERS, FIXED
1—Dubilier .01-microfarad.
1—Dubilier .01+.01-microfarad
1—Dubilier .02-microfarad.
1—Dubilier .1-microfarad mica.
1—Dubilier 1-microfarad 500-volt working.
2—Dubilier 2-microfarad 500-volt working.
1—Dubilier 2-microfarad 800-volt working.
2—Dubilier 4-microfarad 800-volt working.
1—Dubilier 8-microfarad 800-volt working.
1—T.C.C. 50-microfarad electrolytic, 50 volt working, type 521.

HOLDERS, VALVE
2—Five-pin.
1—Four-pin.

PLUGS AND TERMINALS
Selection to suit individual requirements.

RESISTANCES, FIXED
4—Erie, 1-watt type, values: 600, 5,000, 10,000, and 100,000 ohms.
1—Erie 40,000-ohm, 1-watt type.
1—Colvern strip 30,000-ohms, 5-watt type.
1—Dubilier 10,000-ohm, 10-watt type.
2—Electro Truevolt 700-ohm, 25-watt type.

RESISTANCES, VARIABLE
1—50-ohm hum-dinger (Claude Lyons).
1—Colvern 50,000-ohm potentiometer.
1—.5-megohm Centralab modulator, type M500.

SUNDRIES
As necessary for construction.

MAINS TRANSFORMER
1—Parmeko with the following specification:
500-0-500 volts, 100 milliamperes.
4 volts, 2.5 amperes.
4 volts, 2 amperes.
4 volts, 2/3 amperes.
4 volts, 1 ampere.

LOUD-SPEAKER
To user's choice, but should be of the large power-handling type.

VALVES
1—Marconi MH4 Catkin.
1—Marconi PT25.
1—Marconi MU14 rectifier.

resistance to the output valve can be connected between the negative line and the centre point of the heater tapping for this valve.

Pick-up Volume Control

The volume control across the pick-up merits a little explanation since the small capacity between the bottom of the potentiometer and earth is an unusual feature. The effect of this is to prevent the loss of bass as volume is reduced, or rather to boost the bass as volume is reduced—which comes to the same thing in the end as the human ear is less sensitive to bass than it is to the middle frequencies, and when the volume is turned down the lower notes seem to disappear more quickly than the high notes.

The smaller this condenser is, within reason, the bigger the boost given to bass notes. As the amplifier is intended primarily to deal with gramophone records the control has been designed to get the best results from this class of amplifier.

Layout Suggestions

The layout of such an amplifier needs no particular care, though for convenience it may be built on a box-shaped chassis of aluminium or metallised wood of such dimensions that all the wiring and all components other than the valves can be carried out underneath. It will probably be convenient to put the mains transformer on the top of the chassis as this is a somewhat bulky object.

This amplifier has already been connected to a radio unit consisting of a VMP4 amplifier and a double-diode-triode detector. In this form the amplifier portion of the double-diode-triode takes the place of the first valve shown in the circuit, in which case the anode resistance is 30,000 ohms and the breakdown resistance of 20,000 ohms is put immediately after the second choke in order to provide the 200-volt line for feeding the detector and variable-mu screen pentode.

A small loud-speaker will be badly overloaded by this amplifier, but the large types of public address reproducers, though they deliver enormous power, are not necessary.

Dual loud-speakers

Personally, I use Celestion S29 dual loud-speakers, which, being of the permanent-magnet type, can be put anywhere. The quality is very good, and there is no sign of overloading.

I want to make it quite clear that there is nothing difficult about the construction. As I have emphasised before, layout is not critical but a certain amount of care is, of course, necessary.

The amplifier has been thoroughly tested both for gramophone and radio use. It has my wholehearted recommendation.

News from the Valve Makers

Big Changes for the 1935 Programme

NO variable-mu screen-grid valves, no variable-mu high-frequency pentodes, no double-diode-triodes—in fact, no multiple valves at all except frequency changers—is the new 1935 programme of the valve makers. Strange as it may seem, all the valve makers are in agreement about this, and before long these valves will slowly be withdrawn from the active list, but they will be available for replacement purposes.

Set designers are of the opinion that volume control by means of varying the grid volts on the high-frequency valve is not entirely satisfactory. Difficulties are introduced owing to the variation in the anode voltage in sympathy with the variation in the grid voltage, and the consequent loss in stage gain when using a variable-mu type—which is acknowledged, by the way—cannot really be spared.

Although for two or three years many people have been converted to the use of screen-grid high-frequency valves, their defects have proved difficult to remove, and designers are now thinking of other means for controlling the output. A favourite method is to use a pre-set condenser across the aerial-input circuit. Other designers use a variable grid leak in the low-frequency stage. This is, of course, with resistance-capacity coupling.

Double-diode Preferable

Double-diode-triodes have not proved altogether satisfactory, and there are several reasons why it is preferable to use a double-diode followed by a separate amplifier.

Before very long constructors won't have any option but to do this, for there will be no double-diode-triodes available. Of interest also is the news that the 20- and 16-volt D.C. mains valves are to be withdrawn in the near future, leaving us the ordinary high-voltage A.C./D.C. valves.

K. J.

Tests of the New Sets

By the "W.M." SET SELECTION BUREAU

IT is rather interesting to see how the design of radio receivers is slowly changing. Among the most popular sets at the moment are those of the transportable type or, in fact, any set that does not need an external aerial.

Actually, the whole truth of the matter is that the general public has just realised that with new components, valves and circuits, set designers are now able to produce self-contained receivers as efficient as those requiring an external aerial. Incidentally, manufacturing costs have not increased to any appreciable extent.

It will be realised after reading our reports on two transportable receivers in this issue, that there is no need for an aerial and earth in normal circumstances, while many will consider that the transportable type of receiver has much in its favour.

Consider the battery Pye SP/B, for example. It does not look anything like a radio set for all the controls are hidden underneath the lid, while the cabinet is a nice piece of furniture. This type of set creates considerable feminine interest, for it can be carried quite easily into any room in the house.

If you have mains available the Bush transportable will be of more interest. This set will give you all the programmes you are ever likely to want, without any fuss. All that is needed is an A.C. power point.

All-wave sets are still in their infancy, but there are one or two receivers of this type which deserve recommendation. One of these is the Hyvoltstar All-wave Super.

The short-wave section of this receiver provides a pleasant means of whiling away an hour or so when medium and long-wave broadcast stations seem uninteresting.

We commend you to a unique receiver—the R.I. Ritz Airflo. You will find the report most interesting. This receiver has features that have not appeared in any receiver before.

We cannot too highly stress the efficiency and performance of the Cardinal radio gramophone. At its price it is exceptional value for money. Neat, compact and easy to handle, it gives quality above the usual receivers of this price-type.

Ferranti photo

Even after the Christmas rush, set makers are busy turning out hundreds of radiograms for a thirsty public

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No doubt the first 7-metre television receiver will be coming along shortly. The receiver is ready, but is being held until the findings of the Television Committee are published.

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The standard of production seems materially to have improved during the past month or so, and now it seems as if the man-in-the-street can rely upon getting a good bargain, whatever price he may pay. This is a welcome contrast to the position last year, when some of the cheap-set manufacturers pruned down the cost of components and saved on their final tests.

Two really exceptional bargains are the Ekco AD65, a four-valve super-het, at £10 10s., and the Kolster-Brandes 381, at £10 10s. Both receivers are supreme in their class and can be recommended.

Another receiver that should be more widely known is the Marconiphone model 284 at £7 19s. 6d. The specification includes a walnut cabinet, all the batteries and moving-coil loud-speaker, band-pass tuning and a pentode output stage.

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.

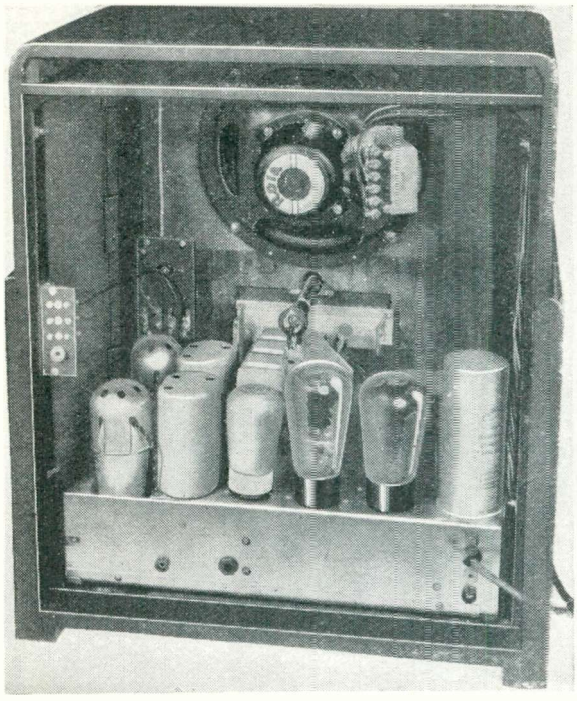
(2) The locality in which the set will be installed.

(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." Tell your friends about this useful "W.M." service.



"Consumption from the mains is approximately 53 watts, giving almost twenty hours of entertainment for 1 unit of electricity. The output averages 3,000 milliwatts"

Bush Super-het Transportable

WE are cultivating a fondness for the mains transportable with its self-contained frame aerial. The new Bush transportable is in every way comparable with the best on the market and, in addition, has several features which make it a desirable receiver. It is at holiday times, such as Christmas, that the transportable really comes into its own.

Few of us can go to the expense of having a good-quality receiver in both the dining-room and lounge; anyway, it is hardly convenient to have two fixed receivers with two complete aerial and earth arrangements, while the use of an extension loud-speaker hardly meets the case.

Do not think that a transportable receiver must be a compromise between sensitivity and portability, and that results have been sacrificed in order to keep the weight down to a minimum. With the Bush receiver it is hardly possible to tell that the set is not working in conjunction with an external aerial and earth.

If anything, selectivity is a little better than usual, while the directional properties of the frame aerial can be utilised to advantage.

Take, for example, the high-pitched whistle which so often accompanies the Luxembourg programme. Here it can be cut right out by rotating the frame aerial.

With the Bush receiver there is a high-frequency stage before the first detector-oscillator which boosts up the sensitivity to counteract the losses incurred by using a frame aerial. Even in daylight weak stations can be received if the set is carefully tuned and the frame aerial is in the correct plane.

The best way to prove this point is to give you some idea of the stations we heard under normal conditions. Let us assure you, first of all, that the receiver can be used as close to the local station as you like; there is no loss of selectivity.

At fifteen miles the local station spreads approximately 3 degrees with two second-channel whistles. At two miles the spread was less than 5 degrees, with an additional second-channel whistle on the long waves.

In daylight, range was restricted to ten foreign stations, including Fécamp, Hilversum, Radio Paris, Huizen, Poste Parisien, etc.

BRIEF SPECIFICATION

BRAND NAME: Bush.
MODEL: SAC7.
PRICE: £16 16s.
TECHNICAL SPECIFICATION: Pre-first detector high-frequency stage (Mullard VP4A), followed by a combined detector-oscillator (Mullard VP4A). Single intermediate-frequency stage uses a variable-mu pentode (Mullard VP4A). Westectors are used for automatic volume control and second detection, the fourth valve being a low-frequency amplifier (Mullard 354V). Following this is the output valve, a pentode (Mullard P4VA), while finally comes a 350-volt rectifier (Mullard 1W3).
TYPE: A.C. mains transportable.
POWER SUPPLY: A.C. mains, 200-250 volts, 40-100 cycles.
MAKERS: Bush Radio, Ltd., Shepherds Bush, London.

Where this receiver scores is that when living in a service flat where interference is at its worst during the morning from cleaners, hair-dryers, and so on, it is less prone to pick up background noise than the standard receiver on an external aerial.

During a period of one week we heard no less than sixty-three stations on the loud-speaker. This included ten on the long waves, which, everything considered, was very good.

Consumption from the mains is approximately 53 watts, giving almost twenty hours of entertainment for 1 unit of electricity. The output averages 3,000 milliwatts with minimum distortion.

"We are cultivating a fondness for the mains transportable with its self-contained aerial"

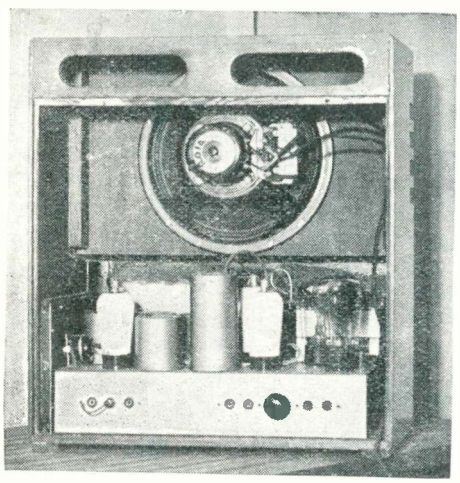
R.I. Ritz Airflo Super-het

"Taken all round, this R.I. Ritz Airflo set is a remarkably fine piece of work . . . it was designed by W. James"

ONE of the most interesting things about this set from the "Wireless Magazine" readers' point of view is that it was designed by W. James, still famous for his Super 60 receiver.

This new R.I. model, one of the best sets of its type that has yet passed through our hands, uses four of the most efficient valves now being made. The first valve is a combined first detector/oscillator and is a combined triode and high-frequency pentode; next comes an intermediate-frequency stage, followed by a triple-diode-triode second detector, and finally comes a big mains pentode output stage.

A special feature of the set is the ingenious way in which the second detector is used as a noise suppressor. For this purpose one of the three diodes is heavily biased (at 40 volts or more), which means that any signal that does not rise above this value is quite inaudible from the loud-speaker.



"This new R.I. model, one of the best sets of its type that has yet passed through our hands, uses four of the most efficient valves now being made"

Thus no interfering noise which does not reach a voltage of 40 at the second detector stage is heard at all; the same applies to other signals, of course, so that the total number of programmes received in these circumstances is, of course, also reduced. Nevertheless, even on an indoor aerial we were able to receive some twenty-five stations on the medium waveband and a good number on the long waveband.

This noise-suppressing device is of great advantage to flat-dwellers, for in many cases interference caused by vacuum cleaners, refrigerators, etc., can be cut right out by the use of this control.

When the noise-suppressing control is not in use the set works as a perfectly normal super-het with amplified self-adjusting volume control. Our tests show that this functions very much better than it does in a good many modern sets.

Quality of reproduction is amazingly good for a table set of this type. The secret of this lies in the use of a good loud-speaker (a Rola, actually) and in the cabinet design. The latter is made of substantial wood and is free from all ordinary vibration; and then the "Airflo" fret at the front seems to have a definite effect on reproduction.

The loud-speaker is mounted on a baffleboard recessed about 3 in. back from the front of the cabinet.

But whatever the technical reasons may be, there is no question at all about the brilliance of reproduction, which can be controlled to suit individual tastes by means of a continuously variable tone corrector.

The controls of the set are recessed into an opening on the right-hand side of the cabinet, where they can easily be reached by the right hand. The main tuning dial actuates a large-size drum scale on which the names of European broadcasters are clearly indicated; there are also wavelength calibrations.

Then there is a combined on-off switch and volume control, which works in the usual way. The volume control works quite independently of the noise-suppressing control and the volume of reproduction is unaffected when the latter is brought into use.

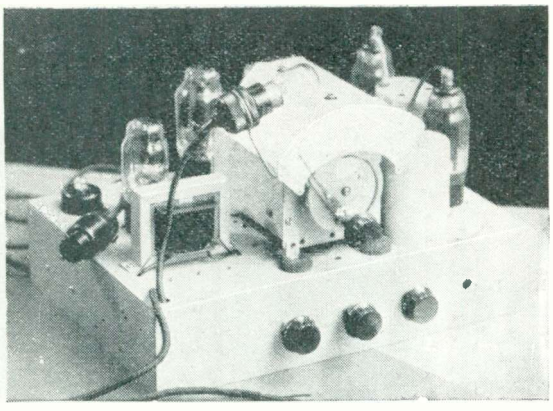
And how is this noise-suppressing arrangement brought into play? Simply by turning a knob which actuates a second combined potentiometer and switch. As soon as the knob is turned back the switch is clicked over and a bias of about 40 volts is applied to one diode of the second detector. The background is then quite silent even though the set is used where interference from electrical machinery is normally experienced.

Taken all round, this R.I. Ritz Airflo set is a remarkably fine piece of work. The external appearance is good and the inside assembly will also bear the closest scrutiny. Selectivity is excellent and plenty of stations can be received at fine volume and quality.

BRIEF SPECIFICATION

BRAND NAME: R.I.
MODEL: Ritz Airflo.
PRICE: £16 16s.
TECHNICAL SPECIFICATION: Four-valve super-het (five including mains rectifier). Triode-pentode combined first detector/oscillator (Mazda AC/TP), intermediate-frequency amplifier (Mazda AC/VP1), triple-diode-triode second detector (Mazda AC/HL/DDD), output pentode (Mazda AC/PEN), mains rectifier (Mullard IW3).
POWER SUPPLY: A.C. mains, 200-250 volts, 50-100 cycles.
MAKERS: Radio Instruments, Ltd., Purley Way, Croydon, Surrey.

Hyvoltstar All-wave Super



"Three separate tuning scales are included, each calibrated in wavelengths . . . this receiver is, without question, of very advanced design"

IT is refreshing to be able to review a receiver full of novel ideas. There are numerous five-valve super-hets available, but the market is very much reduced when you want a receiver which includes short-wave reception.

The Hyvoltstar All-wave Super-het tunes from 18.5 to 52 metres on short waves; from 200 to 580 metres on medium, and from 800 to 2,000 metres on the long waves.

Three separate tuning scales are included, each calibrated in wavelengths. On the short waveband the dial is accurately calibrated in steps of 2 metres. In addition to covering the three wavebands, this receiver also includes full delayed automatic volume control, diode detection, variable tone correction, and it can be used on either A.C. or D.C. mains with A.C. of any frequency. The set also has single-knob switching and tuning.

The valves used are of the high-voltage type with 200-volt filaments and, as is usual with sets of this kind, they are entirely hum-free.

The circuit arrangement is more or less conventional, consisting of a pentagrid frequency changer followed by a variable-mu high-frequency amplifier with a Westinghouse cold detector feeding into a triode low-frequency amplifier.

This valve is in turn parallel-fed transformer-coupled to a power pentode giving 3 watts. The rectifying valve, only used on A.C., is of the half-wave type.

Controls are quite simple and consist of tone corrector, combined on-off switch and volume control, master switch for wave-changing and pick-up-switching, and, finally, the tuner.

The short-wave section is an integral part; there is no additional switching or tuning to be done. You simply switch on to short waves, just as you would to medium or long on an ordinary set.

The set is well made; the steel chassis, with the bulk of the components screened, is particularly impressive, while the moving-coil loud-speaker mounted in the same cabinet is of large dimensions.

This loud-speaker is an energised Magnavox of the latest type. The reproducer is very sensitive and has a free movement, which probably accounts for the excellence of the quality. The frequency response of the receiver varies between 50 and 6,000 cycles, with a slight response down to 42 cycles and up to 6,600.

With an aerial of 45 ft. and at a distance of nine miles from the local station, the selectivity was approximately 8 kilocycles on the medium waves and 9-kilocycles on the long waves. This means that the selectivity is more than adequate to cope with present conditions.

As a general rule we were able to receive about fifty stations on medium waves at one sitting, with an additional ten on the long waves. On more than one occasion this log was increased to sixty stations.

On short waves, after a little care has been taken in handling the receiver, no difficulty was experienced in picking up W2XAD, W8XK, 2YRO, I2RO Rome, VQ7LO Kenya and several others.

BRIEF SPECIFICATION

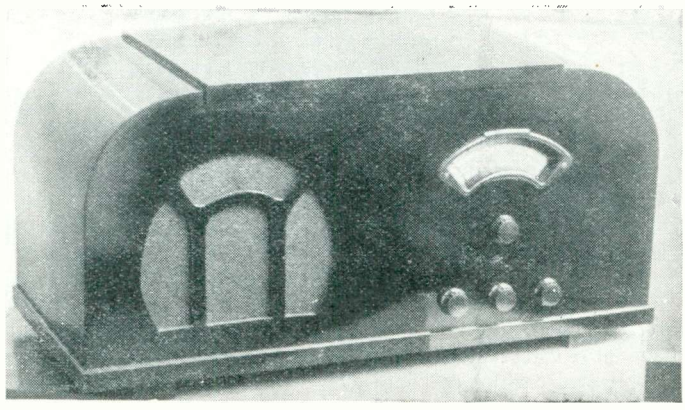
BRAND NAME: Hyvoltstar.
MODEL: Universal Super-het Five.
PRICE: £18 18s.
TECHNICAL SPECIFICATION: Combined detector-oscillator, using a high-voltage pentagrid (Ostar-Ganz B5). The single intermedicte-frequency stage uses a variable-mu pentode. Second detection and automatic volume control are by means of half-wave cold detectors which feed into a triode low-frequency amplifier (Ostar-Ganz A520). An output pentode (Ostar-Ganz M43) gives over 3 watts, the final valve being a half-wave rectifier giving 100 milliamperes (Ostar-Ganz EG100).
TYPE: Table all-wave super-het.
POWER SUPPLY: A.C. or D.C. mains; 200 to 260 volts, any frequency A.C.
MAKERS: Universal High Voltage Radio Co., Ltd., 28-31 Southampton Street, Strand, W.C.2.

On a Sunday morning, using a short indoor aerial, we logged over forty amateur stations on the 40-metre band.

On two evenings we were able to log medium-wave American stations at good loud-speaker strength, and owing to the low background-noise level, these stations could be brought up to fair loud-speaker strength without difficulty.

We have no hesitation in recommending this receiver for it is, without question, of very advanced design.

The number of reliable firms specialising in A.C./D.C. sets is steadily growing. The sets are free from hum.



"The valves used are of the high-voltage type with 200-volt filaments and, as is usual with sets of this kind, they are entirely hum-free."

Pye Model SP/B Battery Super-het

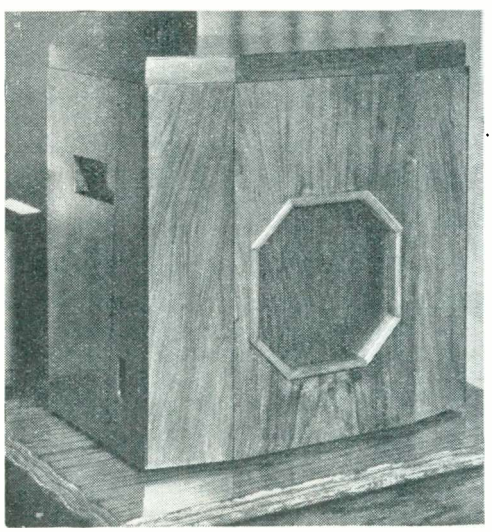
"This Pye battery portable is a receiver which would look well in company with any modern furnishings"

THIS Pye battery portable is a receiver which would look well in company with any modern furnishings.

The set is housed in a really exquisite cabinet of dark walnut with all the controls underneath the lid. These controls, four of them, are variable tone corrector, combination wave-change and on-off switch, master volume control and station selector.

We think that everyone will be intrigued by the original tuning dial. The whole of the tuning plate is black, up against which station names show white and are illuminated from underneath. The travelling pointer, controlled by the station selector, indicates to which station the receiver is tuned.

One half of the dial carries medium-wave stations, the other half long waves, and both are separately illuminated.



"The set is housed in a really exquisite cabinet of dark walnut with all the controls underneath the lid . . . . construction is impressive"

This Pye transportable is as efficient as the majority of battery superhets using an external aerial. The reason for this is the circuit arrangement.

First of all comes a high-frequency stage to increase the sensitivity. This is followed by an unusually good detector-oscillator circuit using one of the new Mazda triode pentodes. The intermediate-frequency stage is conventional and is followed by a double-diode-triode in the second-detector stage. The triode section of this valve is used as a driver to a PD220 class-B valve giving over 1,200 milliwatts.

This circuit is really one of the best possible for battery-operated receivers. It gives long range; really good 9-kilocycle selectivity; low background noise; full automatic volume control; and a large undistorted output without heavy running costs.

The receiver is supplied with 129-volt high-tension battery with a 4.5- and 13½-volt bias battery as an integral part. Provision has been made for an external loud-speaker, which, by the way, should have its own matching transformer.

There is no need to say much about the controls, for all of the knobs are engraved in white. Their functions are at once obvious. The wave-range of the receiver on medium waves is between 200 and 580 metres, and between 890 and 2,000 metres on the long waves.

Current consumption averages 9 to 12 milliamperes at normal volume, but owing to the use of a positive-drive output valve the anode current peaks to a higher value at maximum signal strength.

We do want to stress that quality is distinctly above the average and is as close to the quality given from a mains receiver as is possible to obtain with batteries.

The construction and layout of the receiver is impressive. All the components are mounted on a pressed-steel chassis having the wiring and smaller components out of sight.

BRIEF SPECIFICATION

BRAND NAME: Pye.
MODEL: SP/B.
PRICE: £15 15s.
TECHNICAL SPECIFICATION: High-frequency stage (Mazda VP215), combined oscillator-detector, using a triode pentode (Mazda TP22). Single intermediate-frequency stage with band-pass coupling (Mazda VP215). Second detection, low-frequency amplification and self-adjusting volume control with a double-diode-triode (Mazda L21DD), and this is followed by class-B output (Mazda PD220).
TYPE: Battery portable.
POWER SUPPLY: Internal dry batteries and wet accumulator.
MAKERS: Pye Radio, Ltd., Cambridge.

In the late afternoon or after dark we can assure readers that a minimum of thirty stations can be expected, while in a good locality this number can be increased to over fifty. Remember that if you are living in a bad area for reception a length of wire along the floor will usually make up for loss in volume.

Aerodyne Cardinal Radiogram

WE have tested this season most of the important radio gramophones, and we have come to the conclusion that the most popular of them is the four- or five-valve super-het, which will give good quality at low output. A good example of this type of receiver is the Aerodyne Cardinal under review.

This is, without question, almost the ideal receiver for a small house. If necessary, the output can be increased up to 3,400 milliwatts, while there is still really good bass at 500 milliwatts.

The cabinet, of walnut, is very compact. Its appearance will create a good impression on the prospective buyer.

One visitor to our laboratories termed it the "Floodlit Set," for in addition to the illuminated tuning scale the motorboard is fully lit up.

The circuit consists of a heptode, or octode, frequency changer, band-pass coupled to an intermediate-frequency amplifier. There is a diode speech detector, a second diode for automatic volume control, and a triode low-frequency amplifier. This triode is then resistance-capacity coupled to an output pentode.

You can see from the illustration that the receiver is of the upright type with the controls to the front. There is the variable tone corrector on the left-hand side; in the centre is the master tuner, while beneath it is the radio volume control. The gramophone volume control is on the motor-board and is a part of the combination Garrard unit. Finally comes the wave-change and gramophone switch.

A feature which should be noted is the inter-station noise suppressor. This works well, and the background noise, so familiar with simple receivers having automatic volume control, is absent.

Frequency response is particularly good, varying between 48 and 5,500 cycles, with a distinct rise below 200 cycles. This is excellent for at low volume the quality is pleasant, with ample bass. With the pick-up in circuit needle scratch can be cut off quite sharply by using the variable tone corrector, while the same control will, on radio, wipe out the whistle which usually accompanies the Luxembourg programme.

We were glad to find that even with the lid raised there was no chatter from the gramophone pick-up when it was in action. This even applied to heavily modulated records.

We did not use the mains aerial attachment for our supply is apt to be noisy at times, but with a short length of wire along the floor we were able to bring in a sufficient number of stations for average use.

"The cabinet, of walnut, is very compact. Its appearance will create a good impression on the prospective buyer"

This speaks well for the high-frequency stages.

With an external aerial of 30 ft. the receiver did really excel itself. Selectivity on the medium waves was a little better than 9 kilocycles. Stations separated by this frequency could be received without mutual interference and most of of them, except those close to the local, were free from sideband splash.

BRIEF SPECIFICATION

BRAND NAME: Aerodyne.
PRICE: £21.
MODEL: Cardinal R.G.
TECHNICAL SPECIFICATION: A radiogramophone with a heptode oscillator-detector (Brimar 15A2), and a single intermediate-frequency amplifier using a variable-mu high-frequency pentode (Mullard VP4 followed by a double-diode-triode (Mullard TDD4). The pentode output valve gives over 3 watts (Mullard Pen 4VA) and is followed by a full-wave valve rectifier (Mullard IW3).
POWER SUPPLY: A.C. mains, 200-250 volts. 25-50 cycles.
TYPE: Radio gramophone.
MAKERS: Aerodyne Radio, Ltd., Aerodyne Works, Tottenham, N.17.

The automatic volume control worked efficiently until the station quality actually began to deteriorate. Few readers can memorise the wavelengths of stations under the Lucerne Plan, and a combined dial with wavelength numbers and station names merely tends to confuse. The Aerodyne people have overcome this little trouble with a tuning dial in front—a very large one, by the way, calibrated in wavelengths from 200 to 550 metres and 800 to 2,000 metres. If you receive a station and you don't know what it is, note the dial reading and then refer to a station list fitted on the motorboard.

In normal circumstances a minimum of thirty-five stations was logged during several evening tests. Owing to the design of the input circuit to the octode, second-channel interference has been reduced to an absolute minimum.

On the Crest of the Waves

Radio News from Abroad : By JAY COOTE

AUSTRALIA

SEVEN new regional stations are to be installed by the Commonwealth Government in the course of 1935. The powers of the stations will vary from 30 to 60 kilowatts, and wavelengths between 360 and 545 metres will be used.

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AUSTRIA

Many increases in power are reported from Austrian stations. Klagenfurt already works on 5 kilowatts, and Linz, Salzburg and Innsbruck will be using greater power before the spring.

The new transmitter which is being erected at Lauterbach to replace Dornbirn in the Vorarlberg district, will shortly start on 2 kilowatts. As a third exclusive channel has been allotted to Austria it is expected that several .5-kilowatt relays will be installed to work on a common wavelength.

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BELGIUM

The scheme to provide Belgium with a third transmitter, namely in the eastern portion of the country, has been definitely abandoned. As, however, it is considered that the power used by the Velthem twin transmitters (Brussels No. 1 and No. 2) is insufficient, plans are being drawn up for the construction of two 100-kilowatt stations. It is hoped to get them working by the autumn of 1935.

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FRANCE

Listeners may now look forward to better programmes from the French State transmitters, as publicity announcements and sponsored concerts have been forbidden in the broadcasts made from such State-controlled stations as Radio Paris, Ecole Supérieure (Paris P.T.T.), Eiffel Tower and Radio Colonial. On the other hand, this veto will spell *increased* radio advertising from the *privately* owned studios.

More official pronouncements have been made regarding the future of the Eiffel Tower station. It is stated by the Minister of Posts and Telegraphs that work on its reconstruction is to be started without delay and that experimental transmissions on its new wavelength (namely, in the lower portion of the medium waveband) will be made on some date in April next.

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GERMANY

Berlin has adopted a novel idea for its radiodiffusion services of broadcast programmes. By this system three different entertainments on wavelengths varying between 1,000 and 2,000 metres are superimposed on the telephone network, thus permitting subscribers to the telephone system to use their ordinary radio receivers.

The listener, by this method, if he desires to listen to other programmes, may couple up his set to an outdoor aerial. The tests made at Berlin having proved satisfactory, experiments are to be carried out in provincial districts.

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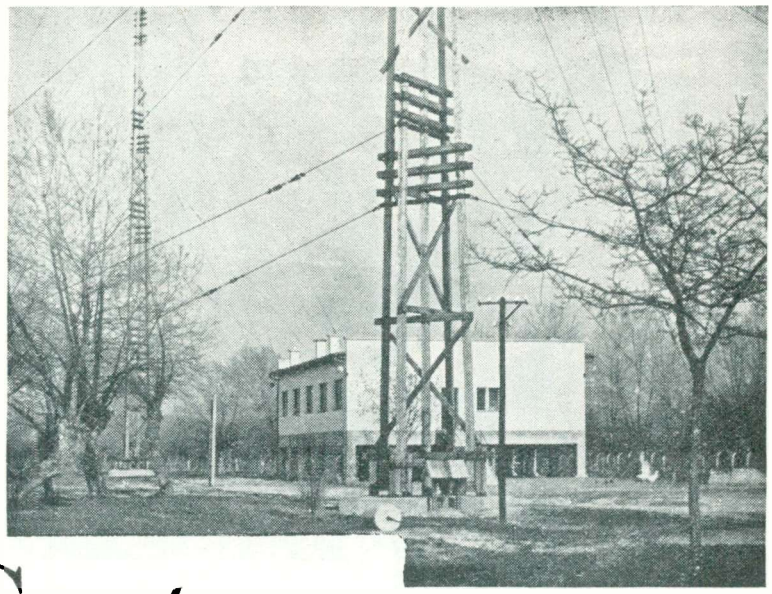
Breslau is now a 100-kilowatter, and thus with the exception of Frankfurt-am-Main and the Deutschlandsender, Germany has, at least for the time being, completed the reconstruction of her principal stations.



Gulliland photo

The transmitting house at the Zagreb station is raised from the ground as a neighbouring river frequently overflows

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HOLLAND

The Dutch Authorities, who now control broadcasting in Holland, have decided to close down the old Huizen station and to replace it by the Kootwijk transmitter. There is also a probability that its power may be doubled.

As two stations are required to ensure an adequate service, the authorities are planning a new high-power station for Hilversum.

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LUXEMBOURG

Luxembourg, which has already extended its programmes on Saturdays until midnight, has now added a further series of afternoon concerts for British listeners. Every Saturday the broadcasts are continuous from G.M.T. 1600 until midnight, the earlier hour being devoted to gramophone records of operatic works, or relayed symphony concerts.

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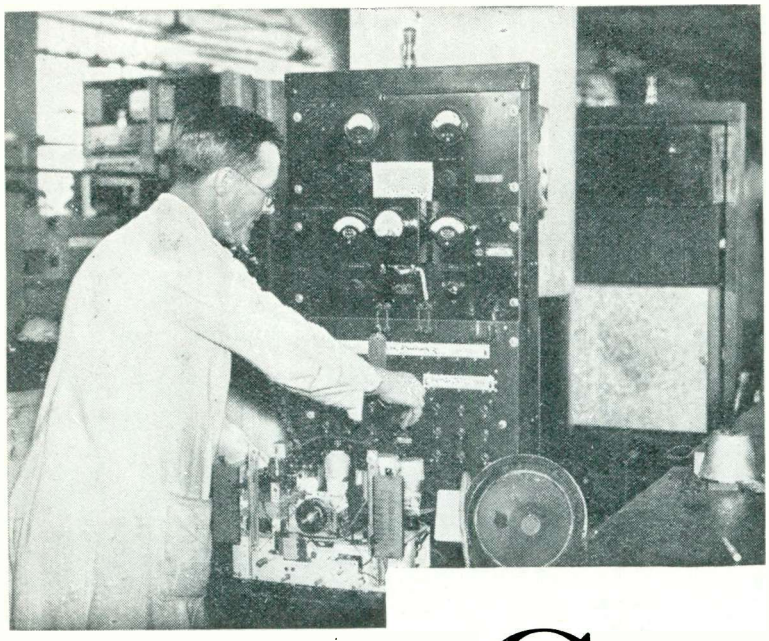
ITALY

A suitable site has now been found for the 50-kilowatt transmitter which the EIAR propose to erect in the neighbourhood of Bologna. As this Italian city was the birthplace of the renowned radio pioneer, it is to be called the *Statione Guglielmo Marconi*.



H.M.V. photo

New apparatus for testing the low-frequency gain of radio receivers has just been installed in the H.M.V. Hayes factory. The operator rotates the frequency-selector switch and by means of an output meter checks the set's performance

In the October, 1934, issue of "W.M." we presented an article by Noel Bonavia-Hunt in which he dealt with the problems of designing and using tone-correcting devices for the top end of the frequency scale. This article was one of the most comprehensive ever published on the subject. This month he turns his attention to tone controls for the bass notes, which he deals with in an equally thorough manner

Controlling the Bass Notes

By NOEL BONAVIA-HUNT, M.A.

IS it possible to have too much bass? It most certainly is, especially if the bass response produces a resonance anywhere between 50 and 150 cycles. These resonances are due to the loud-speaker cabinet, although even if a flat baffle is substituted for the cabinet the resonance may still persist in the loud-speaker itself.

Enormous Variation

Then again, gramophone records vary enormously in their bass-reproduction characteristics, and when a compensating device is employed to boost the lower notes the result is often a preponderance of bass in the 80- to 150-cycle band.

Quite apart from the design of the loud-speaker and the praiseworthy attempts of engineers to straighten out peaks in the loud-speaker response curve, it is most desirable to have some definite control of this lower register in the amplifier itself.

Former Article

It is the object of this article to discuss some of these controlling devices, in the same manner as in a former article I dealt with various forms of high-note control.

First of all, it is obviously necessary to see that there *is* a definite response to frequencies below 150 cycles in both amplifier and loud-speaker. The average loud-speaker responds down to 75 cycles, so that one need not worry overmuch about this part of the chain, though, to be sure, it is very, very, imperfect. A good reproducer will go down to at least 50 cycles.

The amplifier is easily designed to give a good bass register provided the low-frequency coupling units are adopted as recommended in previous articles. However, to prevent mistakes, I refer the reader to Fig. 1, which shows a high-quality two-stage amplifier circuit capable of a good bass response.

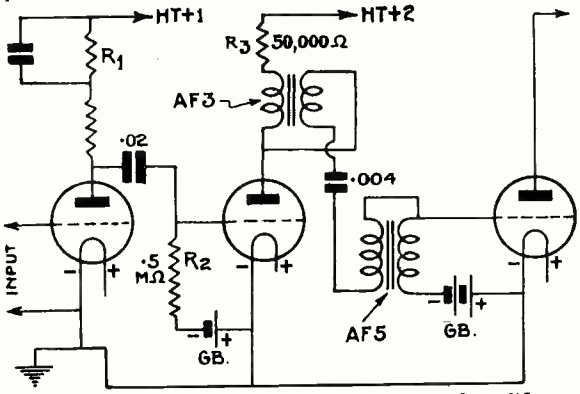


Fig. 1.—A two-stage low-frequency battery-operated amplifier recommended by the author

We will assume that this is the amplifier being used, and that the response curve shows a rising characteristic below 100 cycles. This will ensure a straight-line response of all the original bass frequencies from the deficient loud-speaker; that is, the ear will be helped to interpret the curve as a straight line, which is what we want.

Now it will happen that this straight-line response will sometimes adopt a rising characteristic for one reason or another: either the loud-speaker may possess a resonance at some particular frequency

or band of frequencies, or the transmission may be introducing more bass than normal, or, again, it is a recording with an over-prominent bass. In all these cases, control is needed.

This, then, is our second requisite —bass control, a fully adequate low-note register having been provided in the first instance. How can we control the lower frequencies ?

Rise Below 100 Cycles

The coupling condenser C_2 in Fig. 1 is of a chosen capacity for introducing a rise below 100 cycles, and its value is .004 microfarad. If this value is decreased, there will follow a drop in the bass response; similarly, if it is increased beyond .006. One may, therefore, introduce a second condenser either in series or in parallel for the purpose of

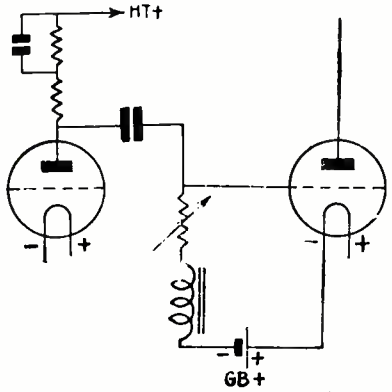


Fig. 2.—A bass control circuit which can be substituted for the grid resistance of the first amplifying stage of Fig. 1.

reducing bass response, with a switch to control its action in or out.

This arrangement works very well, since it effectually eliminates the tuned resonance below 100 cycles. But there is no graduation of the control. It may be desirable to reduce the resonance without entirely eliminating it, and the degree of reduction may not be too obvious.

Looking at the grid resistance of the first stage coupling we could introduce a bass control here by substituting for this resistance the grid circuit of Fig. 2. The resistance, which is now variable, will retain its original value of .5 megohm, while the low-frequency choke may be one possessing an inductance of 35 henries and a D.C. resistance of 800 ohms.

As the value of the resistance R_2 is reduced, so the curve becomes more and more like that given in Fig. 3. Unfortunately, the treble characteristic will seem to rise as the bass diminishes, and this is a feature that may not be desired. The bass curve changes too rapidly also; and there is a tendency for the control to affect frequencies above 100 cycles, that is up to 200.

A small condenser shunted across the choke would keep the treble

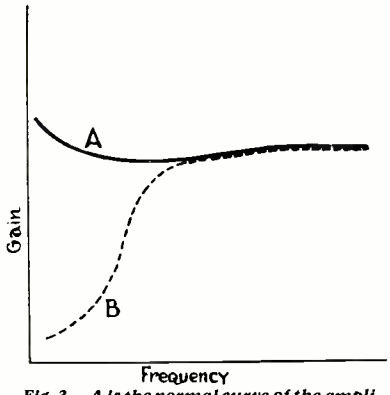


Fig. 3.—A is the normal curve of the amplifier; B shows the curve introduced by the control shown in Fig. 2

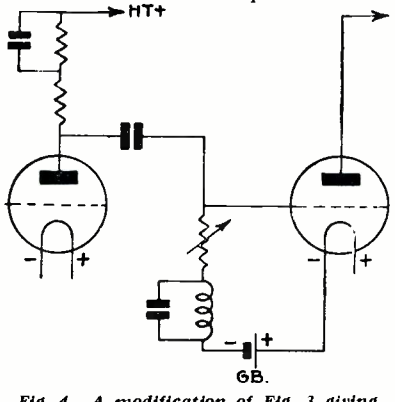


Fig. 4.—A modification of Fig. 3 giving a cut-off at both ends of the scale and a peak at about 3,500 cycles

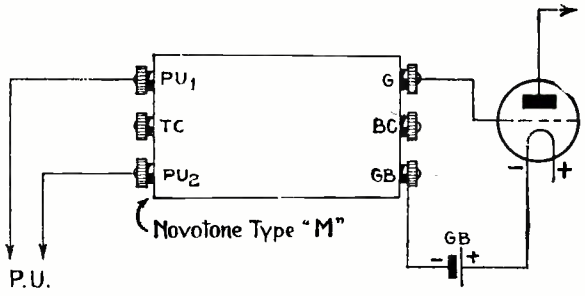


Fig. 6.—Showing the type M Gambrell Novotone connected between the pick-up and first low-frequency stage

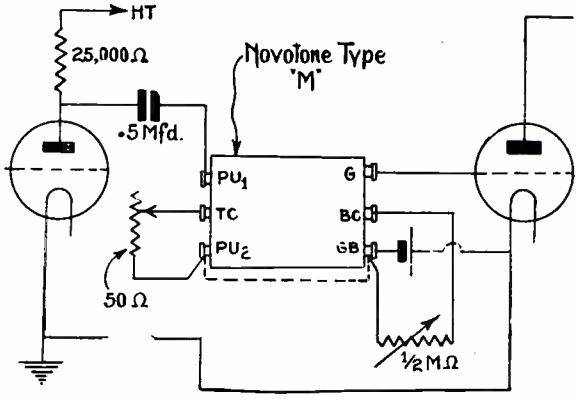


Fig. 7.—Both bass and treble controls are provided in this special Novotone circuit

under better control, but would also introduce a fall instead of preserving the straight-line characteristic in this portion of the spectrum. If a high-frequency choke is substituted for the low-frequency one, with the suggested shunt added (see Fig. 4), we get a cut-off at both ends of the frequency range and, in addition, a peak in the treble at about 3,000 to 4,000 cycles.

This is a horrible state of affairs. The offending peak can easily be lopped off by increasing the capacity of the shunt condenser, in which case we get a fall at each end of the spectrum. Needless to say, this arrangement is useless as a method of controlling the bass.

Another Method

Another device is shown in Fig. 5 where a transformer is substituted for the grid resistance R_2 of Fig. 1, and is connected in auto-choke

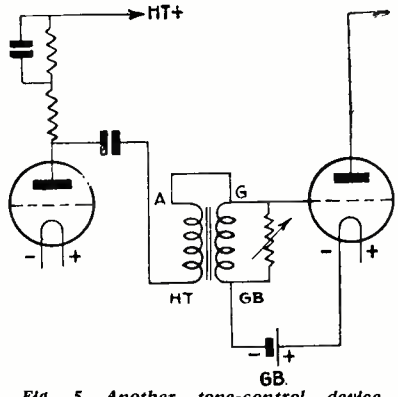
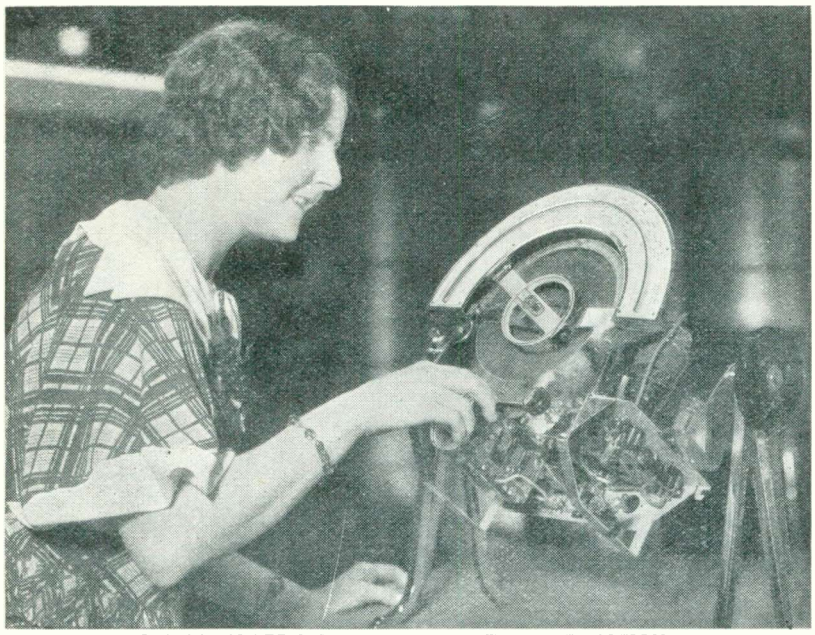


Fig. 5.—Another tone-control device where a transformer is substituted for the resistance R2 of Fig. 1



SHOWING MODERN COMMERCIAL SET CONSTRUCTION

Showing the chassis of the Ekco model 65—the set in the circular bakelite cabinet. Tone control is embodied in this really ultra-modern design. Note the unusual position of the three-gang condenser

fashion. A variable resistance is shunted across the secondary winding of the transformer, the value being 250,000 ohms; as this is reduced the lower frequencies fall in intensity.

So far, so good; but the *range* is also reduced, and this is most undesirable. We do not want to cut off the lower frequencies in order to control the relative intensities of those that remain.

Well-known Device

The Gambrell Novotone is a well-known device for increasing the bass response of gramophone records. The latest type M model can certainly be recommended for this purpose. It is connected between the pick-up and the first low-frequency valve of the amplifier as shown in Fig. 6.

The terminals marked Pick-up (2) and G.B. are connected together internally and to the metal container, so that in reality the component is an auto-transformer. It consists of two transformers, one large and one small, coupled in series with primaries in opposite phase and with secondaries shunted by suitable condensers.

In Place of Grid Leak

Now it is possible to use this component in place of the grid leak R_2 of Fig. 1, as shown in Fig. 7. The middle terminal of the output of the Novotone, labelled B.C. (bass control), can be usefully pressed into service here. All one has to do is to connect a 500,000-ohm variable resistance in parallel with the two terminals marked B.C. and G.B., and by reducing the value of the resistance to effect a gradual control of the bass.

This device will be found to work with quite satisfactory efficiency. Incidentally, a 50-ohm rheostat shunted across the terminals T.C. and Pick-up 2 (on the input side) will provide an excellent control of the upper frequencies; so that the two controls on either side will prove highly useful both individually and in combination.

Another way of introducing the Novotone so that both radio and gramophone may benefit from its use is that shown in Fig. 8. It is necessary to employ a Westector as detector for the radio side, and provided there is no objection to doing so, the arrangement works excellently.

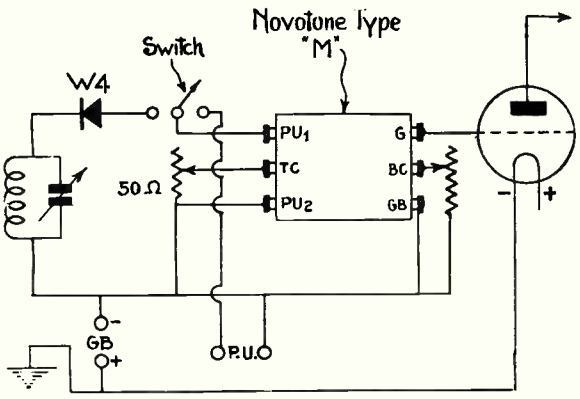


Fig. 8.—Another way of using the Gambrell Novotone. A Westector is used in this circuit, which is operative on both radio and gramophone

The Best Method

There is, however, one further method of controlling the bass of an amplifier. It works better than any other device I have so far tried. The intensities of notes below 128 and down to 50 cycles are controlled with beautiful graduation, while below 50 cycles no reduction is effected, these extreme frequencies being in no need of reduction. Fig. 9 shows the circuit.

I am somewhat loth to give it away, not that I feel the least reluctance in placing it at the disposal of the amateur who is good enough to read these lines, but because the professional engineer will probably sneer at it and then try it out, as I have from past bitter experience so frequently found; it will then quite likely be adopted and no credit allowed to its inventor. I have applied for a patent.

It is essential that the values of condensers C_2 and C_3 should be .004 and .01 microfarad respectively, and the resistance R_4, which is variable, must be at least 2 megohms. As the value of this resistance is reduced, so is the intensity of the bass notes.

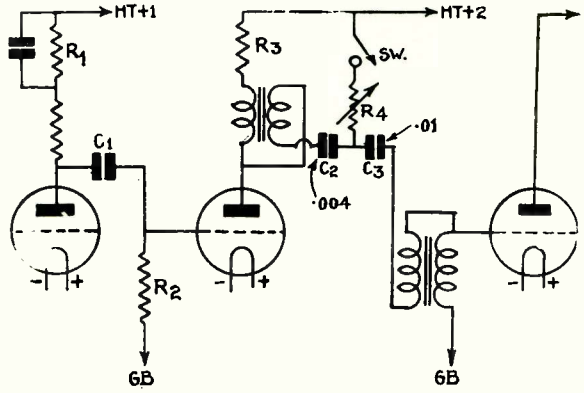


Fig. 9.—Another way of controlling the bass notes below 128 cycles. The author declares that this method works better than any other he has tried

News of the Short Waves

Amateurs Log American Police Radio

By KENNETH JOWERS

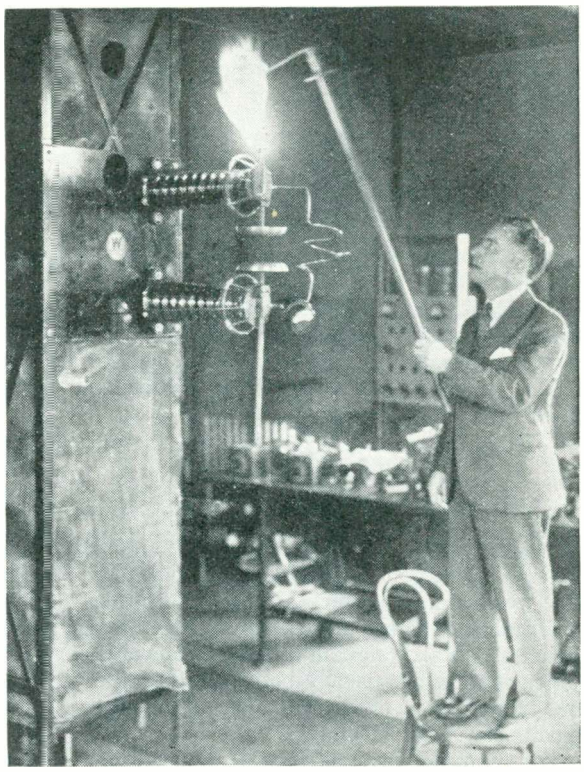
IF you don't give very much thought to it, the idea of learning morse so that you can read a few C.W. signals does not sound very attractive. On the other hand, have you noticed that the listener who reads morse can always show a satisfactory log even when telephony stations are conspicuous by their absence.

This Learning Morse Business !

Looking at it from another angle, you can read weak morse signals that perhaps originate 10,000 miles away.

This morse business came to mind after reading a report from Martin Railton, BRS1605, who received 270 stations from 47 countries in a period of four days. Although a number of them used telephony the bulk were C.W. signals.

Comparing this report with other listeners' experiences, I find that during that period with one exception the average number of telephony stations heard was about twenty. Most of these were more or less local, the best DX being Cuba.



World Wide photo

Dr. Dayton, of the Westinghouse research laboratories, is seen with an arc drawn from a 15-kilowatt 5-metre transmitter

A Hefty Log !

In Martin Railton's report I notice that there are fifty American stations, ten Canadians, one Cuban, five South African, five Austrian, one Moroccan, nine Czechoslovakian, six Australian,one New Zealand, eight Danish, four Maltese, seven Polish, thirteen Portuguese, fifteen Spanish, one each from Jamaica, Jugo-slavia Lithuania, five Dutch, thirteen German, two Swedish, seven Norwegian, seven French, one from the Saar, six Egyptian, thirteen Tunisian, fourteen Russian, the remainder being Irish, Swiss, Latvian, Madagascan, Belgian, Rumanian, Esthonian, Italian, and Ceylonese.

This is usual QSL card, received by an English "ham," is from W8GLY, of Pittsburgh, Pennsylvania, U.S.A.

Mostly Telegraphy Stations

That pretty well covers the whole world. Approximately thirty of these stations use telephony, so you see how many he would have missed if he were unable to read morse.

Then there are all the various meteorological stations, ships, and news transmitters, all of which use C.W. the bulk of the time. So you see it really is worth while brushing up your morse for you never know when you may need it, particularly when conditions are bad for telephony reception.

If you belong to the Radio Society of Great Britain you can obtain details of slow morse transmissions by amateur stations, which are put out for the benefit of members so that B.R.S. listeners and A.A. licence holders can graduate.

◆ ◆ ◆

R. D. Everard logs VK3ME Sydney on a loud-speaker at quite good strength, but he seems to make a habit of picking up unusual commercial stations. By unusual I mean KAY Manilla, JVH, JVM, JVG, JVP, and JAA Tokio, while, of course, the South Americans, LSL, LSM, LSY, LSX, LSN and so on, are regularly logged all on loud-speaker using telephony.

Other stations heard just recently include VK3LR, VK3XX, XGR Shanghai, ZSS Capetown, HRM Honduras.

◆ ◆ ◆

Reception of American Police Radio

Several readers claim reception of American police stations. Not police cars, but the actual State stations. One reader in Chester, L. Montague, has received verification of four stations, all of them on the Pacific, which makes reception all the more noteworthy. These police stations are usually between 100 and 200 metres, and have simple letter call-signs without figures which usually start with W or K.

For example, there is KGZE, San Antonio, Texas, on 2,482 kilocycles, KGPH, Oklahoma City, on 2,450 kilocycles, or WNJ Buffalo, New York, which should be fairly easy to hear, the frequency of which is 2,422 kilocycles. Then there is WPDW, of Washington D.C., which also uses 2,422 kilocycles. I have not heard of anybody hearing Canadian police stations, but there are some using three-letter call signs prefixed with C. For example, CGC, Vancouver, B.C., on 2,452 kilocycles, or CJW, St. John's, N.B., on 2,416 kilocycles.

If you have a really good set with at least one high-frequency stage or two intermediate-frequency stages you stand a good chance of hearing some of these police stations. When you do happen to log one you will find the announcements rather amusing in character.

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A Scottish reader, J. Blessington, of Glasgow, tells me that he hears news bulletins and weather forecasts from Hurlingham via LSN when using its frequency of 9,800 kilocycles. This is a commercial telephony station, so I suppose that these broadcasts are for use with ships at sea.

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In a report from Ridgewell, Essex, F. A. Beane tells me that he has recently obtained verifications from COC, HB9B, YV4RC, XEVT, IRA, and CT1GO. The verification from YV4RC must be particularly gratifying to Mr. Beane for he only uses a small receiver.

Listeners will be interested to know that Mr. Beane has arranged a special broadcast from HB9B by the courtesy of the operator, Dr. K. Baumann. This station is at the Basle Radio Club.

The programme will be for the special benefit of the International Short-wave Club members, and will consist of music by Swiss composers and a talk in English. The date fixed is February 13.

Reports should be sent either to Mr. Beane at Ridgewell, Essex, or to Dr. Baumann, c/o HB9B Radio Club, Basle, Postpack No. 1, Basle, Switzerland.

◆ ◆ ◆

For the last fortnight or so I have been listening to actual American programmes rather than amateur transmissions. Conditions have been so regular that I have been able to tape up all the various wavebands and so rely on getting at least one good programme any time after 1300.

W8XK on the 13-metre Channel

This is the first time that I have heard W8XK on its 13-metre channel so far this year. At the moment it is always good loud-speaker strength until about 1400 or 1430.

W3XAL on the 16-metre channel is very reliable from 1530 onwards, but for some reason or other Pittsburg on 19 metres, which should not be available until after W3XAL, often comes over from 1400.

The only poor period is during the evening from 7 until 10, when you have to rely on the 25- and 31-metre bands which are often jammed by European transmitters. After 10 p.m. if you go on to 48 metres you can always rely on a good programme.

They broadcast items very similar to our *Soft Lights and Sweet Music*, so if you like that sort of stuff you can get plenty of it before midnight. They have a combination consisting of an organ, with a piano section, saxophone, double bass, violin and muted trumpet. It sounds very effective and provides a pleasing change from B.B.C. ideas.

World Wide photo

One of the easiest-heard stations in this country on the short waves is Zeesen. Workmen are seen here at work at the foot of the towers of the directional aerial which serves the North American zone

In Tune with the Trade

FETTER LANE'S Review of the Latest Catalogues

INTERFERENCE!

THOSE listeners who have their radio reproduction spoilt by man-made static should secure a copy of the form issued by Ward and Goldstone. The object of the form is to assist in localising and preventing the interference experienced. To this end numerous questions, all simple to answer, are set out on this form.

When these have been answered and the form returned to the Goltone technical people, the cause and type of the interference is diagnosed and useful suggestions made to assist in overcoming it.

This service is not intended to interfere with the local wireless dealers' activities.

We would suggest that dealers could render a universal service by keeping a few of these free forms available for prospective clients. **438**

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MEET MR. FORD!

I HAVE received some useful information for those listeners who possess American receivers from Henry Ford Radio, Ltd., of Howland Street, London, W.1.

This firm's workshops are a veritable store of American radio gear of all sorts, shapes and sizes. In stock are a full range of line-cord resistances, vibrators for car-radio outfits, besides hundreds of different types of American valves.

If you have an American set that refuses to function, this firm will be only too pleased to send you an estimate for repairs providing you let them have full details of your trouble.

A speciality is the service of Mid-west receivers—big brutes of the sixteen-valve variety—and the small midget sets. On the other hand, if you particularly want to invest in a Yankee outfit get in touch with Mr. Ford. **439**

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ACTON CELLS

THE Acton range of glass-container cells have many features worthy of note, one of the most interesting being the provision of a frosted panel on the side on which the owner's name and charging date can be written.

On the high-tension side there are two units listed, namely a 10-volt and a 60-volt. Both units have a capacity of 5,000 milliampere-hours at 1,000-hour rate, while tappings are provided at every 2 volts.

The dry high-tension batteries are made in three types—the standard, triple-capacity and portable type. **440**

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VOIGT LOUD-SPEAKERS

FOR those interested in power and quality reproduction the details given in a leaflet issued by the makers of Voigt loud-speakers should prove of great interest. The specifications cover most useful technical details, while curves showing the response over a remarkably wide frequency range enable one to obtain a visual indication of the faithful reproduction that can be obtained.

The loud-speaker units are used in conjunction with special metal or wooden horns, which form a feature of the design and render the loud-speakers most suitable for public-address work. **441**

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EDDYSTONES FOR SHORT WAVES

A FINE 16-page catalogue is now available from Stratton and Co., Ltd. This contains extensive details of the latest components for short and ultra short-wave work. While the items are too numerous to mention in this column, the following are rather distinctive.

The multi-wave switch coil unit, which can be supplied in three types, solves the difficulty of covering a waveband extending from 13.5 to 1,900 metres without coil changing. Type No. 960 is provided with three windings which cover five wave-ranges.

The cross-feeder block-aerial system is also described and illustrated. Use of the cross-feeder blocks enables the doublet-type aerial and the cross-feeder system of lead-in to be employed. **442**

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MAZDA VALVES AND CIRCUITS

VALVE booklets should always form part of the constructor's file as they invariably contain much useful information. The new Mazda booklet is no exception as it deals with valves and their circuits in a manner so comprehensive as to render it invaluable to every radio enthusiast.

Full technical details of all their various types are given, while in most cases useful hints and tips regarding their operation in suitable circuits are mentioned. **443**

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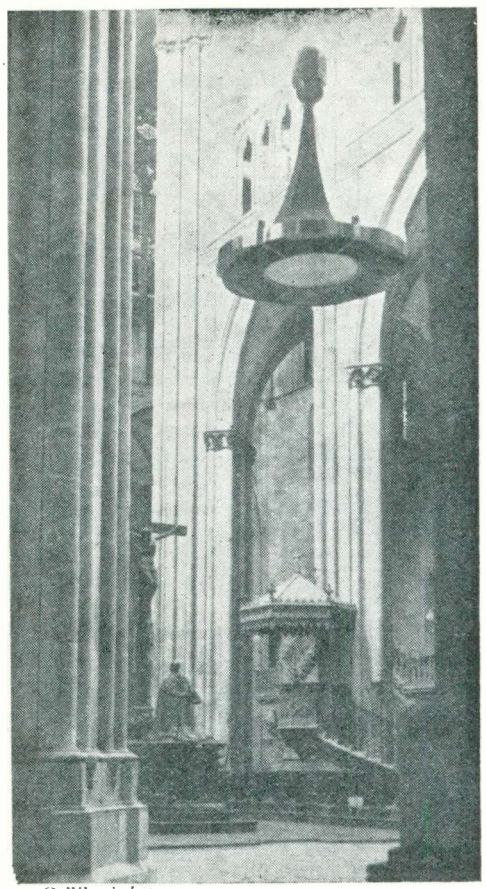
VARLEY PRODUCTS

VARLEY'S new 32-page catalogue will be found most useful. It is generously illustrated and devoted to a detailed description of the many products produced by this well-known firm.

A whole heap of information is given on iron-core coils, their design and application. The latest permeability tuner is discussed in detail.

Readers who run their sets from the mains will find a host of valuable and practical information in this Varley publication. Varley's, as you probably know, make a very extensive range of mains transformers and low-frequency smoothing chokes which are very reasonably price. **444**



Gulliland photo

The "hanging" omni-directional loud-speaker which Telefunken recently installed in the famous Regensburg Cathedral

Directional Properties of Loud-speakers

By J. D.

This interesting article gives an insight into the causes of the directional properties of loud-speakers, the chief of which is shape. The illustration on the left and some drawings show the advance that has been made in Germany by the introduction of the Telefunken omni-directional loud-speaker

FORTUNATELY for the loud-speaker designer, boundary reflection caused by the walls and ceiling of a room has the effect of masking objectionable directional and focusing properties. However, as the loud-speaker is rotated slowly there is usually, even in an enclosed space, an appreciable variation of quality.

Considering, for simplicity, the conical diaphragm type of loud-speaker, the reproduction is best with the concave face to the front, and the high tones and overall intensity are gradually reduced to a minimum as the loud-speaker is brought edge on.

With the convex side in view the high tones are again augmented, but are not so conspicuous, and there is a tendency to give a "round the corner" effect.

In free space these effects become more obvious, and difficulties are so great that special loud-speakers have to be designed to overcome them. A recent German type, which appears to be a success, will be described later.

To understand the nature of this troublesome directional property, we must examine the sound distribution at a particular frequency round a loud-speaker.

When this is done we may show the result most clearly on a polar diagram. This is simply a curve on which a listener would have to move round the loud-speaker in order to hear equally well in all his positions.

For instance, the two curves in Fig. 1 show the distribution round a loud-speaker of 5 cm. radius. You

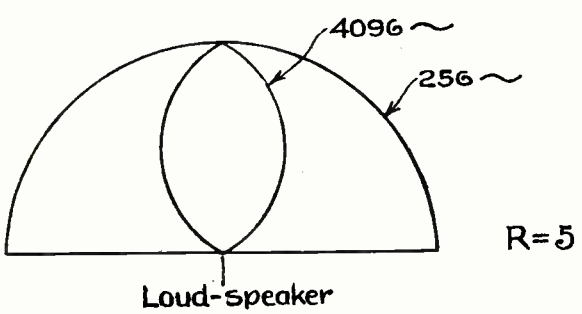


Fig. 1.—These two curves show the distribution round a loud-speaker with a diaphragm of 5 cm. radius

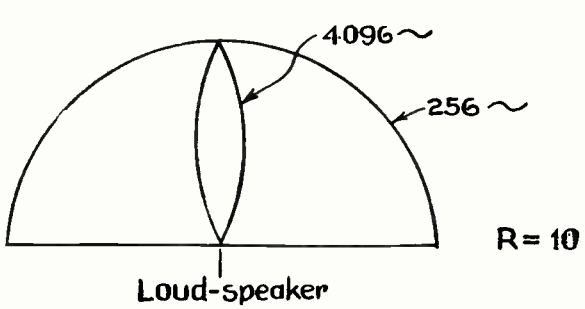


Fig. 2.—Showing the distribution from a loud-speaker with a 10-cm. diaphragm—not so efficient as the Fig. 1 curves

can see that at a frequency of 256 cycles per second the loud-speaker is non-directional, but it is sharply directional at 4,096 cycles per second, frequencies which lie within the ordinary range of speech and music.

It can thus be understood how the tonal balance is upset, especially for those not situated near the axis of the reproducer.

With a larger loud-speaker of 10 cm. radius the distribution is altered—for the worse—as in Fig. 2. In scientific terminology the convergence (focusing) of the beam varies directly as the area of the loud-speaker and as the square of the frequency.

Spherical Waves

The change in directive properties with frequency can be shown in another manner, as is seen in Fig. 3. If the waves were spherical and evenly distributed at all frequencies the total acoustic pressure on the loud-speaker would increase indefinitely, as indicated by the dotted curve. But when the frequency is great enough to give a beam of nearly plane

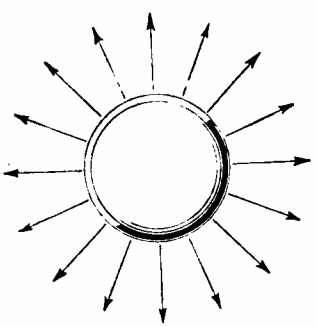


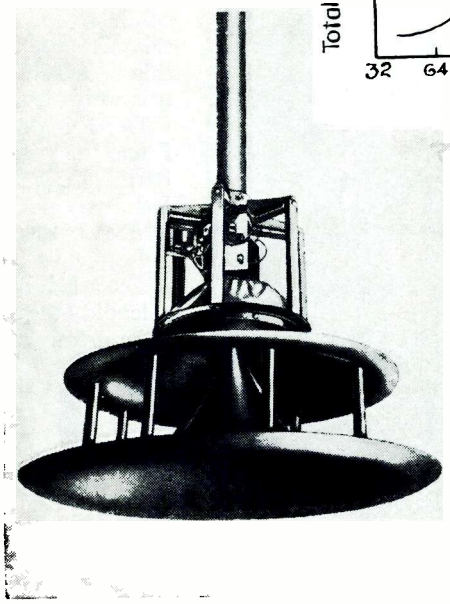
Fig. 4(a).—The sound travels outwards in all directions from the new Telefunken reproducer

waves, interference causes the pressure to reach a maximum and decrease as shown by the full curve.

Effect of Shape

Of course, the shape of a loud-speaker has a lot to do with its directive properties. Horns have a greater focusing effect than cones usually, and with a cylindrical diaphragm the variations in the polar curve are less noticeable than with a conical diaphragm.

It is in this respect that the new German loud-speaker marks an advance, particularly for use in open spaces or large halls. It stands on a pedestal and directs the sound downwards in



Showing the arrangement of the diaphragms of the new Telefunken anti-echo omni-directional loud-speaker

a large circle (Fig. 4). The great point is, however, that this circle has a clearly defined boundary, so that once you are outside it you are out of range of the loud-speaker entirely.

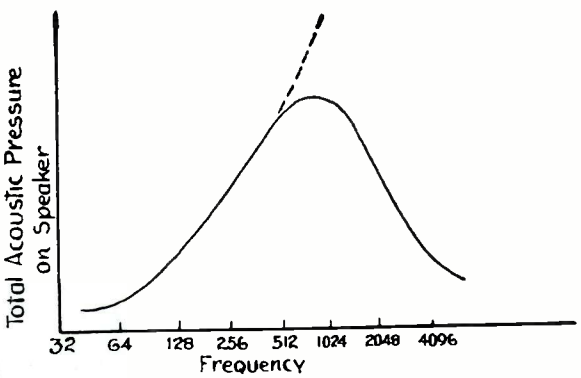


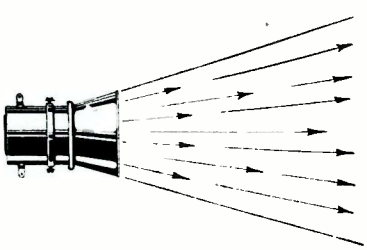
Fig. 3.—Another way of showing the change in directive properties is by means of a graph

If, in an open space, several of these loud-speakers are properly placed, a person between two of them will be able to hear either one or the other by stepping a few paces to the right or left, instead of hearing a ragged mixture of both, which is usually the case.

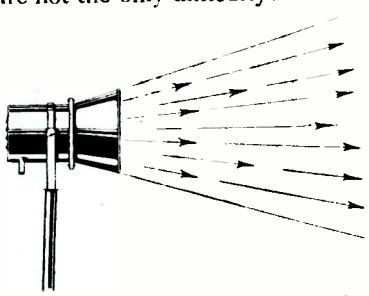
Germany's Pride

Further, it is possible to hear equally well with this type of loud-speaker from any direction. The Germans are proud of their design and recently used several of these loud-speakers in a public square in Berlin on the occasion of a national holiday. They were a complete success.

This article gives the reader only a vague idea of the technical skill that goes into the production of a good loud-speaker. Directional properties are not the only difficulty!



Looking down on an ordinary reproducer, the focusing effect would be as shown by the arrow-headed lines



Looking at the side of an ordinary moving-coil loud-speaker, the focusing effect would appear as these arrow-headed lines

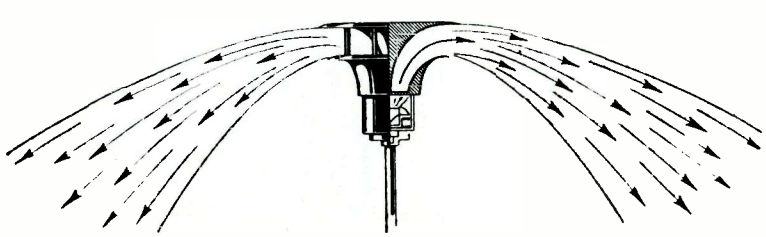


Fig. 4.—Showing how the Telefunken loud-speaker, which can be stood on a pedestal, would direct the sound waves downwards in all directions—see Fig. 4 (a)

Joe Loss, whose band plays at the Kit Cat Restaurant, listens to his records on the latest Cossor radiogram. Joe Loss is now recording for the new Panachord 1s. records

Choosing

We Help You to Pick

WHEN one begins talking about a Mozart symphony it is useless to say which one beyond giving the key. There are so many of them. This one—there is one spinning at the moment—is in E flat. The whole point is: Do you like Mozart symphonies? I do. So do most music lovers. Very well, then.

Here goes for an amazingly well recorded Mozart under the conductorship of Bruno Walter and the orchestra is the B.B.C. Symphony. There is a lovely minuet and trio, almost worth getting by itself. At all events the whole thing has my unreserved commendation. The numbers are H.M.V. DB2258-60, 6s. each.

Another twelve-incher of H.M.V. is DB2365. This should be purchased at once by any lover of light classical music. Mendelssohn's overture, *Ruy Blas*, by the B.B.C. Symphony Orchestra, conducted by Adrian Boult. I should call it a standard rendering of a standard work—and a standard favourite at that.

H.M.V. C2713 (4s.) is worth consideration. In a lighter vein: *One Night of Love Memories*; double-sided, twelve-incher. So that you can guess its purport, it is based on an operatic love-story.

Do you like Grieg? If so I think you ought to hear *Homage March No.* 3 played by an orchestra under John Barbirolli (H.M.V. C2711). It makes very good light classical music.

Columbia produces (DX651 and 652, 4s. each) Coleridge Taylor's *Petite Suite de Concert*, played by the Bournemouth Municipal Orchestra conducted by Sir Dan Godfrey. If you like this composer's *Hiawatha* I think you will like this because it is very typical of him. Anyhow, it is worth hearing.

Decca is doing a couple of records of Cesar Franck's *Psyche* by the Lamoureux Orchestra of Paris. Very good recording and pleasing music. I strongly recommend these discs to your notice (CA8193, 4s. each).

Respighi's *Villanella*—a most attractive work—is recorded by Parlophone. The orchestra is splendid—the Milan Symphony, under Guarnieri. I am greatly attracted to it (E11263, 4s.).

A ten-inch Decca of an organ is fairly good. Alfred Sittard plays *Now That the Day is Ended* and a *Song in C*. These works were composed by Sittard and are of a very tuneful character. Light organ music at its best!

Alfredo and his orchestra play *Memories of Old Vienna* on a double-sided disc (H.M.V. B8256, 2s. 6d.). Quite worth hearing, but I think one of the best of this little batch is B8254, which is a Cavalcade of Martial Songs like *The King's Horses*, *When the Guards are on Parade*, etc. Quite a good show.

Count John McCormack before the H.M.V. mike at the Abbey Road Studios. He has recorded two typically Irish songs, which are reviewed this month

A red-label ten-incher of H.M.V. (DA1396) should appeal to a good many. John McCormack sings *The Dawning of the Day* and *Terence's Farewell to Kathleen*. Both are distinctly Irish in atmosphere.

You have heard Walsh and Barker on the wireless? Very good duettists. They sing *Roll Along, Covered Wagon*, and *Don't Forget* on MR1532 of Regal Zonophone (1s. 6d.).

A boy soprano record for you if you want one (MR 1535). Also *Alone* and

Song of Paradise, sung by Cavan O'Connor on MR1586. Very good, this!

Ravel's *Bolero* is on the wax again. This time by a "Grand Symphony" Orchestra in Paris. (Parlophone, R1995, 2s. 6d.). The first part hardly comes out well—but I always think the work, if played as Ravel would like it played, is a bad recording proposition in any case.

Parlophone also does a record of the tenor, Joseph Schmidt, on R1933. Contents: *My Song Goes Round the World* and *One Life, One Love*. Very good singing.

Columbia (DB1480, 2s. 6d.) is an excellent Albert Sandler record. He plays *Melody at Dusk* and *Daybreak*. So you get him at both ends of his perfect day. Both tunes are composed by Reginald King, who accompanies Sandler on this record.

Decca F5344 does another eight pianos affair. It is the well-known *Valse des Fleurs* from Tchaikovsky's *Nut-Cracker Suite* which lends itself admirably to the treatment it receives here.

Whitaker-Wilson.

Columbia photo

C. B. COCHRAN'S LATEST STAR
Larry Adler—the wonder mouth-organ player whom Mr. Cochran discovered in America and brought back with him—is now one of the outstanding successes in "Streamline," Cochrane's latest London show. He has recorded "Smoke Gets in Your Eyes" and "The Continental" for Columbia this month

Your Records

the Best Records for Your Radiogram

Popular Records Recommended
By Chopstick

ORGAN MUSIC

Famous Tauber Melodies, Harold Ramsay, 2s. 6d. **PARLO R2000**

Ramsay plays at the Tooting Granada organ—and a fine instrument it is. Really nice tunes these; Schubert's "Serenade," "In Your Arms To-night," and, of course, "You Are My Heart's Delight." Ramsay makes use of a Hawaiian guitar to get a "silky" effect. An outstanding production!

★**1812 Overture,** Quentin Maclean, 4s. **COL DX654**

A twelve-inch masterpiece. Full of effects—wonderful some of them—but a success because of Maclean's genius in arranging this semi-classical stuff for a cinema organ. You all know this rather hackneyed composition: it takes on a new freshness here. I do ask you, particularly if you have a hefty radiogram, to try over this disc.

PIANO SOLOS

★**Waltz Medley,** Harry Roy's Tiger Ragamuffins, 2s. 6d. **PARLO R2009**

This shows that Roy's usually hot-stuff pianists can turn their hand to quiet—in fact, dreary—tunes when they wish. The most important point is that although a medley, the time is constant and you can dance to it. The lads are accompanied at times by a Hawaiian guitar—quite a craze. Tunes are old, but good. "Love will Find a Way," "My Hero," "Destiny," and "Alice Blue Gown," are some of them.

Piano Medley in Dance Rhythm, Harry Jacobson, 2s. 6d. **H.M.V. B8257**

Quite pleasant. The title explains the disc. Jacobson plays well, having a rather quiet style. He chooses lively tunes, though. "Miss Otis Regrets," "Heat Wave," "Not for All the Rice in China," "I Saw Stars," and "Sweetie Pie" are examples.

LIGHT SONGS

(*a*) **June in January,** (*b*) **I'm Lonesome for You Caroline,** Layton and Johnstone, 2s. 6d. **COL DB1485**

Interesting record this! Columbia has done its double recording trick on (*b*). In the last vocal chorus, Layton and Johnstone sing a duet with themselves. This involves a tricky process. The chorus is sung twice; then one version is superimposed on the other. Both (*a*) and (*b*) are topical, and are sung as only this famous variety pair can sing them.

(*a*) **Who Made Little Boy Blue,** (*b*) **Pal o' Mine,** Les Allen, 2s. 6d. **COL DB1476**

Les Allen is accompanied here by his Melody Four and on (*b*) he has the valuable assistance of his young son, Norman and Mrs. Allen. In spite of that, (*a*) is, I believe, a much neater tune and well worth hearing.

TRUMPET SOLO

★(*a*) **I Can't Dance, I've Got Ants in My Pants,** (*b*) **Carolina** Nat Gonella and orchestra, 1s. 6d. **DECCA F5322**

(*a*) is some title; and isn't Nat some trumpeter! I admire Gonella's technique. He plays at tremendous speed and never misses a note. That is more than can be said about brass players in some broadcast symphony orchestras. Real hot stuff this.

MODERN-RHYTHM SURVEY

★**A Short Survey of Modern Rhythm,** 2s. 6d. **BRUNS 2000**

This is a unique record that every keen up-to-date listener should possess. It is actually eight excerpts of very differing types of hot stuff. Red Nichols plays an excerpt of "Eccentric," Duke Ellington plays "Slippery Horn," a fragment of "Got the Jitters" is given by Don Redman's band, and Spike Hughes plays "Sweet Sorrow Blues." On the other side, fragments are played by Jack Teagarden, Louis Armstrong, Joe Venuti and Eddie Lang.

DANCE MUSIC

(*a*) **I'm on a See-saw** (f), (*b*) **Dancing with a Ghost** (f.), Jack Jackson and His Orch., 2s. 6d. **H.M.V. B6565**

Both from the film, *Jill Darling*. Admirably played and admirable H.M.V. recording!

★(*a*) **I Saw Stars** (f.), (*b*) **Ole Faithful** (f.), Roy Fox and His Band, 1s. 6d. **DECCA F5212**

This takes the biscuit for the best dance record of the month. (*a*) is one of to-day's outstanding dance tunes. Fox plays it well. Recording, too, is perfectly balanced. Vocal choruses are by Syd Buckman—a stranger to me—who sings outstandingly well.

★(*a*) **Judy,** (*b*) **Stars Fell on Alabama,** Carroll Gibbons and His Boy Friends, 2s. 6d. **COL DB1487**

Carroll, the perfect dance-band pianist, at his best. You will like his (*a*).

★(*a*) **La Cucaracha,** (*b*) **The Continental,** London Piano-accordion Band under Scott Wood, 1s. 6d. **REGAL-ZONO MR1516**

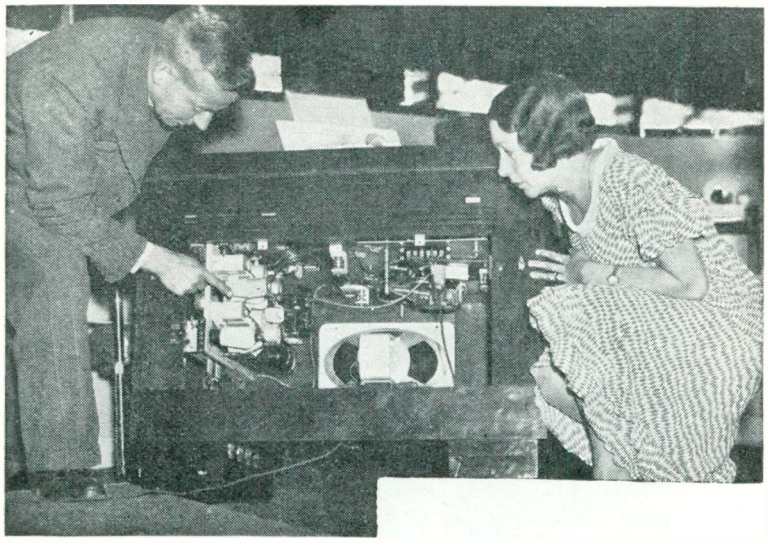
Two rumbas. (*b*) has taken on with gusto and Scott Wood's band has got the right touch on this new rage. Ideal for either dancing or listening.

★(*a*) **No! No! a Thousand Times No!** (w.), (*b*) **I'm Goin'a Wash My Hands of You** (f.), Ambrose and His Orch., 1s. 6d. **DECCA F5318**

(*a*) needs little introduction. It is performed here exactly as in the recent Ambrose broadcasts. Elsie Carlisle is the heroine. I imagine a rush for this. Both numbers are typically Ambrose: 'nuff said!

(*a*) **Orient Express** (novelty f.), James Kok's Dance Orch., (*b*) **The Acrobat,** Paul Godwin's Orch., 1s. 6d. **DECCA F5354**

A double-purpose record. (*a*) is a terrifically hot foxtrot if you like, or, a modern version of train noises. (*b*) can be a foxtrot, but it is better as light orchestral work, the high spot of which is plenty of tricky instrumental solos.



H.M.V. photo

Note the rather unusual elliptical shape of the loud-speaker in this compact H.M.V. radiogram

The A B C of Automatic Grid Bias

By L. O. SPARKS

BEFORE any method of obtaining automatic bias can be considered it is essential to refresh one's memory about Ohm's Law. This law states that the difference of potential between two points on a wire is proportional to the current flowing along the wire. In spite of the fact that this law was propounded just over a hundred years ago it still holds good, and forms one of the basic laws governing calculations relating to electrical problems.

In Another Form

Without going into details, we can put Ohm's Law in another form and say that when an electric current is flowing along a conductor which offers any resistance to it, there will be a difference of potential between the two extremities. This difference of potential or voltage will depend on the value of the current and the amount of resistance present in the circuit.

Simple Example

Let us take a simple example; we will assume that a loud-speaker has a resistance of 4,000 ohms and through it we have a current of 7 milliamperes flowing. If readings are taken with a meter, or if a simple calculation is made using the formula volts = milliamperes × ohms divided by 1,000, we shall find that we have lost 28 volts across the loudspeaker.

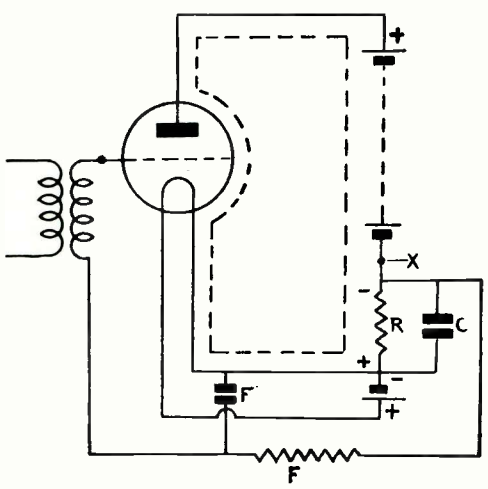
It is quite easy to verify this, but please remember to divide by 1,000 if the current reading is in milli-amperes. This may all seem very remote from automatic bias and perhaps a little boring, but it is vital to understand this fully, as all forms of automatic bias depend on the laws governing resistances and voltage dropping.

Current Path

I am going to assume that you are all familiar with the current path of a valve, and how the complete circuit is made from the anode through the high-tension battery to the filament or its equivalent.

You can see the scheme in Fig. 1, where the dotted portion represents the circuit. It should be noted that the negative of both batteries is common.

Let us insert a milliammeter at the point marked X and find out how much current is flowing along this wire. It will be found that the value is the total current consumption of the receiver, therefore if we now insert the resistance R at this point it stands to reason that a certain voltage drop will be produced.



AUTOMATIC BIAS FOR BATTERY SETS
Fig. 1.—Showing the method used for obtaining automatic bias in battery receivers

Another very convenient fact will come to light, and that is that the polarity of the voltage will be just right for our purpose. The point X will be so many volts, depending on the resistance and current, negative in respect to the low-tension negative or common earth line.

Smoothing

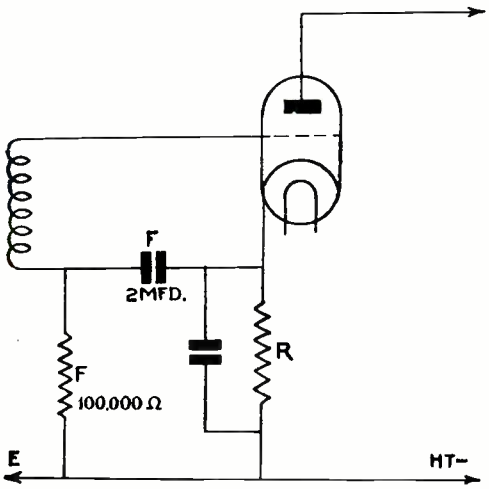
This being so, it now only remains for a connection to be made to the grid circuit of the output valve through a grid leak or the secondary of the low-frequency transformer, according to the coupling used, from this point. You will of course notice the condenser connected across the resistance, and if you have not guessed what it is for I will tell you.

The current flowing is fluctuating the whole time, likewise variations are produced in the voltage, which if allowed to pass into the grid circuit are liable to set up a form of reaction.

Steady Voltage

The purpose of the condenser is to smooth out the supply and ensure steady direct-current voltage. It is quite possible that bias will be required for valves other than the output, therefore to obtain other values tappings should be made on the bias resistance.

For instance, if a pick-up is in use it will no doubt be necessary to apply 1.5 or 3 volts negative bias



BIAS FOR INDIRECTLY-HEATED MAINS VALVES
Fig. 2.—Similar to the method shown in Fig. 1, except that the cathode takes the place of the filament

to the detector valve. By using the same formula the exact value of the resistance between the tapping and the high-tension negative can be determined.

In multi-valve circuits it is sometimes necessary to insert simple filters in the grid circuits to prevent any high-frequency current getting through. The usual arrangement is shown by the two components marked F.

Bias for Mains Valves

Where mains valves of the indirectly-heated type are employed the method of deriving the bias is just the same except that the cathode takes the place of the filament. As the cathodes are electrically insulated and not common to the circuit, it is possible for the anode current of each valve to be used to provide independent bias. This is sometimes termed self-bias, as the arrangement can be looked upon as a self-contained unit for its associated valve.

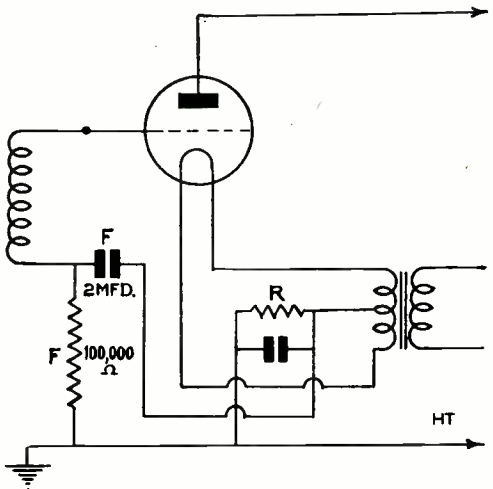
Fig. 2 shows how the resistance is inserted in the cathode lead. A by-pass condenser is used in a similar manner to the battery counterpart, but it should be remembered that to determine the value of the resistance the current taken by the valve under consideration must be used in the calculation and not the total current consumption as in the previous case.

Directly-heated Mains Valves

In certain receivers output valves are employed which have their filaments heated by raw A.C. In this case a slightly different arrangement is necessary, although the basic principle is identical.

Fig. 3 shows a typical circuit and it will be noted that the centre tap, which is normally taken to earth, is the point where a bias resistance is inserted. It will be obvious that it is advisable for separate filament windings to be provided.

It will be found that it is more advisable to employ the grid filters or decoupling in mains receivers, and a word of warning is necessary regarding the value of the decoupling resistance.



BIAS FOR DIRECTLY-HEATED VALVES
Fig. 3.—The circuit used for obtaining bias for directly-heated valves, that is valves that have their filaments heated by raw A.C.

If too high a value is used there is the danger of affecting the high-note response, therefore it is advisable to use the lowest value consistent with stability.

For high-frequency valves a by-pass condenser across the bias resistance should have a capacity between .01 and .1 microfarad.

In the detector circuit 1 microfarad can be used, but on the output side it is an advantage to use nothing smaller than 2 microfarads.

All-wave Three in Barbadoes

BARBADOES (British West Indies).—I am often building all kinds and types of sets (from four to ten valves, even), and having an odd day recently I scanned the circuit of this set—having got a couple of British General All-wave tuning coils.

I was somewhat dubious of the All-wave Three, but in less than two hours it was assembled with results.

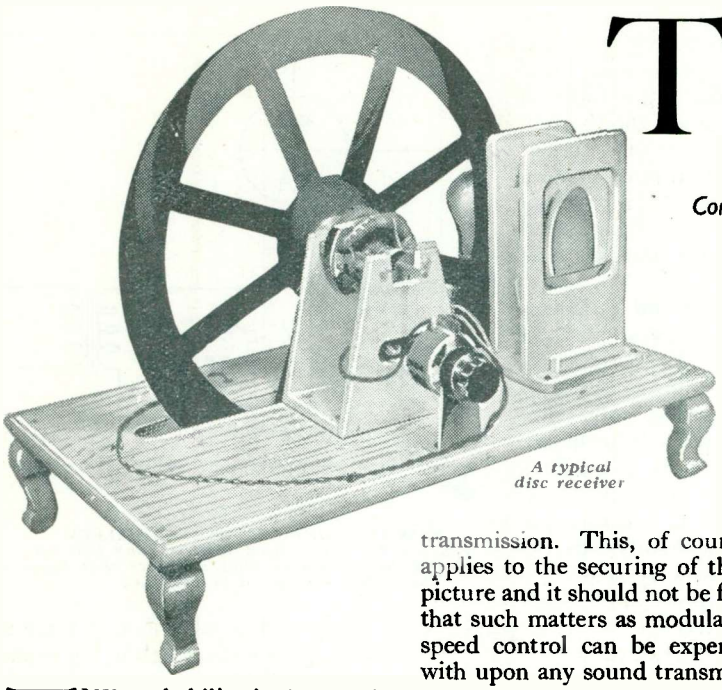
I then put a Mazda Pentode 220A for the output (this change means altering two wires only), and consider it the cheapest and best all-waver you have published to date—loud-speaker results definitely on over 100 stations; a little touchy below 19 metres, but up to 550 its results are nothing short of marvellous.

It is a foolproof set; its selectivity on the 25-, 31-, and 49-metre bands has to be known to be believed.

Sound, if required, can be heard clearly 50 yards away from the house—Australia, Germany, Canada, Japan, Indo China, Daventry, U.S.A., Brazil, Agentina, Venezuela, Bolivia, in fact, every station which can be picked up by any multi-valve American set is to be picked up with ease on this All-wave Three.

Hints on Receiving Television

Common Faults : : Adjusting Scanner Speed
Negative Pictures : : Interference



A typical disc receiver

THE probability is that on the first attempt to receive a television broadcast the results will be nil—or, at all events, all that will be seen will be a number of floating splashes of light.

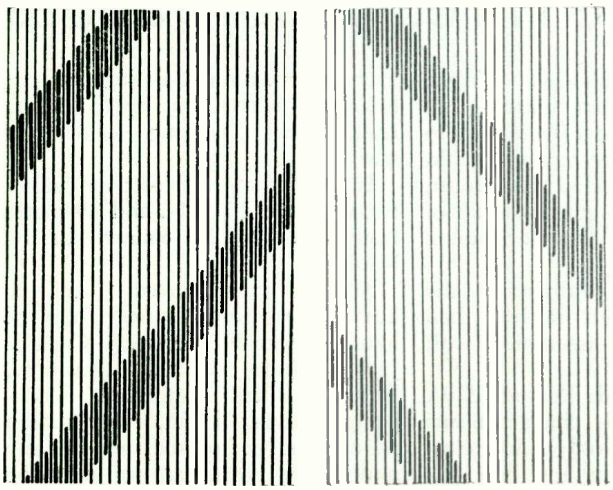
Unfortunately, the duration of the television programmes is so short that there is practically no time to make adjustments; and when it is appreciated that there is a fault there is, as a rule, nothing that can be done to remedy it until the next transmission. This, of course, only applies to the securing of the actual picture and it should not be forgotten that such matters as modulation and speed control can be experimented with upon any sound transmission.

Receiving Sound Pictures

It is as well, therefore, to put in a little practice with the receiver before any attempt is made on an actual television broadcast. There will be no mistaking the appearance of the screen when a sound transmission is being received, and the opportunity can be taken of ensuring that the greatest brilliancy of screen is being obtained.

Accurate tuning of the wireless receiver is essential and the effects of slightly detuning and the use of too much reaction should be noted. These are matters which may appear very obvious, but during an actual television transmission it may be found that they just suffice to prevent a picture being resolved.

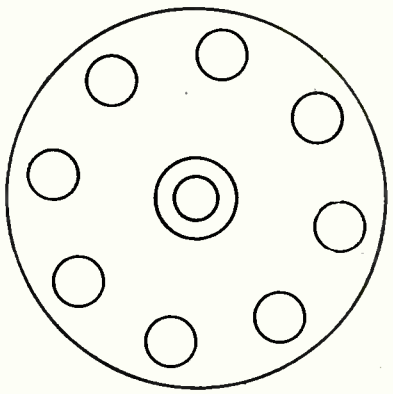
On a sound transmission the screen should be marked by faint vertical lines which vary in their intensity, in their length and the general appearance will be what is usually termed "shot," but the pattern will be constantly varying.



If the motor is running too slowly, dark bands will appear which travel towards the right-hand bottom corner; if the speed is too great, the bands will appear to move in the opposite direction

Obtaining Correct Motor Speed

Assuming that this effect is obtained, there is only one other incorrect condition that will prevent you obtaining pictures—and this is the speed of the scanning device. The requisite speed is 750 revolutions per minute, and the slightest error—either fast or slow—will prevent a picture being formed.



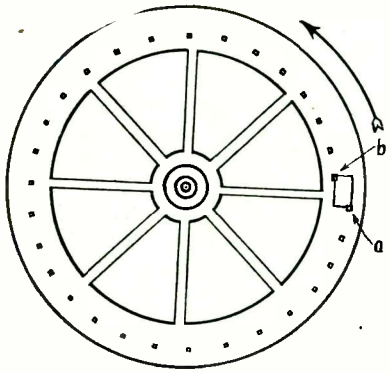
A simple stroboscope for determining scanner speed

A check of motor speed can be made at any time, irrespective of transmission, provided that A.C. mains are available. Scanning devices are provided with eight spokes or dots, and when these are viewed by the light of a lamp fed from 50-cycle A.C. mains and the motor is running they appear to be stationary when the correct speed is attained.

This effect can be observed with the light from an ordinary incan-

descent lamp, but it is much better to use a small neon lamp as the light from this goes right out between cycles and the stroboscopic effect can be very clearly seen.

It is easy to make the mistake of running the scanner at half-speed, for in this case the eight spots or spokes will be clearly defined, though closer observation will show that a very faint indication of a spot or line lies between each. The effect



This diagram shows the direction of rotation of the disc. The picture area is between a and b

of half-speed is to produce four quarter pictures, and in the case of the disc receiver these would be so small that unless everything was working perfectly the possibility of them forming pictures would in all likelihood be overlooked.

On a sound transmission there is no indication on the screen of correct speed though, after a little practice, it is possible to form a fairly reliable estimate by observing the amount of flicker.

If you should have a picture split vertically, as shown by the drawing, allow the motor to revolve a little faster and you will find that as the picture slowly travels up it will also move sideways until the picture is completely in view

On an actual television transmission there are definite indications of speed which, with a little experience, can be easily interpreted. The first appearance will in all probability be that of a number of patches of light which are travelling either up or down almost vertically.

In either case, the speed of the motor is definitely wrong; if the travel is downwards the speed is too slow, and if upwards too fast. When a correction of speed is made the patches will begin to assume an oblique direction, and finally horizontal at the proper speed.

The probability, however, is that the passage through the critical speed will be so quick that it will be found impossible to accelerate or retard the motor in time. Acceleration or retardation, therefore, should be very gradual, and this will be denoted by the rather slow change in the obliquity of the moving pattern.

Experience makes a wonderful difference in the control of speed, and after a little practice it is possible to gauge the amount of control necessary to apply in advance by merely watching the screen. Generally speaking, it is better to rely upon some sort of friction device on the shaft of the motor rather than upon a variable resistance, for the latter does not act sufficiently quickly.

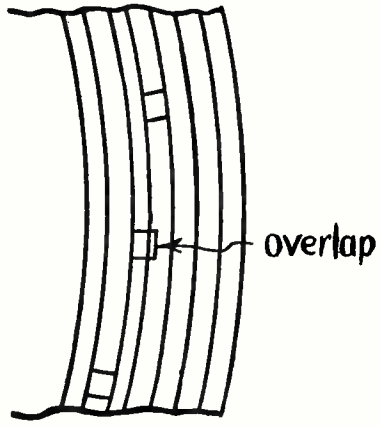
Another useful trick is to switch the motor off momentarily—the mere off-on flick of the switch will usually suffice, though, of course, in this case the motor must be tending to run too fast.

It is always better for the motor to have a tendency to run too fast rather than too slow, for it can be retarded more easily and quickly than it can be accelerated.

These remarks apply equally well to scanners which are fitted with synchronising devices, and in this case it will be found that irrespective of manual control the picture tends to hold more steady when the motor is inclined to run a little fast; also should the synchronising device lose control, correction can be more quickly applied.

Negative Pictures

It is practically essential to run the motor for a little time in advance of the actual transmission, for the speed characteristics of these small motors varies with the temperature and for steady running, therefore, it should be allowed to warm up in advance; the length of time will depend upon



The effect of incorrectly spaced holes will be to produce either light or dark bands in the direction of the scanning lines

the motor and its load, but twenty minutes is the approximate period.

Assuming that some sort of picture is obtained, there is the possibility that it may be negative; this, however, is a matter which is fairly easy to remedy by any of the three following methods:—

(1) If you are using leaky-grid detection, change to anode-bend and vice versa.

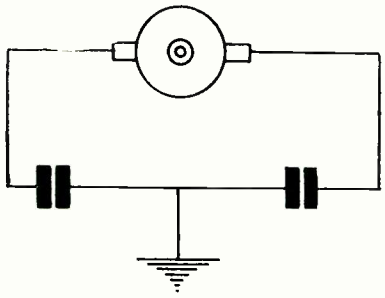
(2) Reverse either the primary or secondary of a low-frequency transformer if you have this coupling. It

If the picture is split horizontally a very slight alteration of speed will correctly frame the image

is no use attempting this with resistance-capacity coupling or with auto-coupled transformers.

(3) Add a further stage of amplification between the detector and the output.

Another fault which often occurs when a receiver is first tried out is an

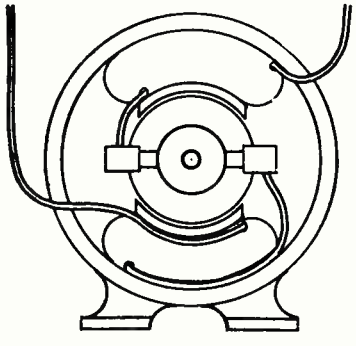


Interference due to sparking of the commutator brushes can be prevented by the use of two condensers as shown

upside-down picture. The sole reason for this is because the scanner is rotating in the wrong direction; the disc should revolve in an anti-clockwise direction so that the scanning spot travels upwards, commencing at the bottom right-hand corner of the screen and travelling to the left.

Direction of rotation can be corrected either by mounting the motor in the reverse direction or changing over the brush connections relative to the field windings. This latter will be clear from the diagrams.

When a picture is obtained, some



If the image is upside down it shows that the motor is revolving in the wrong direction. This can be corrected by changing over the connection between the field winding and the commutator brushes of the motor

curious effects may very likely develop. One very common one is for the picture to be split vertically which indicates that it is out of phase due to the motor running isochronously with the transmitting motor. This can be corrected by allowing the picture to slip a few frames, the number depending upon the position of the dividing line; as the frames are slipped it will be noted that this lines moves to the right if the motor is slowed down and to the left if it is accelerated.

Concurrent with this fault the framing may be out, but the correction of this slight fault will be evident and when synchronising gear is fitted merely necessitates this being rocked a little in one direction or the other.

Interference

Any interference is, of course, observable in the picture, and this may possibly be somewhat pronounced where A.C. mains are used unless steps are taken to eliminate it. A.C. mains interference is discernible as dark and light vertical bands on the picture, the strength of the bands corresponding to the amount of interference.

As the speed of the disc varies, the bands will slowly drift from side to side. This fault lies in the receiver, and ordinarily it would reveal itself as A.C. hum. It is, therefore, here and in the aerial system that a cure must be found; though, incidentally, it is advisable to keep the leads to the neon lamp as short as possible in order that there will be no pick-up here.

Heterodynes are visible as a fine grain or pattern which covers the whole of the picture. Motor interference may result if there is sparking at the motor brushes. It produces splashes of light and spots and streaks as is noticeable when a damaged film is used at a cinema. Attention should first be given to the motor commutator and brushes.

See that the latter press firmly, but lightly, and that the commutator is quite smooth and bright. A slip of fine sandpaper held lightly against the commutator as the motor is running will effect an improvement, though if the commutator is only dirty, and not rough or burnt, a small

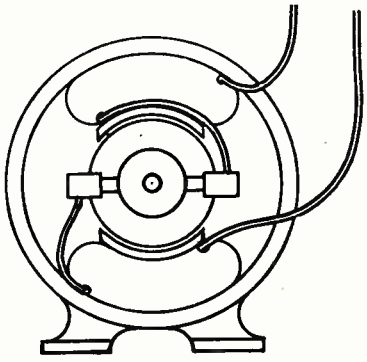
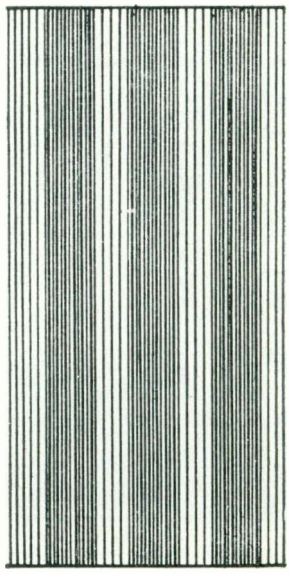


Diagram showing how the motor connections can be altered to reverse the direction of rotation

piece of cloth damped with turpentine will do all that is necessary; do not use emery cloth on the commutator.

A filter across the motor brushes, as shown by the diagram, is a useful refinement; and in cases where sparking is not very bad it will eliminate any trouble in this respect. Condensers of 1 to 2 microfarads will be suitable with the centre point connected to earth, as shown.



If there is interference from A.C. mains, dark bands will appear on the screen, passing from one side to the other

News from All Quarters

Broadcasting in India

THE High Commissioner for India in London has placed a contract with the Marconi Company for the supply and erection of a 20-kilowatt broadcasting station at Delhi.

This is the first step towards the accomplishment of the Indian Government's policy of extending broadcasting in India, announced by the Viceroy in August last year.

Work on the manufacture of the equipment for the Delhi station is to begin immediately at the Marconi Works, Chelmsford.

The transmitter will be of advanced design, incorporating the most modern developments of broadcasting technique, and with its unmodulated aerial energy of 20 kilowatts it will be several times more powerful than any broadcasting station previously erected in India.

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Mischa Spoliansky

The announcement by Parlophone of two records by Spoliansky recalls the historic fact that it is not always that a child prodigy consolidated his early successes later in life.

The composer of *Tell Me Tonight*, Mischa Spoliansky, is an exception in this respect. He began as a pianist at the age of ten, and now he is one of those brilliantly fortunate artists who can never write an indifferent song nor play other than beautifully on his piano.

The world first heard of him in Dresden, where as a boy he once startled the severe critics by improvising on a Mozart air—a feat achieved through sheer nervousness!

This incident laid the foundation of his career and he has never looked back. His fame as a pianist grew, and almost alongside he achieved a reputation as a composer of better-class songs.

These at first were written in his spare time, but people began to take notice of his catchy melodies, and he became so busy receiving commissions to write music that his career as a pianist had to be abandoned.

Max Reinhardt claimed him for many of his German productions, and a large number of Continental hits during the last ten years have come from Spoliansky's pen.

His popularity spread over here, and his famous song *Tell Me Tonight*, which he composed for Jan Kiepura, may be said to have made his name in England. Since then he has written many successes for super British films, including *My Song For You*, *Evensong*, and *The Private Life of Don Juan*.

The Parlophone Company recently persuaded Spoliansky to play a piano medley of his own "best sellers" and this offers practically the only opportunity of hearing a fine pianist and a brilliant composer simultaneously.

◆ ◆ ◆

Exide Batteries

A still further advance in battery design has been made by Exide. For the first time, an Ironclad positive plate (the same plates that make Exide Ironclad submarine and traction batteries so reliable) is used for radio purposes.

The new IFG/C, the only radio battery of its kind in the world to incorporate this feature, has a greatly increased life, holds its charge longer, and reduces listening costs.

It is also fitted with a popular indicator that tells when it is time to recharge and, at 11s. 6d., is more economic than ordinary batteries without specially strong Ironclad plates. This new battery will appeal essentially to the discriminating user, who will have one of the best batteries that money can produce.

The principle of the Ironclad plate is that the active material is locked up in finely slit ebonite tubes and so held securely in contact with the grid of lead alloy. The tubes allow free access of the electrolyte to the active material, which is prevented by the fineness of the slits from being washed away, thus prolonging the life of the plate and maintaining it in a high state of efficiency.

The battery, which has a capacity of 45 ampere-hours, is identical in size with the well-known Exide DFG Mass-type specially made for sets having little demand for low-tension current.

The discharge is steady and the charge is retained for a considerable time. When not in use the battery may be left without attention even though partially discharged.

CHANGE OF ADDRESS

Will readers please note that in future all correspondence—whether to the Editor, the Publisher, or the Information Bureau—should be addressed to:

"WIRELESS MAGAZINE,"
8-11 Southampton Street,
Strand, London, W.C.2.

Approach to Art

The B.B.C. announces that a special pamphlet, "An Approach to Art," is published in connection with Eric Newton's talks series, "The Artist and his Public," which began in January.

The pamphlet contains an article by Mr. Newton and a syllabus of the talks and discussions which make the series. In addition, thirty-two pages of illustrations have been carefully chosen to fit in with the talks. The illustrations are so closely linked with the talks that listeners will find the pamphlet of great benefit in following the series.

One of the main objects of the series is to explain Modern Art to the man in the street by showing its continuity with the past.

The pamphlet costs 7d., or 9d. by post, from the Publications Department of the B.B.C.

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Sunbeam Battery

The Fuller Accumulator Co. (1926) Ltd., is now manufacturing a new "Sunbeam" high-tension battery, supplies of which are available.

The prices are exceptionally reasonable. They are 3s. 6d. for the 60-volt type, 5s. 6d. for the 100-volt, and 6s. 6d. for the 120-volt type.

◆ ◆ ◆

New Marconi-Osram Valves

Two new valves by the Marconi and Osram companies have recently been released. They are known as the N40 and N41. We understand that the N40 is a purely experimental valve which has not yet been placed on the market. It attracted considerable attention when it was exhibited at the recent Physical Society Exhibition.

The N40 is a high-slope output pentode, in the 4-volt A.C. range. It is fitted with an indirectly-heated cathode taking 2 amperes. It is

capable of giving a comparatively high undistorted power output, with small input grid voltages.

This feature renders it very suitable for the output stage of an A.C. mains receiver where it is desired to obtain a high degree of sensitivity with the minimum number of valves.

At an anode voltage of 250 the anode current is 32 milliamperes. It has an anode dissipation of 8 watts and under normal operating conditions an amplification factor of 210.

The valve is fitted with a seven-pin base and a new dome-shaped bulb. The retail price is 18s. 6d.

The N41 is purely an experimental output tetrode. Owing to the fact that a pentode possesses two general advantages over the triode—(*a*) it gives greater undistorted power output for a given consumption of high-tension energy and (*b*) it gives a greater undistorted power output for a given A.C. input voltage to the grid—it is used in the large majority of modern receivers.

While the pentode is more complicated and costly than the triode, its advantages definitely outweigh these considerations and it is therefore a very important component in radio design.

The pentode is really a tetrode with an additional grid between the screen grid and the anode. This grid, usually referred to as the suppressor grid, is connected to the cathode and is thus rendered sufficiently negative, with respect to the anode, to ensure that the latter's secondary emission is substantially returned intact to its source.

This has the effect on the characteristics of extending the available undistorted anode voltage swing and giving us the features described previously.

THE "W.M." A.C./D.C. SUPER FOUR

Continued from page 12

To gang, turn the wave-change switch to the left; the receiver is then on the medium waveband. Tune to a station at the bottom of this band, that is, at about 10 degrees on the scale. Turn the middle knob on the intermediate-frequency transformer to about the mid-point and adjust the trimmers of the condensers tuning the aerial and the tuned-transformer coils. These two trimmers are nearest the front of the receiver and should be adjusted for maximum signal strength.

Now turn the dial to the other end of the band, that is, to about 500 metres, and adjust the *oscillator* trimmer for maximum signal strength. The main tuning drive should be turned a little on either side of the tuning point to make sure that you have the correct setting.

The intermediate-frequency transformer should now be trimmed for maximum signal strength. There is a definite setting for each of these trimmers and no difficulty will be experienced in finding the best.

Long-wave Adjustments

Now turn the wave-change switch to the right for the long waveband. The only adjustment that need be made is with the series pre-set condenser at the rear of the tuning coils. Tune with the main condenser to a station at the top of the waveband, such as Radio Paris, and turn the pre-set condenser for maximum strength, at the same time turning the main tuning control to make sure that the correct setting has been found.

On no account alter the main tuning condenser trimmers, for if you do when you come back to the medium waveband the receiver will not be in gang.

LOW-FREQUENCY COUPLING CIRCUITS

Continued from page 20

I have not found any disadvantages with class-B so far, except that if you are rather forgetful with decoupling, then you are likely to get a little feedback and the whole low-frequency side would become unstable.

Finally, there is the direct-coupled method, which is not very popular, for it means the use of several hundred volts to obtain a satisfactory degree of amplification. It has the advantage that quality is almost perfect and the response curve is as level as it is possible to obtain.

On the other hand, who wants such good quality with a short-wave receiver? For you only get out of the low-frequency stage what you put into it and, as a general rule, top-note cut off is very bad and there is not sufficient separation between stations to allow for a high definition.

Each circuit seems to have something in its favour and something against it, but you should know by now some of the little points associated with the different types of circuits.

BLUEPRINT COUPON

Valid only until Feb. 28, 1935 (or until March 31, 1935, for overseas readers)

FOR ONE BLUEPRINT ONLY

If you want a full-size blueprint of any ONE of the sets constructionally described in this issue for half price, cut out the above coupon and send it, together with a postal order, to Blueprint Department, WIRELESS MAGAZINE, 8-11 Southampton Street, Strand, London, W.C.2.

This coupon is valid for a blueprint of any ONE only of the following sets at the prices indicated :—

£5 5s. BATTERY FOUR (page 44), No. WM381, price 9d., post paid.

"W.M." A.C./D.C. SUPER FOUR (page 7), No. WM382, price 9d., post paid.

INFORMATION COUPON

Valid only until Feb. 28, 1935 (or until March 31, 1935, for overseas readers)

If you want to ask any questions, cut out the above coupon and send it, together with a postal order for 1s. and stamped addressed envelope, to the Information Bureau, WIRELESS MAGAZINE, 8-11 Southampton Street, Strand, London, W.C.2.

Note that not more than two questions may be asked at a time and that queries should be written on one side of the paper only.

Under no circumstances can questions be answered personally or by telephone. All inquiries must be made by letter so that every reader gets exactly the same treatment.

Alterations to blueprints or special designs cannot be undertaken : nor can readers' sets or components be tested.

If you want advice on buying a set, a stamped addressed envelope only (without coupon or fee) should be sent to the Set Selection Bureau, WIRELESS MAGAZINE, 8-11 Southampton St., Strand, London, W.C.2.

COIL EXPERIMENTS WITH OUR TEST SET

Continued from page 28

back again by re-tuning. Notice that when the screen is very close to the coil a very considerable increase of capacity has to be made to bring the tuning up to the correct point.

I hope that, as suggested in the last article, you have been taking copious notes of these experiments. If you have done so you will find it most interesting to read back over your notes and see how many new facts have been brought to your notice.

Commercial Coil

The next time you take the can off a commercial coil you will be in a much better position to appreciate the problems of the coil designer and how accurately everything has to be made if the coils are to be ganged with a standard double or triple-gang condenser. You will also realise the purpose of certain spacings and how vitally very small capacities can affect the tuned circuit.

A reaction coil, for example, wound immediately on top of a grid coil may have so much capacity between its windings and those of the grid coil as to give a much greater coupling, capacitatively, than is given inductively. At the same time this capacity may completely upset the grid-coil design.

Fine Reaction Windings

You will also realise why it is that reaction coils are generally wound with very fine wire in such a way that the capacity between them and the coil on which they have to act is reduced to a minimum, just as you will begin to have the correct idea of why the long-wave winding is sometimes placed at right angles to a medium-wave winding and so on.

And all this rumination will probably suggest a lot of other experiments, which in turn will suggest further ones, and you may be well on the way to discovering something new.

After all, new inventions come as frequently from freshness of mind as from lengthy experience. It is so very easy to get into a groove with radio and to avoid trying new experiments because you think you know what will happen. A final word! Don't forget to use your notebook regularly.

INDEX TO ADVERTISERS

Next Month

RADIO AS A SCIENCE.—A striking and provocative article by Paul D. Tyers.

* * *

ALL ABOUT PIEZO-ELECTRIC PICK-UPS.—A discussion of the standard of quality, characteristic curves, etc., by P. Wilson.

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Percy W. Harris starts a new series for users of commercial sets.

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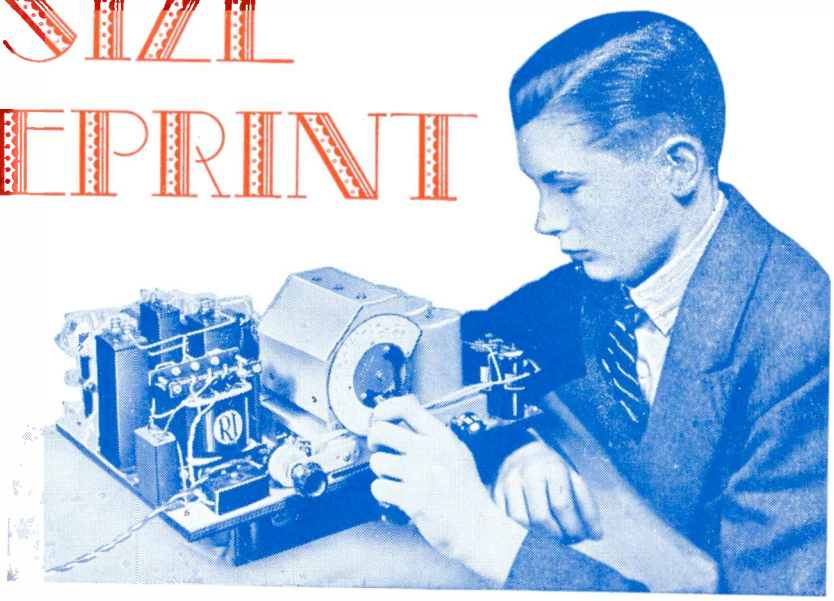

Each blueprint shows the position of each component and every wire and makes construction a simple matter. Copies of "Wireless Magazine" and of "Amateur Wireless" containing descriptions of most of these sets can be obtained at 1s. 3d. and 4d., respectively, post paid. Index letters "A.W." refer to "Amateur Wireless" sets and "W.M." to "Wireless Magazine" sets. Send, preferably, a postal order (stamps over sixpence unacceptable) to "Wireless Magazine," Blueprint Dept., 8-11 Southampton Street, London, W.C.2.

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Economy-pentode Three (SG, D, Pen)	*Oct. '33*	WM337
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65/- Four (SG, D, RC, Trans)	*17.12.32*	AW370
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Mains Operated

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Merrymaker Super, A.C. ...	*Dec. '33*	WM345
Heptode Super Three, A.C. ...	*May '34*	WM359
"W.M." Radiogram Super, A.C.	*July '34*	WM366
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