GERMANY AND TELEVISION

Wireless Magazine

OCTOBER

AND MODERN TELEVISION

Edited by PERCY W. HARRIS M.I.R.E.

GEORGE NEWNES LTD. LONDON

The Minitube Three—
A Midget-valve Receiver
for Constructors

Noel Bonavia-Hunt on
Multiple
Tone Control

Building a
Serviceman's
Oscillator

All-wave Reception
Problems

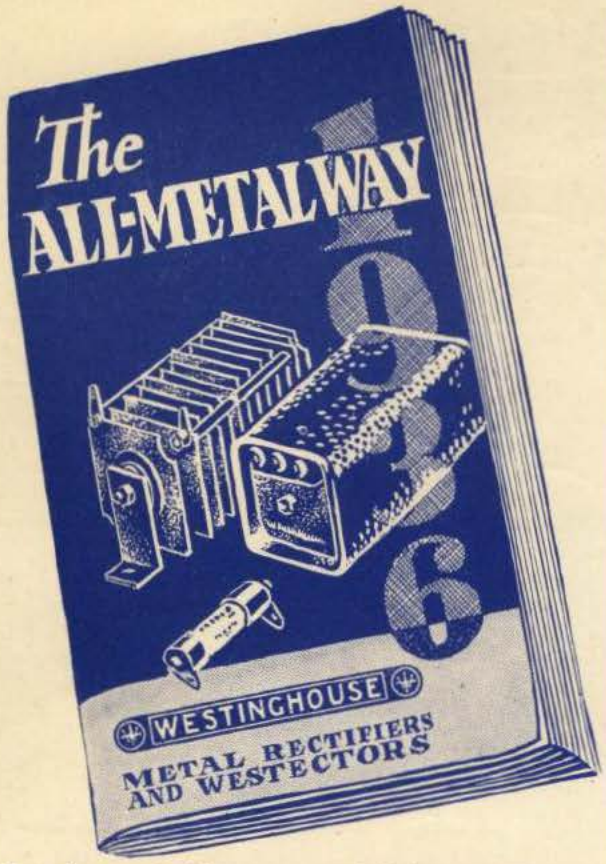
Calibrating Your
Short-waver

Features for Set Buyers
and Tests of Four
New Sets

1/-

BUILDING THE VARSITY FOUR

OUR NEW VARIABLE SELECTIVITY SUPERHET



There's one booklet you mustn't fail to get when you visit the Manchester Radio Exhibition—"The All-Metal Way, 1936." It's more than a catalogue of Westinghouse Metal Rectifiers and Westectors—it's a treatise on A.C. Mains Radio, distortionless detection and Automatic Volume Control. It contains chapters on trickle-charging both H.T. and L.T. accumulators, operation of moving-coil loud-speakers from the A.C. Mains, Universal Receivers, etc., etc. Get a copy from Stand 3, and while you're there, don't forget to ask for any technical information you may require.

Westinghouse Brake & Signal Co., Ltd.
82, York Road, King's Cross, London, N.1.

WESTINGHOUSE

METAL RECTIFIERS

STAND 3 **MANCHESTER RADIO EXHIBITION**

RADIOLYMPIA

again confirms

the popularity of

T.M.C.

BRITISH MADE

HYDRA

CONDENSERS

Radiolympia was right! The interest consistently focused on the T.M.C.-HYDRA Stand was ample confirmation of the popularity and merit of these outstanding condensers. Several important new types were released for the first time at Radiolympia, which now meet every possible need in Radio and Television.

Write for a copy of the NEW catalogue

SOLE DISTRIBUTORS:

T.M.C.-HARWELL (SALES) LTD

Britannia House, 233 Shaftesbury Avenue
London, W.C.2. (A few doors from New Oxford St.)

Telephone: Temple Bar 0055 (3 lines)

Made by TELEPHONE MANUFACTURING Co. Ltd

Wireless Magazine

AND MODERN TELEVISION

Technical Editor: G. P. KENDALL, B.Sc.

Vol. XXII : OCTOBER, 1935 : No. 129

Assistant Editor: T. F. HENN.

Edited by Percy W. Harris, M.I.R.E.

Contents

Subscription Rates: Inland and Abroad, 15s. 6d. per annum; Canada, 13s. 6d. per annum.

Editorial and Advertisement Offices—"Wireless Magazine," George Newnes, Ltd., Southampton Street, Strand, London, W.C.2. Registered at the G.P.O. for transmission by Canadian Magazine Post.

News from the Radio Societies

Conducted by G6QB

Under this heading we publish reports every month of the activities of short-wave and transmitting societies. We shall be pleased to give publicity to any announcements of forthcoming events, etc., and secretaries of short-wave societies, whether national or local, are asked to make the fullest use of this space

The Radio Society of Great Britain

THE R.S.G.B. held its tenth annual convention during the last three days of the Radio Exhibition. The stand at the "Show," serving as a rendezvous for members, and the convention as a final celebration, have now become almost traditional and this year's affairs showed no sign of diminishing enthusiasm.

New members seemed to be fairly pouring in at Olympia; the attendances at the meetings on Friday and Saturday, August 23 and 24, left nothing to be desired.

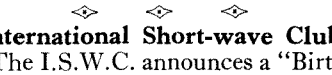
On the Friday evening the usual conversazione was held and the society films were shown. Several excellent films of National Field Day and some of the recent visit to Belgium and the Brussels Exhibition were particularly interesting.

On the Saturday the business meeting was held in the morning. The resolutions passed do not concern non-members and members will, of course, receive full details in "The Bulletin." After the taking of the Convention photograph at 1.50 p.m. (another tradition, by the way !) a lecture was given by Mr. G. Parr on the subject of cathode-ray developments. Demonstrations of the various uses of the cathode-ray tube were given, the lecturer clearing up several practical problems in a particularly lucid manner.

Over two hundred members attended the dinner on Saturday night. A very pleasing feature of this year's Convention was the large number of overseas amateurs who were able to attend. Well-known members from Australia, New Zealand, Ceylon, Hong Kong, and the U.S.A. were present, and most of them gave short talks about conditions in their various countries.

National Field Day, by the way, resulted in a win for the Home Counties (No. 9) district, with the Southern (No. 7) district as runners-up. It was decided at Convention that this popular event should still be run in a competitive manner in future years.

This year's Loyal Relay of birthday greetings to H.R.H. The Prince of Wales was another extremely successful effort, some twenty-four messages from all parts of the Empire being handled by British stations.

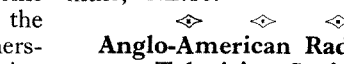


International Short-wave Club

The I.S.W.C. announces a "Birthday DX Contest" in October celebrating the sixth anniversary of the founding of the club. Several short-wave stations will broadcast special programmes, to which listeners will tune in at the appropriate times, reporting reception to headquarters.

Several valuable prizes are offered and, in addition, several really interesting transmissions are promised. These will, of course, be available equally for members and non-members. Non-members may participate in the contest.

Full details are obtainable from the London Secretary, Mr. A. E. Bear, 10 St. Mary's Place, Rotherhithe, S.E.16.



Anglo-American Radio and Television Society

The above society has recently held several successful events, including a visit to Brookman's Park station and to Broadcasting House. A second private dance and social has also been held and the society's own dance orchestra has broadcast from Radio Normandie.

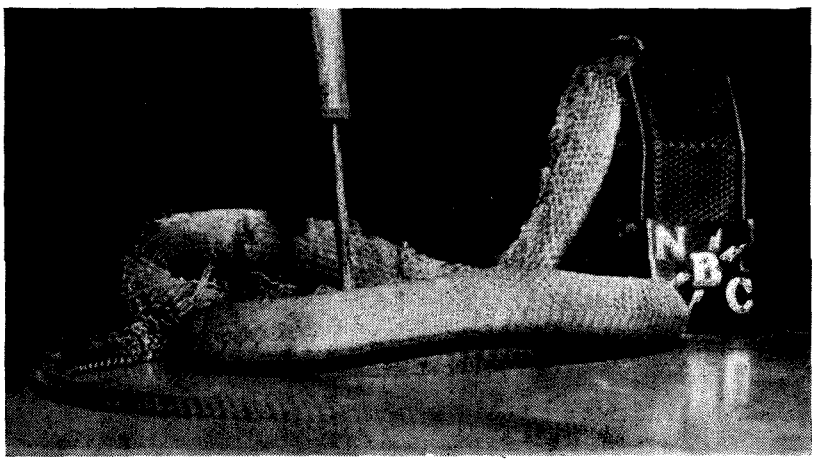
Particulars of proposed winter activities and full details of membership may be obtained from Mr. Leslie W. Orton, "Kingsthorpe," Willowbank, Uxbridge, Middx.

Tottenham Short-wave Club

Readers in North London interested in short-wave working are cordially invited to get in touch with Mr. L. Woodhouse, secretary of the Tottenham club, at 57 Pembury Road, Tottenham, N.17.

AN INVITATION

Secretaries of short-wave and transmitting societies are invited to make full use of this interesting feature in "W.M." Contributions and notices should be addressed to G6QB, c/o the Editor, "Wireless Magazine," George Newnes, Ltd., 8-11 Southampton Street, Strand, London, W.C.2



STRANGE SHORT-WAVE HAPPENINGS IN THE STATES !
The National Broadcasting Company of America is well known for its stunts. Some short while ago a small cobra was "interviewed" before the microphone to amuse listeners at home and abroad. The cobra seems to have taken quite a liking to the mike !

Wavelengths of the Principal European Broadcasters

Stations Best Received In the British Isles are Indicated in Bold Type

Wave-length	Name of Station	Dial Readings	Country
203.5	Plymouth		Great Britain
	Bournemouth		Great Britain
204.8	Pecs		Hungary
206	Eiffel Tower		France
208.6	Miskolcz		Hungary
209.9	Beziers		France
	Alexandria		Egypt
210.7	Radio LL		France
211.3	Tampere		Finland
215.4	Radio Lyons		France
216.8	Warsaw No. 2		Poland
218.2	Basle, Berne		Switzerland
221.1	**Turin (2)**		Italy
	Milan (2)		Italy
222.6	**Dublin**		Irish F. State
	Bordeaux S.O.		France
	Königsberg		Germany
224	Montpellier		France
	Lodz		Poland
	Hanover		Germany
	Bremen		Germany
225.6	Flensburg		Germany
	Stettin		Germany
	Magdeburg		Germany
230.2	Danzig		Germany
231.8	Linz (Klazenfurt)		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
	Kaiserslautern		Germany
253.2	Kharkov (2)		U.S.S.R.
255.1	**Copenhagen**		Denmark
257.1	**Monte Ceneri**		Switzerland
259.1	Kosice		Czechoslovakia
261.1	**London National**		Great Britain
	North National		Great Britain
	West National		Great Britain
263.2	**Turin (1)**		Italy
265.3	Horby		Sweden
267.4	**Newcastle**		Great Britain
	Nyiregyhaza		Hungary
269.5	Fecamp		France
270	**Moravska-Ostrava**		Czechoslovakia
271.7	Madona		Latvia
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	Heilsberg		Germany
	Parede		Portugal
293.5	Cracow		Poland
296.2	**Midland Regional**		Great Britain
298.8	**Bratislava**		Czechoslovakia
301.5	Hilversum		Holland
304.3	**Genoa**		Italy
307.1	**Belfast**		N. Ireland
309.9	Odessa		U.S.S.R.
312.8	**Poste Parisien, Paris**		France
315.8	**Breslau**		Germany
	Goteborg		Sweden
318.8	Algiers		North Africa

Wave-length	Name of Station	Dial Readings	Country
321.9	**Brussels (2)**		Belgium
325.4	Brno		Czechoslovakia
328.6	Radio Toulouse		France
331.9	**Hamburg**		Germany
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.
364.5	**Bucharest**		Roumania
368.6	**Milan**		Italy
373.1	**West Regional**		Great Britain
377.4	**Lvov**		Poland
	Barcelona (EAJ1)		Spain
382.2	**Leipzig**		Germany
386.6	**Toulouse PTT**		France
391.1	**Scottish 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	**Cologne**		Germany
463	**Lyons PTT**		France
470.2	**Prague (1)**		Czechoslovakia
476.9	Lisbon		Portugal
	Trondheim		Norway
483.9	**Brussels (1)**		Belgium
492	**Florence**		Italy
499.2	**Sundsvall**		Sweden
	Rabat		Morocco
506.8	**Vienna**		Austria
514.6	Grenoble		France
	Riga		Latvia
522.6	**Stuttgart**		Germany
531	**Athlone**		Irish F. State
539.6	**Beromünster**		Switzerland
549.5	**Budapest**		Hungary
559.7	Wilno		Poland
	Bolzano		Italy
569.3	Viipuri		Finland
	Ljubljana		Yugoslavia
578	Innsbruck		Austria
	Hamar		Norway
696	Oulu		Finland
748	Moscow		U.S.S.R.
	Geneva		Switzerland
765	Boden		Sweden
834	Budapest No. 2		Hungary
845	Finnmark		Norway
1,107	Moscow (2)		U.S.S.R.
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
1,389	**Motala**		Sweden
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
1,875	**Kootwijk**		Holland
	Huizen		Holland
	Brasov		Roumania
1,935	Kaunas		Lithuania

Complete List of Short-wave Broadcasters Next Month

Staying Power

A first-class footballer must keep his form, right to the final whistle. So should a first-class battery. Cheap batteries may start well—but they quickly deteriorate. Make sure of staying power. Buy Siemens Full O' Power: the battery that maintains quality and tone throughout an exceptionally long life.

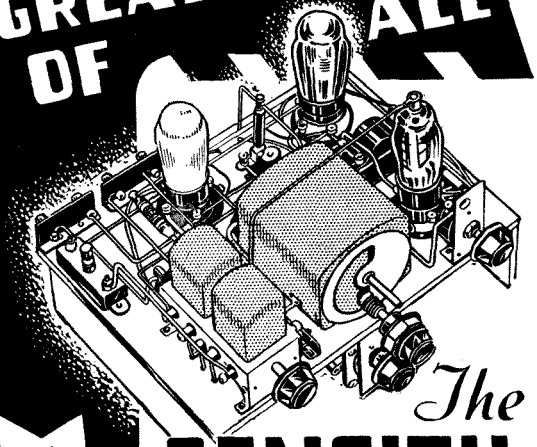
FREE BOOKLET WITH 1st LEAGUE FOOTBALL FIXTURES and full battery information. Ask your dealer or write to address below.

CADET TYPE			STANDARD RANGE—SUPER TYPE		
H.60	60 volts	3/9	H.1	60 volts	5/6
H.99	100 ,,	6/3	H.2	108 ,,	9/6
H.108	108 ,,	6/9	H.3	120 ,,	10/6
H.120	120 ,,	7/6	POWER TYPE—VERTICAL		
H.G.120	111 v.+9G.B.	8/9	V.4	60 volts	8/-
H.L.120	120 ,,	7/6	V.8	120 ,,	16/-

SPECIAL REPLACEMENT BATTERIES ARE AVAILABLE FOR EVERY TYPE OF SET

Advt of SIEMENS ELECTRIC LAMPS AND SUPPLIES LTD
38/39, Upper Thames Street, London, E.C.4.

BUILD THE GREATEST SET OF ALL



The

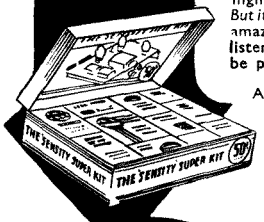
SENSITY SUPER

100% MATCHING
MONO CONTROL
SUPER SELECTIVITY

Screened Grid Pentode 3-valve Receiver

WITHIN REACH OF EVERY CONSTRUCTOR

Now, for only 1/3 per week, you can buy the complete Kit for building the SENSITY SUPER, the receiver that incorporates *every* refinement, including MONO-CONTROL. The Sensity Super actively competes with assembled sets of the highest grade—yet its price is within reach of all. *But it is performance that tells*—performance that has amazed the technicians, delighted thousands of listeners. The SENSITY SUPER is a set you will be proud to have built!



A turn of the wrist, the whole network of European stations is at your command with superb fidelity; another, and your gramophone records spring to life through your loudspeaker. You *know* the advantages of your own-built receiver, always dependable—always up-to-date. Send to-day for the illustrated folder which fully describes the King of all Constructor-Receivers THE SENSITY SUPER!

COMPONENT KIT
5/- DEPOSIT and 11 monthly payments of 5/- or 50/- cash
COMPLETE with Graham Farish RING MATCHED VALVES
7/1 DEPOSIT and 11 monthly payments of 7/1 or 75/- cash

If your usual Dealer cannot supply the Kit, send direct to the manufacturers: GRAHAM FARISH LTD., Masons Hill, BROMLEY, KENT.

GET THIS FOLDER!

To Graham Farish, Ltd., Masons Hill, Bromley, Kent.
Please send FREE Broadsheet describing and illustrating the SENSITY SUPER Component Kit.

NAME.....

ADDRESS.....

.....

Tick here if Deferred Terms Agreement is required. ☐

If you are concerned with nearly perfect reproduction here is a book you *must* have. It contains details of the finest amplifiers ever designed by Ferranti.

For instance, the Ferranti A.C. 6C. This amplifier has a curve which is almost horizontal from 25 to 10,000 cycles. If drawn on a decibel scale, the maximum deviation from perfection is less than a ½ d.b. over this range and less than 2 d.b. at 12,000 cycles. It is equally suitable for pick-up or microphone. For the A.C. 12C Amplifier the curve is within a ½ d.b. from 25 to 8,000 cycles, and within 3 d.b. to 10,000 cycles.

THESE CURVES INDICATE THE OVER-ALL PERFORMANCE AND INCLUDE THE OUTPUT TRANSFORMER.

The book also contains details of a Q.P.P. Amplifier for battery or eliminator operation; the A.C. 2.5C 2½ watt amplifier for A.C. Mains operation; and the A.C. 12C 12½ watt amplifier for Mains operation. The book is profusely illustrated with diagrams, charts and curves, besides containing much information and data and lists of parts for each amplifier.

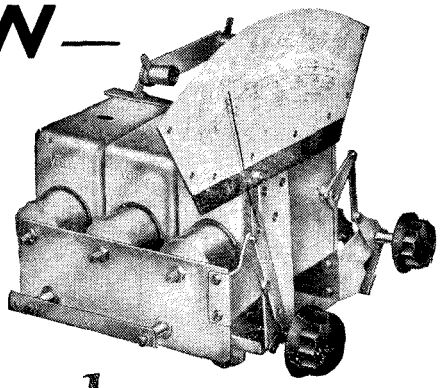
The booklet No. R105 will be sent post free on receip of 6d.

Other Ferranti booklets are: Valves, R103; Audio Transformers, R104; Mains Components, R102. These will be sent post free on receipt of 1½d. for one or 3d. for three to:

Dept W.M.
FERRANTI LTD., Radio Works, Moston, Manchester, 10

FERRANTI

NOW—



Superhet
Permeability Tuners
List No. BP105 71/6
List No. BP106 89/-

Superhet—
PERMEABILITY TUNING

This form of tuning which has been so successful ever since it was introduced has received an added interest by the introduction at Olympia of the superhet permeability tuner.

If you are not acquainted with the infinite possibilities of this form of tuning, a postcard to Woolwich will bring our illustrated leaflet on this subject.

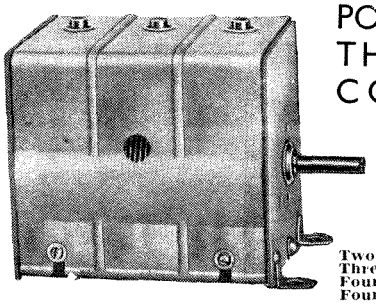
Varley

Oliver Pell Control Ltd.

Bloomfield Road, Woolwich, S.E.18

Telephone: Woolwich 2345

POLAR SPECIFIED *for the*
"VARSITY FOUR"



POLAR MIDGET THREE GANG CONDENSER

One-piece steel frame, aluminium vanes. Ball-bearing shaft. Sections matched within ½ per cent or 1 mmfd. whichever is the greater. Trimmers operated from top **16/6**

Also made in
Two Gang 11/-
Three-gang Superhet ... 16/6
Four Gang 22/-
Four-gang Superhet ... 22/-

. . . ALSO SPECIFIED POLAR V.P. HORIZONTAL DRIVE

Slow motion with vertical moving pointer. Scale calibrated in wavelengths. Moulded escutcheon Lamp holders ... **6/6**

Other Polar Drives include—
Semi-circular 5/9
Arcuate 5/9
Vertical C.K. 6/6

The **MINITUBE THREE** also specifies these

POLAR COMPONENTS

Two Polar 'Compax' condensers, .0005. (Also made in .0003, .00015, .0001 and .00005) ... 2/6

Two Polar Panel-mounting Disc Drives (with type "D" bracket) 5/6

One Polar "Differential" Condenser, .0003. (Also made in .00015, .0001) 3/-

WINGROVE & ROGERS LTD.

188-9 Strand, London, W.C.2.
'Phone: Temple Bar 2244.
Works: Old Swan, Liverpool.

CA 7445

Wireless Magazine
and Modern Television

The Editor's Page

October, 1935

It Pays to Know Your Set!

WITH the wireless exhibition over and the coming of the darker evenings, the best season of the year for the keen amateur begins. Modern sets are so efficient that many listeners are still unaware of the considerable seasonal variations in reception conditions, or even of the fact that reception after dark on distant stations is considerably better than in daylight. A few years ago when sets had a relatively low sensitivity these facts were self evident, but with the popularisation of the superhet even the daylight range of a reasonably priced set is now greater than was obtainable not very long ago with some much more costly receivers.

Set manufacturers, we think, would do well in all their booklets to make clear to purchasers the differences that exist between summer and winter, and day and night reception. Several cases have been brought to our notice where an intending purchaser, having narrowed down his range of choice to a couple of sets of equal price, has tested one in daylight and the other late in the evening with the result that he has come to the conclusion that the latter was by far the better performer. Actually there has been nothing to choose between them when they have been tested side by side at the same hour of the day.

Again, a number of receivers on the market are by no means selective enough for certain conditions. After dark, when the distant stations come in strongly, there may be so much interference between stations that relatively few have any programme value, whereas if the same receiver is tested in daylight none of this interference will be heard on the comparatively few stations then audible.

We have also known salesmen to demonstrate the so-called selectivity of a receiver in daylight by tuning in to the local station with the volume control turned well down and showing that the station is "completely gone" half a degree on either side of the tuning point. Such a demonstration proves nothing either way.

The point in all this is that it pays every listener to get acquainted with the general principles of reception, even though the modern commercially-built receiver is a marvellous performer, highly efficient, and so simple to handle that first-class results are at once obtainable even by people who have never previously handled a set.

We are all in favour of sets being made "foolproof" —none but the enthusiast enjoys the manipulation of a multitude of controls to get the best results—but it must not be imagined that *all* the skill has gone out of wireless listening and that a little knowledge of principles will not put the user into a much better position to get consistently good results with his receiver.

Even sharpness of tuning and freedom from interference in a set bring with them certain minor problems. For example, if a set is really highly selective the tuning is so sharp that a slight variation one side or the other of the best tuning point will bring about a sacrifice in quality, and with automatic volume control it is not too easy in some receivers to realise which *is* the best tuning point for one cannot necessarily judge it on intensity of sound. On the best point the quality is definitely superior.

So do not let us abuse the simplicity of handling which the radio manufacturer has given us in modern receivers. Handle your modern set carefully and the little extra care will well repay you!

The absence of any television exhibit from Radiolympia aroused a good deal of comment. The authorities apparently hold the view that until there is a service of high-definition television in being, and until suitable sets are available, it is premature to give demonstrations. We think this attitude is wrong. The public should have been given demonstrations of high-definition television in a separate section, so as to prepare them for the coming service, which will be well under way before the next Radio Exhibition.

Percy W. Harris.

A New Superhet With Variable Selectivity—see page 169

The Varsity Four

A New Superhet with Variable Selectivity

Designed Specially for "W.M." by PAUL D. TYERS

This is the completed Varsity Four, no doubt the finest battery-operated superhet yet offered to the home constructor

Here we take great pleasure in presenting details for building a four-valve battery-operated superheterodyne designed for "W.M." by Paul D. Tyers, who is known to many of you for his now famous series of home-constructor Stenode receivers. This Varsity Four, with its variable-selectivity I.F. transformers, is our response to readers' requests for a set giving high-quality reception of the local stations and, at the same time, maintaining knife-edge selectivity for general foreign-station listening

IN the last issue of the "Wireless Magazine" I discussed very briefly the essential feature of the variable-selectivity/variable-quality superhet. I pointed out that whereas in the past listeners had been content with good selectivity and reasonable quality, there was now a demand for improved quality from the local stations. This can be achieved by providing some means of varying the selectivity of a receiver.

For the benefit of those who are not too well acquainted with the interdependence of selectivity and quality it is well to consider how these two important factors are so intimately connected.

Modulation Effects

When a carrier-wave such as that of a broadcast transmitter is modulated, frequencies are produced equivalent to the sum of the carrier frequency and modulation frequency and the difference of the carrier and modulation frequencies. These new frequencies which are so produced are referred to as sidebands. An inductance and capacity connected in parallel produce what is known as an oscillatory circuit. At one particular frequency the circuit is said to be resonant.

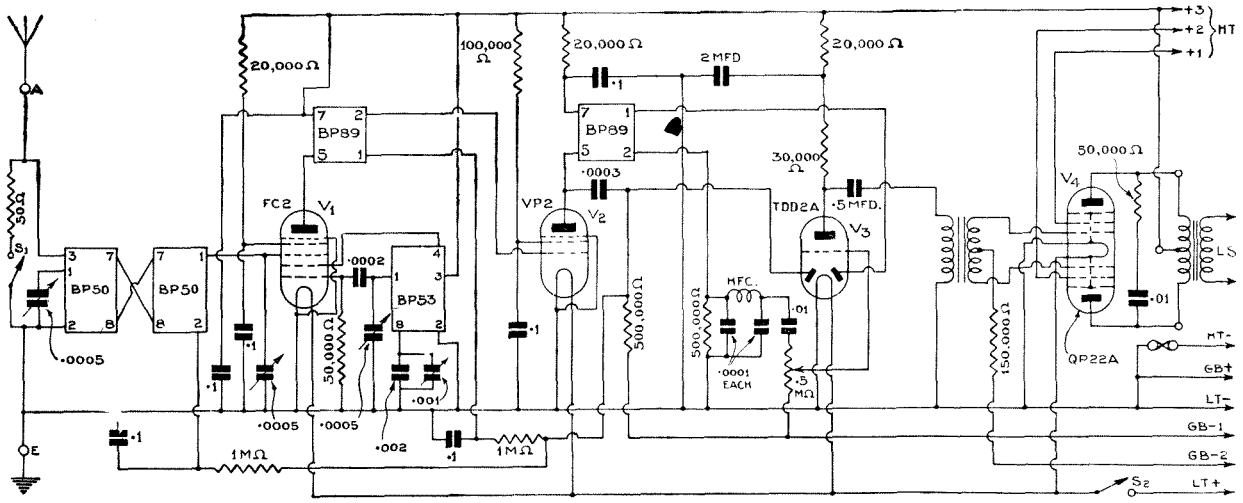
The process of tuning a receiver is to resonate a fixed inductance, that is the tuning coil, with a variable capacity in the form of a variable condenser. The values are so adjusted that the circuit resonates at the desired carrier-wave frequencies. A sharply resonant circuit is one showing the greatest impedance at the resonant frequency and a rapidly falling impedance to frequencies on either side of the resonant frequency. This condition is necessary for selective reception.

Square Tops

Actually a single circuit alone is useless, and in a modern superhet six circuits are generally employed—two circuits in the pre-selector position and four circuits in the two intermediate transformers.

By such a means it is possible to obtain selective reception because the combination of a number of resonant circuits gives a sharper overall resonant effect. Actually we do not set out to obtain a knife-edged peak, but we always endeavour to produce a band-pass effect not only in the pre-selector but in the intermediate circuits. It is our aim to obtain a reasonably flat top over the range of frequencies equivalent to the width of our desired audio-frequency transmission band, preceded and followed by an exceedingly steep front.

Our ideal condition would be one represented by a vertical rectangle in which the top covered our desired



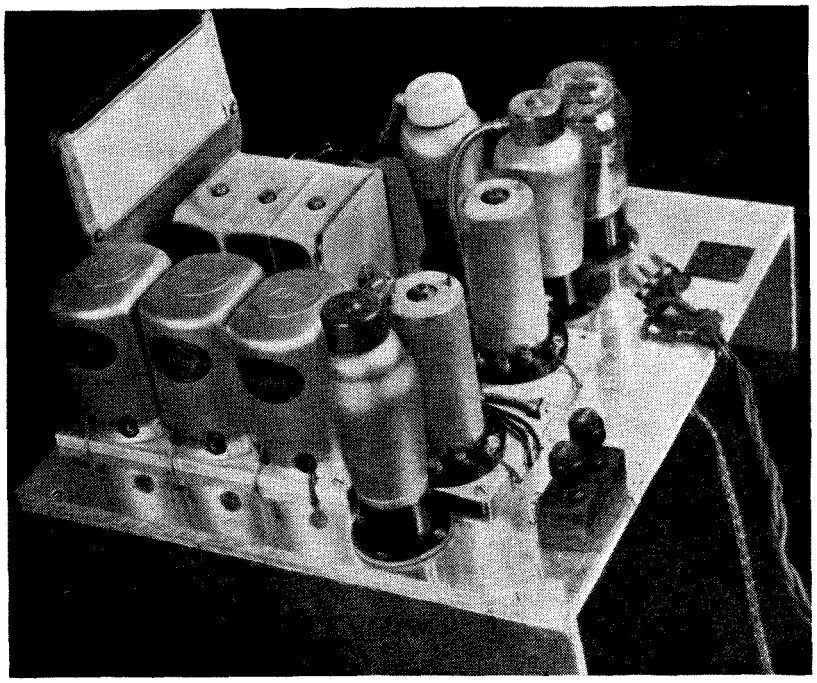
The theoretical circuit of the Varsity Four. It follows straight forward lines with two pre-selector circuits working into an octode frequency changer: then follows a high-frequency pentode as the intermediate-frequency amplifier and a double-diode-triode second detector feeding into a Q.P.P. output stage

modulation frequencies and the side then cut off to zero at right angles. This condition, however, is never obtained in practice. We invariably have quite an appreciable skirt and a top which may not be flat and is very frequently peaked and asymmetric.

Customary Limits

In order to obtain sufficient selectivity between adjacent stations owing to the large number of transmitters it is necessary to limit the width of our transmission band, and in the average superhet response above 5,000 cycles falls away extremely rapidly because we make our high-frequency circuits cut off as much as possible in this region in order to prevent overlap from the sidebands of the adjacent transmitting channel.

Now it is well known that much of the crispness and natural quality of speech and music is due to the presence of a large proportion of frequencies well above 5,000 cycles, and it follows therefore that if these are deliberately cut out of our recevier the approximation to natural reproduction must be somewhat poor.



This view of the Varsity Four emphasises the business-like nature of the design. The three coils seen on the left comprise the two band-pass and the oscillator coils, but note carefully that the oscillator coil is mounted in the centre

The obvious solution to the problem is therefore to provide a means of increasing the band width so that we tend to reproduce the higher audio frequencies with the same intensity as those in the vicinity of the carrier frequency.

It is easy to see that this can be achieved by two methods. In the first place we can use circuits which give a flat top band-pass response of variable width. Alternatively we can so flatten the resonance curve and make the slope of the skirt so slight and the overall width so great that we still reproduce our higher frequencies at about the same level as those of the carrier frequency.

Effect of De-modulation

If we do this, however, we are obviously likely to obtain far more interference because the width of our skirt will spread into many adjacent channels on each side.

There is one rather important point to which I would

Quality and Selectivity Under Complete Control:

draw particular attention as it is fundamental in the study of variable selectivity, and it is a point to which little reference appears to be made by those who have dealt with the subject.

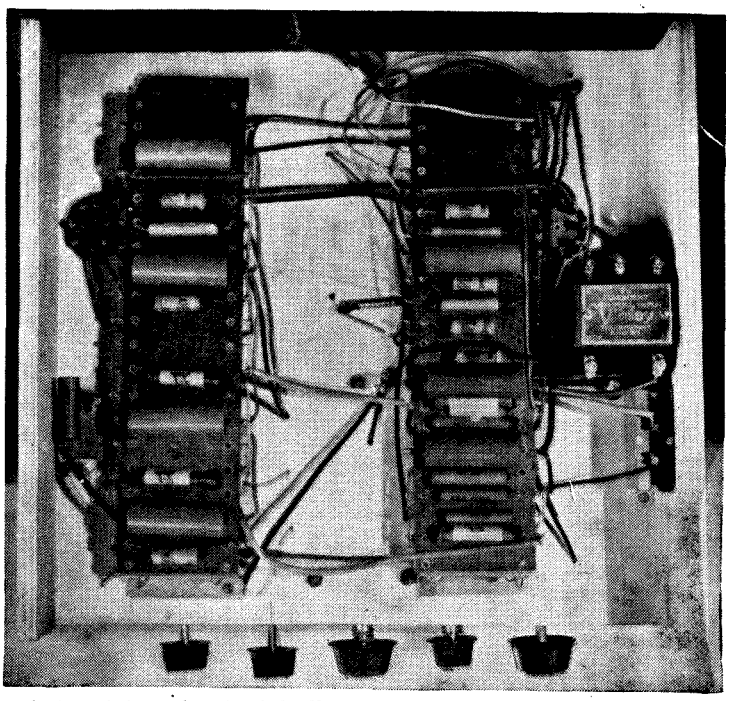
The reader may well ask how it is that we can obtain a wide frequency response from our local station without interference if we are experiencing overlap of sidebands from the adjacent channel. The lack of appreciable interference under these conditions is due to the de-modulation effect which occurs owing to the presence of a strong signal.

Advantages of Variable Selectivity

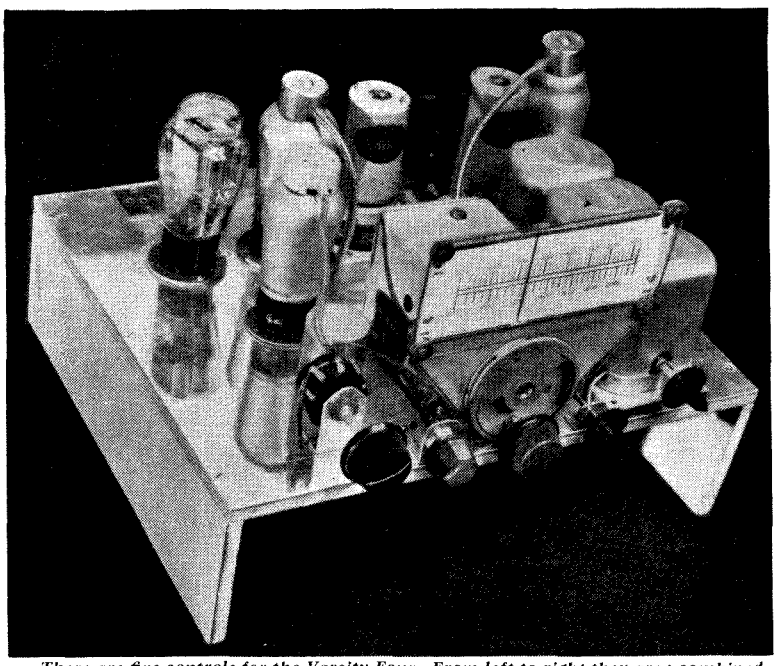
This means therefore that the full advantages of variable selectivity in so far as high-fidelity reproduction is concerned can only be achieved when the desired station has an intensity considerably greater than the sidebands of the adjacent channel. This is a point that readers should be particularly careful to bear in mind.

It is quite easy to see that if two stations of equal intensity are working on adjacent channels with normal carrier separation we cannot obtain high-fidelity reproduction of either without interference from the other. In actual practice, however, one invariably finds that there is a large number of stations of which the field strength is very much greater than that of the adjacent channel, and it is under these conditions that we can then take full advantage of the variable selectivity properties of the receiver.

From a practical point of view it is not very difficult to provide variable selectivity. Quite a number of schemes have been suggested, and that which appears to appeal to component manufacturers at the moment is the system of varying the coupling in the intermediate-frequency circuits. It is obviously impossible to vary the coupling of the input circuits because the frequency of these is constantly changing and to do so would be an extraordinarily difficult procedure.



A view of the underside of the Varsity Four. It is important to note that wires of sufficient length must be soldered to certain of the valve holders before the resistance and condenser strips are mounted over them



There are five controls for the Varsity Four. From left to right they are: combined on-off switch and volume control, local-distance switch, main tuner, variable selectivity control and wave-change switch. The tuning scale is calibrated in metres

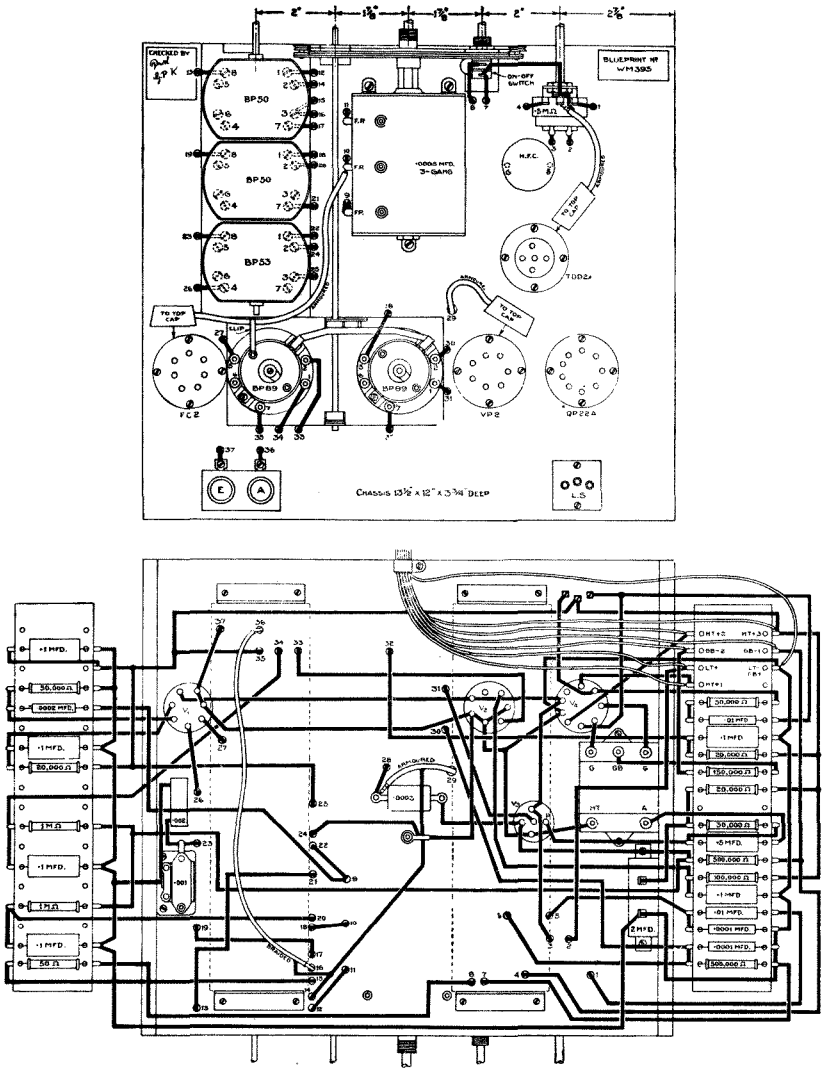
The coupling is therefore varied in the intermediate-frequency circuits, which are normally arranged to give a band-pass effect. Coupling devices of this type have now been produced, some for high intermediate frequencies and others for lower frequencies.

Possible Conversions

I have already pointed out that it is easier from an engineering point of view to produce a variable coupling for a high intermediate frequency. High intermediate frequencies, however, are not generally employed by the home constructor and the majority of constructors appear to have superhet gear intended for operation at about 110 kilocycles.

In order that readers may experiment with the new system I have designed a very straightforward superhet operating at 110 kilocycles, making use of entirely standard types of coils and condensers and associated circuits throughout.

Q.P.P. Output Stage for Full Loudspeaker Volume



If desired, a full-size blueprint can be obtained for half-price (that is, 9d., post paid), if the coupon to be found on the last page is sent, with remittance, before October 31. Address your application to the "Wireless Magazine" Blueprint Department, George Newnes, Ltd., 8-11 Southampton Street, Strand, London, W.C.2. Ask for No. WM395

Any constructor, therefore, who has an ordinary standard 110-kilocycle superhet need only remove the standard intermediate-frequency transformers and replace them by the special variably-coupled types to which I have already made reference.

To a designer there is nothing more fascinating than producing a complete receiver to function in a particular manner in which every single part is definitely designed to fulfil its specific purpose to the best advantage.

Excellent Results

To design a receiver, therefore, in which every part is a standard component produced by another designer is not too easy a task, but the set described in these pages gives a very satisfactory performance and does demonstrate the value of variable selectivity or variable quality, whichever one prefers to call it.

The set is built for battery operation. I may be criticised for suggesting the use of variable selectivity to give high-fidelity reproduction with battery valves when one naturally assumes the full advantage of high quality would only be manifest with a large high-fidelity audio-frequency amplifier and a super-power loudspeaker.

It is obvious that under such conditions it would be easy to derive the full benefits of the system, but the use of a reasonably good battery valve with a contemporary loudspeaker immediately shows the increased response at the higher frequencies. As the building of such a receiver is far less expensive and complicated, and as many constructors already have battery superhets, it is felt that the introduction of the system under these conditions is more than justified.

Easy Construction

The only difference between the design of a variable superhet and a fixed one lies in the intermediate stages and it is therefore quite easy for the constructor with mains apparatus to introduce the variable feature without any difficulty.

The construction of the actual battery superhet is a very easy matter, but it may be advisable to outline briefly the general arrangement and draw particular attention to any points calling for special care.

The circuit arrangement of the receiver is orthodox, and comprises two pre-selector circuits which work into a battery octode frequency-changer. This is a Mullard FC2. The pre-selector circuits and oscillator coil comprise three standard Varley coils tuned by a Polar three-gang superhet condenser.

Variably Coupled Intermediates

The intermediate-frequency amplifier is a variable high-frequency pentode, that fitted being a Mullard VP2.

The variably-coupled circuits are arranged, of course, in the standard position between the frequency-changer and the intermediate-frequency amplifier and between the intermediate-frequency amplifier and the second detector. Use is made here of a combined double-diode-triode, which feeds a Q.P.P. output valve. If desired, of course, any other type of output or further amplifying valve may be used.

As the gain of a battery set is invariably lower than that of a mains-driven model tremendous care in screening is not necessary.

WORKING VOLTAGES OF THE VALVES IN THE VARSITY FOUR

Valve	Voltage	
FC2	Oscillator anode	118
	Anode	120
	Screen	80
VP2	Anode	110
	Screen	75
TDD2 ...	Anode	80
QP22A ...	Anode	120
	See makers' slip for screen voltages.	

For simplicity the receiver has been built on a metal-covered wooden chassis. The screening, however, is important, and it will be noticed that all the leads to the valve caps are screened, while a screened high-frequency choke is also fitted. All the inter-valve and feed condensers and resistances are carried on two paxolin strips. In the assembly shown in the photographs the strips are actually mounted on brass angle brackets, but the constructor can mount these on ordinary wooden blocks if brackets are not available.

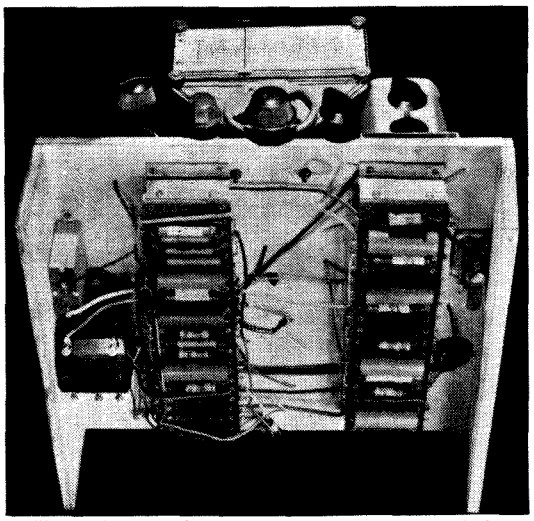
Beginning Construction

The construction and wiring of the set is extremely simple. First of all the components located on the top of the chassis should be bolted or screwed into position, great care being taken with the arrangement of the pre-selector and oscillator coils.

The tuning condenser is arranged so that the oscillator section is at the back. In order to prevent crossed leads and complication in wiring the three coils must be arranged so that looking from the front the oscillator coil is between the two pre-selector coils.

Attention is drawn to this point because it is believed that the manufacturers normally bolt the coils on the base in a different order.

The construction of the receiver is continued by wiring the condenser and resistance strips before they are connected to the chassis. It will be noted that the condenser which feeds the A.V.C. diode is mounted in mid air, and accordingly this must be soldered into position together with the other leads on the valve holder and those on the Mullard VP2 holder before the resistance strip is screwed to the underside of the chassis, as otherwise there will be difficulty in making the connections.



The designer makes use in the Varsity Four of the same system of resistance and condenser mounting found so successful in the Stenode receivers. The condensers are mounted first of all on the strips before the latter are placed in position on the underside

Adjustments

Actually it is found convenient to solder the leads to all the valve holders and then connect these to the appropriate positions on the resistance strips when the latter have been screwed to the chassis.

Little need be said with regard to the remainder of the wiring and construction, which should be practically self-evident.

The receiver is adjusted on exactly the same lines as an ordinary superhet. For correct ganging use should undoubtedly be made of a modulated oscillator, but provided the trimmers on the variable couplers and the three-gang condenser are not interfered with simultaneously it should be possible to adjust the set without the use of instruments.

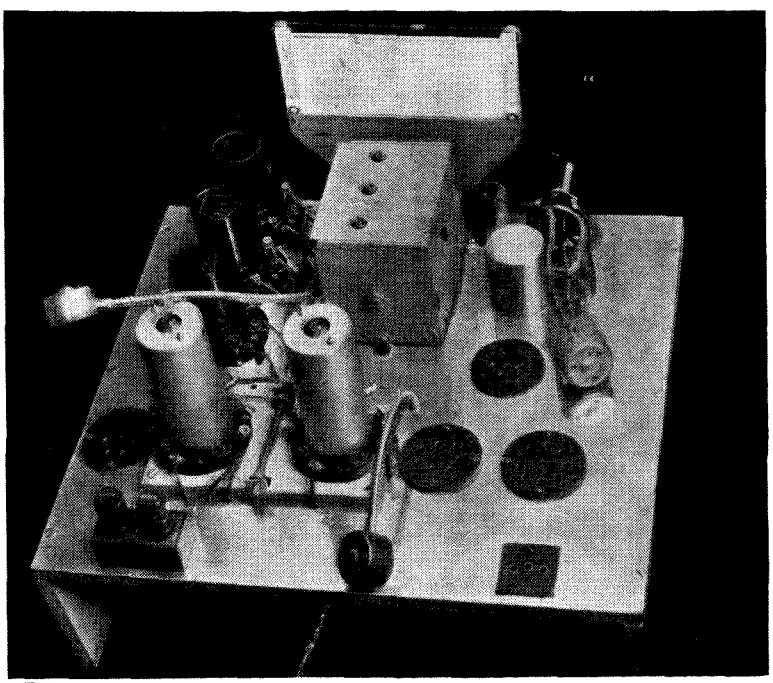
Before connecting the batteries the usual precautionary test should be made to make quite sure that everything is properly wired. Assuming that this is the case the variable coupling should be adjusted to about half way and the set should be tuned in to the local station. It will be noted that use is made of a local-distance switch with a view to bringing down the gain when listening to powerful local stations.

This switch is particularly necessary owing to the fact that the design of the variable couplers is such that the gain tends to vary with adjustment and unless a local-distance switch is fitted the magnification may be so great that distortion results.

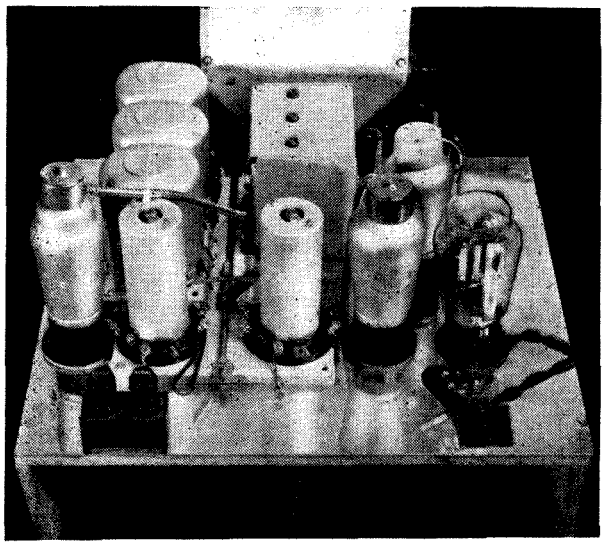
First of all the dial should be adjusted in conjunction with the oscillator trimmer until the local station tunes in to the correct setting. The strength should then be brought to a maximum by slight adjustment of the trimmers on the two variable intermediate-frequency transformers.

Be Careful Here

The trimmers fitted are of the concentric type, one condenser being adjusted by a screw-driver slot and the other by a nut. The adjustment is rather critical and care must be taken not to turn the controls too far. The set should then be tuned to a weaker station and the strength brought to a maximum by



This photograph taken minus valves and coil covers emphasises the simplicity of the layout on the upper side of the metal-covered wood chassis. Note the three-way socket on the front at the right for the loudspeaker connections



Here is a back view of the completed Varsity Four—an up-to-the-minute design presented with every confidence. Readers are particularly invited to send their reports and opinions on the performance of this receiver to the Editor

adjusting the trimmers on the aerial and band-pass sections of the condenser.

Dial Correction

The setting should then be checked at a point near each end of the tuning scale. It may be found necessary to make some slight compromise on the setting of the two trimmers resulting in a slight inaccuracy on the setting of the dial. It should be observed, however, that the dial is so constructed that the scale may be moved slightly in each direction. This can be achieved by adjusting the four small screws which hold the scale in position on the frame. Quite an easy job!

Having adjusted the set on the medium wave, the long-wave section should next be trimmed. The only adjustment here is that of the padding condenser, and this should be varied slightly until the stations tune in at the correct setting on the scale.

Adjusting the Coupling

In normal use the setting of the variable coupling in the region of the mid-position will be found to give the correct band-pass effect and the correct gain to the receiver. Extra gain coupled with a wider frequency response and a greater tendency for interference owing to the reduced selectivity can then be obtained by increasing the coupling. If the coupling is increased through small limits the frequency response will widen without any appreciable increase in gain, and this is the correct setting of the device.

In exceptional cases the gain can be increased considerably by using very tight coupling Under such conditions, however, a very assymetric resonance form is obtained and the quality is liable to suffer, and the set should certainly not be operated under these conditions unless it is desired to obtain a programme from some very weak transmission.

Local-distance Switch

When listening to the local or powerful stations with the set adjusted for the widest frequency response it will generally be found necessary to make use of the local-distance switch, which connects a low resistance between the aerial and earth.

Finally, some reference must be made to the low-frequency side of the receiver. Any good moving-coil loudspeaker may be used, but it is very important that it should be capable of being correctly matched to the output of the Mullard QP22A valve.

COMPONENTS—OUR POLICY

COMPONENTS used in receiver designs published in "Wireless Magazine" are chosen for their suitability, efficiency and reliability. Their selection must not be taken to indicate any more than this, nor that other good-quality components are not equally suitable, save in a few cases clearly indicated where there are no suitable alternatives.

In a large number of cases there exist numerous good alternatives, as a study of the advertisement pages of this journal will show.

COMPONENTS YOU WILL NEED FOR BUILDING THE VARSITY FOUR

CHASSIS

1—Peto Scott chassis to specification, Plymax covered 8 6

COILS

1—Varley Nicore Flat Gang unit BP62 with 2 BP50 coils and 1 BP53 coil 1 13 0

1—Variband I.F. unit with 2 BP89 coils 15 0

CONDENSERS, FIXED

2—T.C.C. .0001-microfarad tubular 2 0

1—T.C.C. .0002-microfarad tubular 1 0

1—T.C.C. .0003-microfarad flat mica type M 8

1—T.C.C. .002-microfarad tubular 1 0

2—T.C.C. .01-microfarad tubular 2 0

6—T.M.C./Hydra .1-microfarad tubular 7 6

1—T.M.C./Hydra .5-microfarad tubular 2 0

1—T.M.C./Hydra 2-microfarad ... 3 3

CONDENSERS, VARIABLE

1—Cyldon .001-microfarad mica type 2 0

1—Polar midget 3-gang with dial 16 6

CHOKE, HIGH FREQUENCY

1—Belling & Lee screened ... 6 6

RESISTANCES, FIXED

2—Erie ½-megohm, 1-watt type... 2 0

2—Erie 1-megohm. 1-watt type ... 2 0

1—Amplion 50-ohm
3—Amplion 20,000-ohm
1—Amplion 30,000-ohm
2—Amplion 50,000-ohm
1—Amplion 100,000-ohm
1—Amplion 150,000-ohm
} 1-watt type 9 0

RESISTANCE, VARIABLE

1—Centralab ½-megohm volume control with switch 4 6

SUNDRIES

2—Belling & Lee low-loss screened leads with top cap 3 0

1—Bulgin screened lead and top cap 6

1—Pair Belling & Lee mounting strips (stenode type) 4 9

1—Belling & Lee 3-pin plug and socket, No. 1119 ... ... 1 3

1—Belling & Lee aerial and earth terminals, baseboard mounting 1 0

1—Belling & Lee 9-way battery cord with wander fuse ... 5 0

SWITCH

1—Bulgin Rotary on-off, type S91 1 9

TRANSFORMER, LOW FREQUENCY

1—Varley Q.P.P. input, type DP36, ratio 1 to 9 ... ... 15 0

VALVE HOLDERS

1—Clix 9-pin, chassis-mounting ... 1 0

2—Clix 7-pin, chassis-mounting ... 1 6

1—Clix 5-pin, chassis-mounting ... 6

ACCESSORIES

LOUDSPEAKER

1—W.B. Stentorian 1936 senior model 2 2 0

VALVES

1—Mullard QP22A 1 2 6

1—Mullard TDD2 ... ... 9 0

1—Mullard VP2 ... ... 13 6

1—Mullard FC2 ... ... 18 6

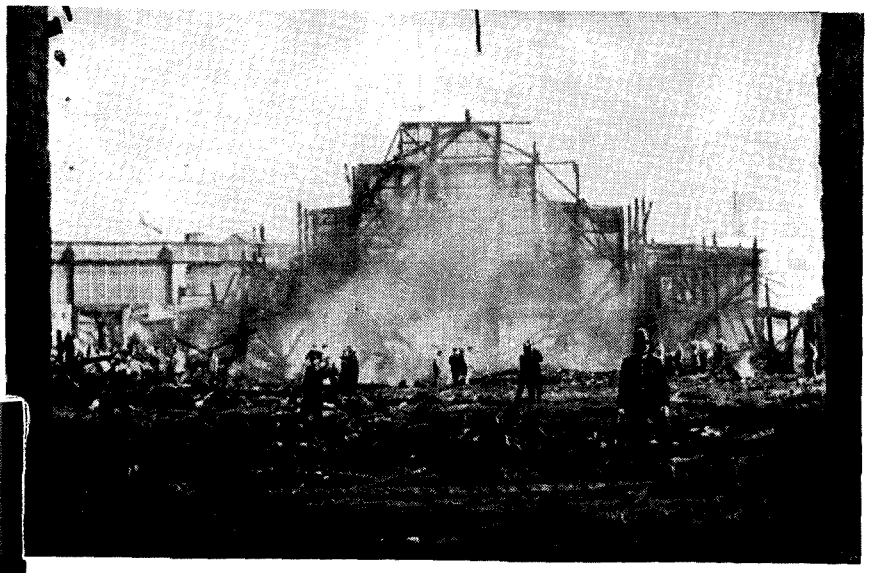
BATTERIES

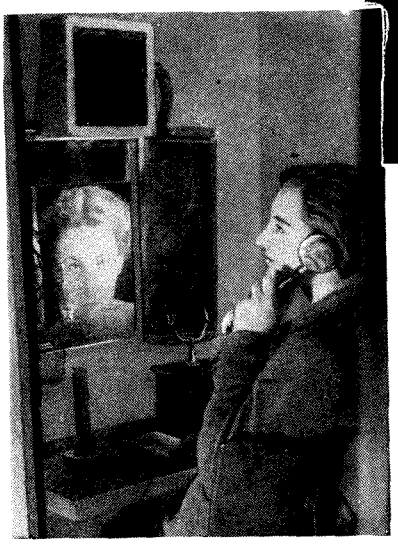
1—Full O' Power 120-volt ... 16 0

1—Full O' Power 9-volt grid-bias unit 1 3

1—Exide 2-volt accumulator, type 2RGN7 ... ... 10 6

By
A. A. GULLILAND
Our Special
German
Correspondent





The photo at the top of this page was taken by our correspondent the morning after the fire which destroyed one of the halls at the Exhibition and burnt out the restaurant in the Radio Tower, 150 feet above ground. (Above) The latest in television. Two-way point to point television was demonstrated at the show. This illustration shows one of the 'phone boxes

A Visit to the Berlin Radio Show

Berlin recently held its great annual radio show—an exhibition where listeners are really shown all that is new in radio and television. Unlike Radiolympia, the German show is notable for its many demonstrations —television for the home use and on large screens, individual demonstrations of radio receivers, manufacturing processes revealed, and so on. This special article gives an insight into the great interest taken by the German people in their radio and television

DR. GOEBBELS, Minister of Propaganda, opened the twelfth German Radio Exhibition on Friday, August 16. On the fourth day after the opening, on Monday, August 19, fire broke out in one of the larger halls : Hall 4. This hall had been specially erected in 1924 for the second radio exhibition in Berlin. The hall was built of wood and fire completely destroyed it in a few hours' time.

The courageous action of the Berlin fire brigades prevented the fire from spreading to the adjoining halls, and soon put out the flames in the Radio Tower restaurant—150 feet above the ground—which had caught fire owing to the heat.

Next morning the exhibition was able to continue as usual and within 24 hours of the outbreak of the fire the fourteen exhibitors affected had provided tastefully decorated new stands in one of the exhibition restaurants. The television exhibits which had been removed from Hall 3 as a precautionary measure were replaced and operating within an equally short time.

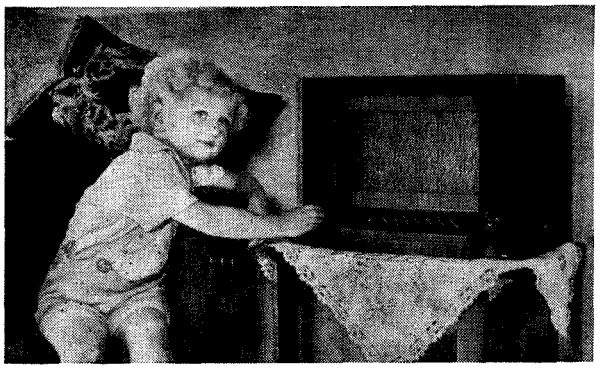
Three transmitters (the old Witzleben 1.5-kilowatt station, which was occasionally used as a standby, and the two 16-kilowatt ultra-short-wave television transmitters) which were permanently housed in Hall 4 were completely destroyed.

The Post Office, together with the engineers of the Telefunken company, rigged up a small 20-watt auxiliary television transmitter so that television demonstrations at the exhibition could continue. But Berlin itself is without a television service as a result of the fire. The Post Office placed orders almost immediately with the Telefunken company for the supply of new high-power ultra-short-wave stations and these, it is understood, will be ready shortly.

Receiver design at the Berlin Show revealed a number of interesting developments. The appearance on the market of universal valves encouraged the production of any-mains sets, and the new 2-volt battery valves have caused a number of set constructors to turn to the design of new battery models and even to portables, a type of set hitherto unpopular in Germany.

The new valves have been fitted with a pinless socket type of low-loss base valuable for use in all-wave receivers. Some of these new valve socket holders are made of the new ceramic materials which still further reduce losses.

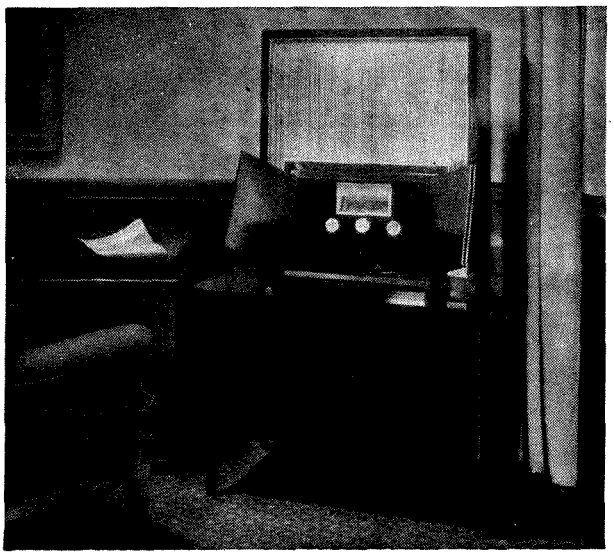
Cabinet design has greatly improved. Most of the manufacturers have placed the loudspeaker to one side of the chassis instead of above,



A typical modern German set—an A.E.G. three-valve "straight" set costing 235 marks

and this produces a receiver with a pleasing oblong shape. Others have fitted the tuning scale in a slanting position above the loudspeaker so enabling the owner to place it on a low table and to tune without having to get down on to his knees or otherwise strain the muscles of his neck.

Modern German receivers can be roughly subdivided into four categories: The straight receivers with the one-circuit two-valve combination (this usually employs a diode which is not counted as a valve in Germany—we would style these sets three-valvers) and the two-circuit four-valver (German designation three-valver).



Germany's latest high-fidelity radiogram for local reception. Made by Siemens, the set employs two matched loudspeakers—fitted behind the screen at the top—operated by a four-valve "straight" circuit with a powerful push-pull output stage

The second category is the small superhet. Most German manufacturers have now abandoned the reflex circuit which had become quite popular last year in this class.

German All-wavers

The third category is the all-wave four-, five-, or six-valve superhet with full A.V.C., tone control, etc. The higher-priced sets in this class have two loudspeakers and some of them variable selectivity. High-fidelity radiograms are a new departure for the German manufacturers. Siemens has a very fine model selling at 1,000 marks. The best ever!

The fourth category ought to have come first, but it is a class apart; the cheapest German set, the famous "People's Set" sold at reduced profits to manufacturer and trader alike and of which close on two million have already been made. Another million will be manufactured by the German radio industry this season.

This receiver sells at 76 marks. It is a 2-valve mains-operated loudspeaker set. The A.C./D.C. type employs 55-*volt valves specially* made for it. The German firms have arranged by convention that the next price-class must not be below double the price of the "People's Set" so as to ensure a large turnover. It is largely due to this cheap and quite good-quality "People's Receiver" that the number of German listeners has increased so rapidly in the past two years.

Tuning scales have now lost their sensationalism and are becoming more and more practical. The provision of a two-gear tuning knob, first seen last year, has now been copied by some others. This is a great boon when tuning short-wave stations.

There was one exception in the line of tuning scales. One firm made use of an ordinary automatic telephone dial in the front of its sets and had so arranged tuning that it was only necessary to dial a two-place number to get a station which had previously been looked up in a novel "telephone book." This set operates without variable condensers.

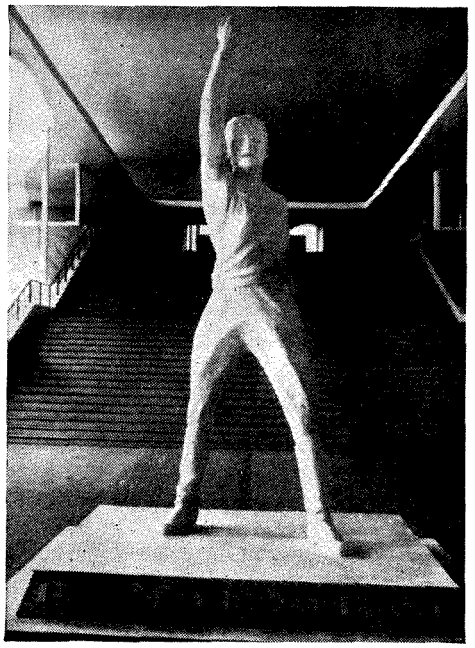
Another new idea concerned current consumption: A one-circuit straight receiver was shown provided with a switch for turning down the volume to a very low level. At the same time, mains current consumption is reduced from 55 watts to 30 watts without impairing quality.

Low Current Consumption

This idea is very commendable, as full volume on a set is seldom required. The fact that a modern three-valver consumes 55 watts may come as a surprise to some, but I would not like to add up the current consumption of some of our modern eight- or nine-valvers!

Components for constructors were less to the fore than parts for manufacturers. A short-wave enthusiast, an ardent home constructor, who went round the show was disappointed to find that components were, in his eyes, still heavy and clumsy.

The increasing use of the new ceramic insulating materials has produced some with quite remarkable new



This statue, the symbol of German radio, greeted visitors on their arrival at the Berlin Radio Show

properties. One firm specialising in them is now able to manufacture a hard insulating material with a negative temperature coefficient.

German manufacturers have made a bid for the overseas market this year by producing a number of special short-wave sets, most of which give reception on the medium and long waveband as well. These receivers usually cover wavebands from 12 or 13 metres up to 100 or 140 metres as well as the usual medium and long waves.

The modern German battery portable. This Korting model is a four-valver with moving-coil reproducer and costs 315 marks complete

Multi-valve Short-wavers

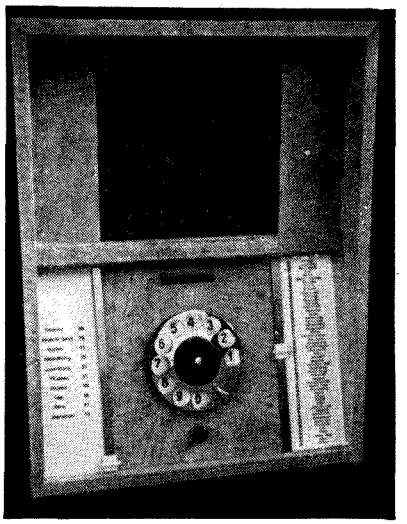
They are A.C.-mains operated as a whole, but one or two are supplied for batteries operation. These all-wavers employ between eight and eleven valves and are sold for export at definitely competitive prices in spite of the high exchange rate of the German mark.

Television at the German Radio Exhibition again showed considerable progress from last year. Whereas in 1934 the very first tentative models were merely to show what a commercial sight-and-sound high-definition television receiver might look like, this year six firms were showing sets for receiving the Berlin television service.

Twenty of these new commercial sets of various makes were placed by the broadcasting company on both sides of a centre aisle in the television hall. This "Television Street" enabled visitors actually to compare the performance of six different makes of television receivers *all operating under exactly the same conditions.*

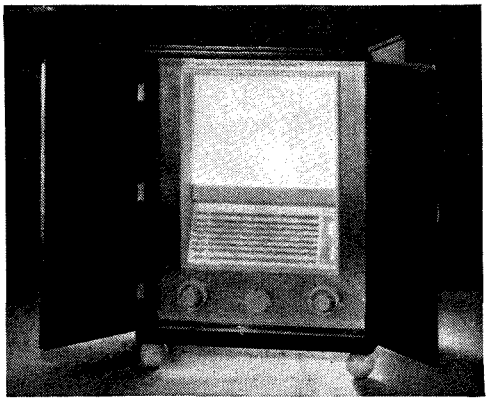
The system used is of 180-line definition with 25 frames per second. The size of the cathode-ray tube screen is 19 by 22 cm. and smaller. Two of the twenty sets were using the mirror screw—the only mechanical means of receiving a television picture that has survived the increase in definition.

The clear-cut black and white picture made a very pleasing impression on the looker, but unfortunately the size of the apparatus was prohibitive (125 by 95 by 80 cm.) and the picture has to be viewed in almost total darkness.



A novel tuner shown at the Berlin Show. The stations are listed on each side of the dial together with a number. When the number is dialed, the set automatically tunes itself to the required station

A visit to the various firms and official stands in the television hall showed the rapid development of German television technique towards higher definition and a non-flicker picture. The Fernseh A.G. was demonstrating a mechanically-scanned 320-line picture on a cathode-ray tube with a 24- by 30-cm. screen. A glance at one of the 180-line pictures showed that for larger scenes 320 lines will be essential —and to think that only a few years ago we were speaking very pleasingly in terms of 30 and 60 lines !



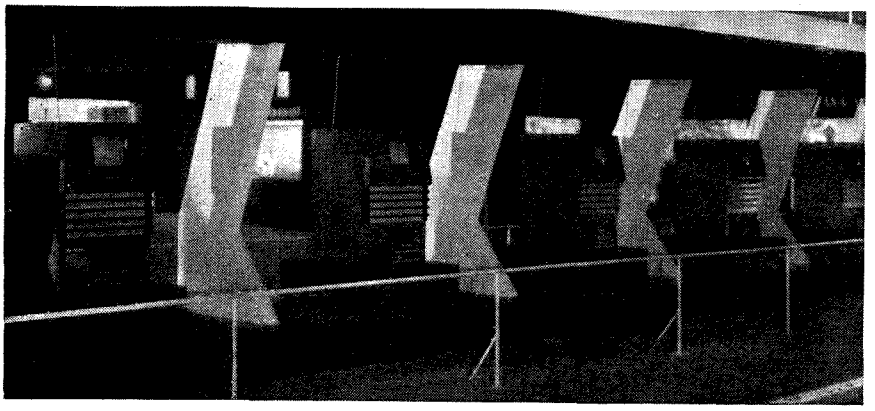
German sets are noted for their clean lines. This example is the new Siemens four-valve superhet, which sells at 386 marks for A.C. and 418 marks for A.C./D.C. operation

Unusual Screen

On the other side of the hall Telefunken were showing another type of large screen receiver. The screen itself was composed of 10,000 ordinary pocket lamp bulbs connected in banks of 100 each.

The Post Office had erected television telephone boxes which were connected by cable.

180-line and 25-frame-per-second point-to-point two-way television was being demonstrated here. It is generally understood that the Post Office intend opening a television telephone service between Berlin and Leipzig early next year when a special new cable has been laid.



Part of Television Street, showing five receivers made by the Telefunken concern. Note the short vertical aerials projecting from the back of each receiver

While Harry Roy and his band are away holiday-making, Maurice Winnick deputises for him at the Mayfair Hotel. Here is Maurice Winnick's band with his three charming vocalists

The B.B.C. Is Going

By T. F. HENN

WHILST many of us have been holiday-making those poor souls responsible for entertaining seven million licence holders and their families have had their noses to the grindstone working out new schemes—schemes to make the coming "listening season" the best ever.

I dropped in at Broadcasting House in the middle of the recent heat-wave weather. Poor chaps, I felt really sorry for them. Very few think of the enormous preparation that has to be made for even the simplest of programmes, let alone preparing big plans to try to please teeming millions for a few months on end.

The result of the programme arrangers' work lies on my desk neatly condensed into a dozen typewritten pages. Even I, rather hardened by reading "Huge Autumn Schemes" for many years now, feel that broadcasting is likely to assume a new face. The schemes show very clearly that more than ordinary hard work has been put into them.

It is not my intention to make this article a catalogue of forthcoming events, but I do hope you will excuse the amount of "news" I have to cram into this small space.

Light entertainment is probably of the greatest interest. Eric Maschwitz, Variety Director, is out to beat all records. He has decreed that *Music Hall* shall be broadcast once a month only. Don't get alarmed! They will be "all-star" and last ninety minutes. Each show will offer the cream of music-hall talent available at the time.

In case you have been led to think that there is a chance of a dancing chorus boom following the glowing newspaper accounts of the Radiolympia girls, let me put your mind at rest by telling you officially that there will be no regular dancers. Incidentally there will be fewer studio audiences. Audiences are to be the exception, not the rule!

Following the great success of the Jubilee Galas, a monthly "gala" of first-class performers from the music halls, theatres, and concert halls with two bands is to be given. No audience to ensure quick-fire presentation.

Once a month Bryan Mitchie is to produce an all-musical non-stop variety show and there will be more frequent broadcasts of ordinary variety programmes. You remember that a new form of radio variety known as Stanelli's *Stag Parties* was introduced recently; these are to be continued and others are being asked to hold similar functions. Jack Payne is holding one or two.

In Town Tonight has gone; in its place we are to have a feature programme on Saturdays lasting forty-five minutes called the *Saturday Magazine*. This will include several serial features, and something on the lines of *In Town Tonight* will be included.

Walford Hyden, of Café Collette fame, is giving a series of entirely new shows, but not Café Collette.

"Soft lights and Sweet Music" is returning to the mike this autumn. The fine guitar playing heard in these shows is the contribution of Albert Harris

The Café's place will be taken by *Villa San Marino*—an Italian equivalent, the link between the music being supplied by English tourists in an Italian seaside café.

And there are dozens more in this long list: John Watt is giving a series of eight programmes which he has called *Meet Mickey Mouse*, the material and music being supplied by Walt Disney; another

Gay This Autumn!

series of *Soft Lights and Sweet Music* will start as soon as Austin Croom-Johnson returns from the States.

One very important change is the decree that dance-music programmes are to be shorter. No one band will be allowed to play for ninety minutes as they do now. A change I should have liked to see—it is not mentioned—is a new style of dance band. I must admit that I for one am very weary of good dance music played by Britain's leading bands. I want more soothing music, dance music of the type played by German bands.

The B.B.C. could do it very well by getting either the Theatre or the Variety orchestra to play sessions of popular dance tunes with some good old waltzes thrown in. I am heartily tired of these continual hot quick raucous noises intermingled with the bleatings of a crooner, blessed with the title of "the best English dance music." Mr. Maschwitz has only to listen to Berlin and Stuttgart one evening between 11.0 and midnight and I am sure he would fall for the idea.

This reminds me of musical plays, a feature of which I personally am very fond. This autumn we are to hear adaptations of the *Cat and the Fiddle*, *Veronique*—a great pre-war success in which "Swing High, Swing Low" is the principal song, and a revival of Eric Maschwitz's own radio-version of *A Waltz Dream*.

Other very important productions are the first English performance of Emmerich Kalman's most famous operetta, *Countess Maritza*, in which Gitta Alpar is likely to play the name-part, and *Death in the Dressing Room*, a musical murder-mystery which has been written for the B.B.C. by two well-known Hollywood scenarists.

After a month of Prom concerts I have to gather courage to mention serious music plans. My grumble is not with the Proms themselves, but with the lack of suitable alternatives. I can't forget the one evening, late in August, when the B.B.C. gave us that long operatic relay from abroad as a Prom alternative. A terrible mistake. I wonder how many of the 7,000,000 switched off early that night.

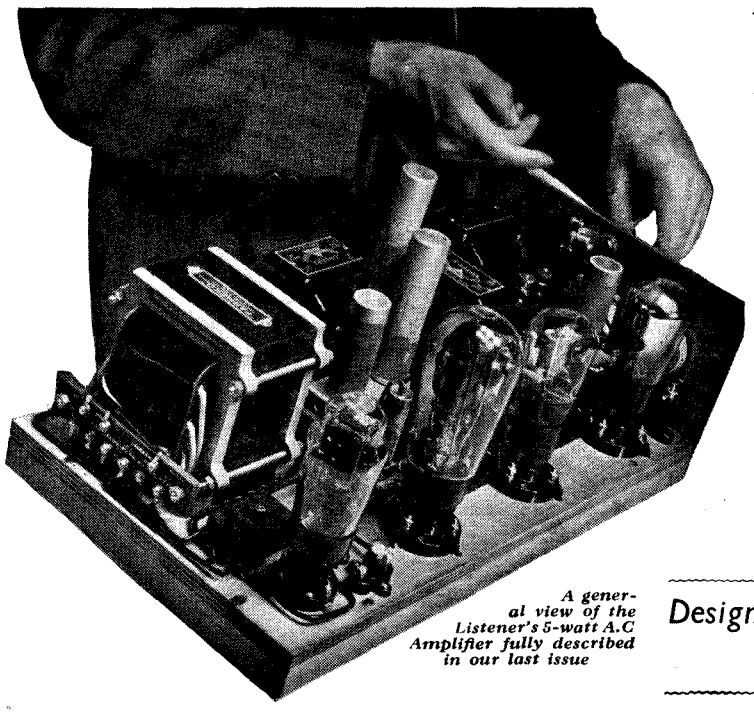
Anyway, just a brief reference. Main interest will naturally centre round the autumn season of Queen's Hall Symphony Concerts, for which an imposing array of international artists and guest conductors is being engaged. In addition there are to be four big symphony concerts in the four Regional centres; Dr. Boult is to conduct these concerts. The main Queen's Hall season opens on October 23.

By the way, promsters will be pleased to know that the B.B.C. is planning a further two-weeks' season of Promenade Concerts from the Queen's Hall from Monday, December 30, 1935, to Saturday, January 11, 1936, inclusive. This will be the third winter season to be given by the B.B.C. Symphony Orchestra under Sir Henry J. Wood.

Sports enthusiasts are to be well catered for in forthcoming outside broadcasts. We have had running commentaries on the T.T. races; now the B.B.C. is turning its attention to Brooklands. Brooklands racing track has never yet figured in the broadcast programmes, and it is hoped that motor racing enthusiasts will have their first experience of a broadcast from this famous course on October 19. This will take the form of a description of the mountain race at 3.30 p.m., an open international event.

Idol of thousands of music lovers all over the world, Sir Henry Wood, who is going strong with his forty-first season of Prom concerts!

Walford Hyden, known to all for his Cafe Collette shows, is now happily recovering from his recent serious illness. Our illustration shows him at his home with Mrs. Hyden and Bruno listening to the new G.E.C. "Fidelity" superhet



A general view of the Listener's 5-watt A.C Amplifier fully described in our last issue

Radio Unit for the Listener's Amplifier

Designed by L. O. SPARKS and T. F. HENN

JUDGING by the great interest shown at Olympia concerning the Listener's 5-watt Amplifier, it is apparent that the design is meeting with general approval.

After analysing all the reports and criticisms—which, incidently, we are always pleased to receive—we find ourselves in the happy position of having very little to say regarding the original specification, apart from a few words about the anode resistance forming part of the coupling between the second stage and the output valve.

It will be remembered that we stressed the fact that that resistance has to carry about 25 milliamps but through a slip in the figures specified a 5-watt rating. It is, of course, obvious that the required rating is slightly in excess of this. A resistance that will operate in comfort under the above conditions has been produced by the Erie Resistor Co., who will supply it with all orders stating that it is for use in the Listener's Amplifier.

Now for a few words about the promised radio unit, which we were hoping to describe in this issue but, for very sound reasons, we have decided to hold over until next month. To those who have completed the amplifier and are ready to start on the radio section, we offer our apologies for keeping them waiting, but we feel sure that they will agree with our policy of not letting anything appear in these pages until we are sure that the job is worthy of our readers' confidence. (That Exhibition took much of our time!)

We can tell you that the circuit is a " straight " one, and that not more than two valves will be employed It will be capable of giving a satisfactory degree of selectivity combined with an effective range which we feel will more than meet the requirements of those interested in quality reproduction.

New readers should note that blueprints of the amplifier (No. WM392) can be obtained for 1s. 6d., post paid, from the publishers.

LIST OF COMPONENTS NEEDED FOR THE LISTENER'S 5-WATT A.C. AMPLIFIER

CHOKES, LOW FREQUENCY

	£ s. d.
1—Varley type DP11	15 0
1—Varley standard, type DP10 ...	15 0
1—Varley constant-inductance, type DP12	17 6

CONDENSERS, FIXED

	£ s. d.
1—T.C.C. .01-microfarad, type 34 ...	3 0
1—T.C.C. .05-microfarad, type 25A...	5 6
1—T.C.C. .1-microfarad, type 25A ...	8 0
2—T.C.C. 2-microfarad, type 80 ...	8 0
2—T.C.C. 4-microfarad, type 502 electrolytic	8 0
2—T.C.C. 8-microfarad, type 802 electrolytic	12 0
1—T.C.C. 10-microfarad, type 50C electrolytic	2 6
2—T.C.C. 50-microfarad, type 12C electrolytic	5 0

FUSES

	£ s. d.
1—Bulgin double fuse holder and fuses, type F19	2 6
2—Bulgin single fuse holders and fuse bulbs, type 5, bulbs to be Bulgin type C	2 0

LOUDSPEAKER

	£ s. d.
1—Epoch A.C. energised moving-coil loudspeaker, type 667 ...	7 2 6

MAINS TRANSFORMER

	£ s. d.
1—Parmeko with the following specification :— 425-0-425 volts, 150 milliamperes 4-volts, 2-amperes, 4-volts, 2.5-amperes, 4-volts, 5 amperes, standard A.C. inputs ...	3 5 0

RESISTANCES, FIXED

	£ s. d.
1—Erie .25-megohm, 1-watt type ...	1 0
1—Erie .5-megohm, 1-watt type ...	1 0
1—Erie 350-ohm, 1-watt type ...	1 0
1—Erie 550-ohm, 2-watt type ...	2 0
1—Erie 1,000-ohm, 1-watt type ...	1 0
2—Erie 5,000-ohm, 1-watt type ...	2 0
1—Erie 10,000-ohm, 1-watt type ...	1 0
1—Erie 10,000-ohm, 8-watt type ...	3 0

RESISTANCES, VARIABLE

	£ s. d.
1—Erie .25-megohm potentiometer, without switch	3 6
1—Erie 15,000-ohm potentiometer, without switch	3 6

SWITCH

	£ s. d.
1—Bulgin double-pole on-off toggle switch, type S104	2 0

SUNDRIES

	£ s. d.
2—Bulgin single-circuit jacks, type J3	2 6
2—Bulgin jack plugs, type P16 ...	3 0
1—Bulgin signal indicator, type D34	1 3
Connecting Wire, 20 gauge Insulated sleeving	
Wood for chassis as per specification on blueprint	
Brackets for mounting condensers (home-made or Peto Scott) one double and one double cut in half.	

VALVE HOLDERS

	£ s. d.
2—W.B. five-pin baseboard mounting	1 4
2—W.B. four-pin baseboard mounting	1 0

VALVES

	£ s. d.
1—Osram MHL4	13 6
1—Osram ML4	14 0
1—Osram PX25	1 5 0
1—Osram MU14 rectifier ...	1 0 0

Television Notes and News

Popper photo

An experimental transmission in progress in a German television studio. An image of the singer is being formed by the electron camera manipulated by the operator in the natty white coat. From the camera cables run to the actual transmitter

Television—Why This Waste of Time?

Asks Paul Woodward

MUCH regret is being expressed, at the time of writing, on the subject of the imminent stoppage of the low-definition service : for the life of me I cannot see anything to regret if only the authorities would take the matter to its logical conclusion and simultaneously start up an interim high-definition service from the Crystal Palace.

Even if it were definitely an experimental service, and not necessarily scanned in accordance with the final decision for the official transmission, it would be some help; we could get on with circuit design and get some valuable experience. At present there are occasional transmissions from the Baird station, but the times are not publicly known and the power appears to be low, while one never knows what is really being done and hence may waste time trying to sort out something which doesn't really make a picture at all.

That is not much help, but it is surely better than wasting time working on a 30-line signal unrelated to the high-definition transmission of the future: there is really scarcely anything to be learned from the low-definition service nowadays, doomed as it was to give but the crudest kind of image from the very start.

To me it seems that its cessation can only be regarded as setting free valuable transmitting time for the legitimate purpose of medium-wave broadcasting—sound transmission.

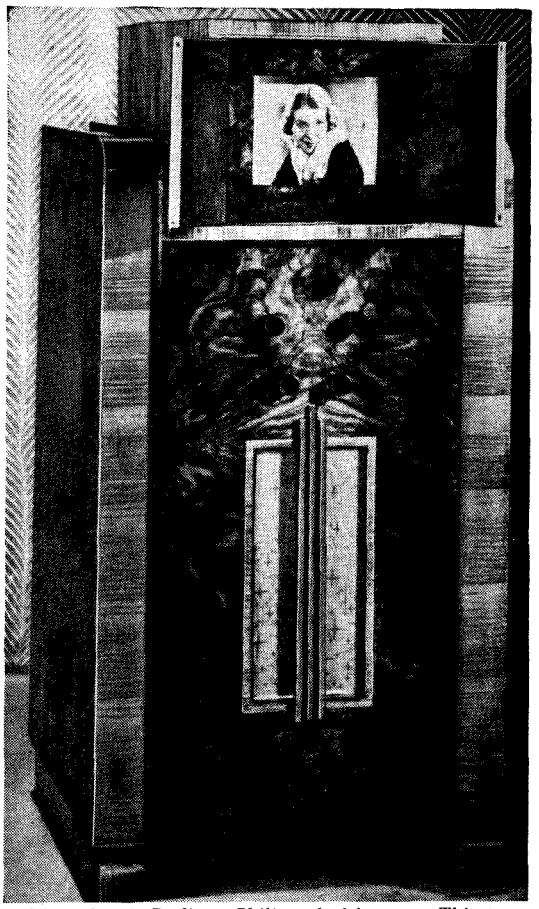
It seems fair to add, too, that the authorities may have been influenced by the fear that innocent members of the public may in the interval go on buying low-definition apparatus under the impression that it can be converted "quite easily" for the new service when it starts.

The only real ground for regret appears to me to be found in the fact that some thousands of keen amateurs are left with 30-line apparatus for which there is no transmission, and no immediate prospect of anything else to which they can turn their energies.

One of the Lorenz-Von Ardenne television receivers shown at the German radio exhibition. The sound channel employs a three-stage reaction circuit while vision is handled by a four-stage superhet arrangement. The picture size is roughly 8½ in. by 7½ in., and a cathode tube is used

Mention of that once-vexed question of converting low-definition mechanical scanners reminds me to draw your attention to a very significant fact about the German wireless exhibition. No doubt it will have been noticed that out of twenty television receivers shown, only two employed mechanical scanning : remember that this is for dealing with a service of only 180 lines, too. It certainly suggests that the expected difficulties of dealing mechanically with a large number of lines had not been exaggerated, doesn't it ?

More noteworthy still, to my mind, are the observations of those who have witnessed the results obtained with the two mechanical receivers in question : in most cases they comment on the clean black and white tone of the picture, implying that there is considerable colouration in the German cathode-ray pictures, but this is perhaps to be expected since one gathers that the pleasant sepia and almost black and white effects of the Baird tubes have not yet been achieved on the Continent.



Also on show in Berlin : a Philips television set. This, too, is of the twin-channel type and employs a cathode-ray tube for viewing

What struck me more forcibly was the comment of more than one witness on the poor illumination of the mechanically-scanned picture.

It appears to demand a thoroughly darkened room for satisfactory viewing, in notable contrast to the cathode-tube picture with which it is only necessary to screen off any direct light from windows or lamps. It would seem that the great claim for the mechanical system, namely, brilliance of image, was based on a misconception of what happens when scanning is speeded up and to leave the method with nothing but its clear black and white colouring to recommend it.

A Good Suggestion

A very interesting point was raised in the course of a conversation I had recently with a large radio manufacturer who is impatiently waiting to go into production with a series of television receivers to sell at prices *much* below those usually estimated : he referred to the common policy in certain sections of the industry of telling the public that television is a long way off yet; will be only experimental when it does start; and will be very expensive. He suggested that there was a much better way of dealing with the admittedly quite erroneous idea that television would be here any minute and would make all ordinary radio sets obsolete.

His idea was that a better method of allaying the quite natural but unnecessary public uneasiness was to push the use of a convertor unit for the sound part of the television transmission. In this way the ordinary broadcast receiver would serve for the reception of the sound channel, and all that would be necessary in addition would be a comparatively inexpensive vision receiver.

It seems quite a practical scheme, although there are certain minor technical difficulties, and it will be interesting to see whether it is taken up by others.

To me it seems that even this amount of reassurance should be unnecessary, since the whole matter is so obviously one which a very little clear thinking would straighten out. I have met several non-technical wireless users who were considerably perturbed at the idea of their new and cherished radio sets "becoming obsolete as soon as television begins," but instead of assuring them that it wouldn't begin for a long time yet, would cost a fortune when it did, and so forth, I just asked them a series of innocent-seeming questions :

" Do you want to go on listening to ordinary musical programmes ? "

" Why, of course ! "

" Would you like to watch the performers by television the whole time ? "

" Good Heavens, no ! That's the great advantage of radio—you don't have to look at them ! "

" Would you like to watch Professor So-and-So reading his talk in front of the microphone ? "

" Certainly not. It's bad enough to *know* that he is reading it—if one saw him as well it would destroy one's last trace of illusion of spontaneity."

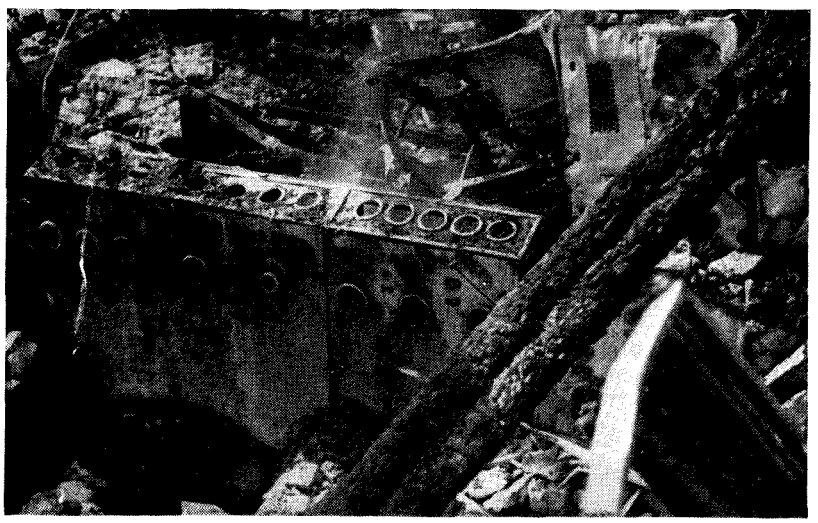
" What part of the normal B.B.C. programme *would* you like to see as well as hear ? "

" Mighty little, when you put it like that—probably just a few of the turns in a vaudeville programme."

" Evidently you don't really need television for the B.B.C. type of transmission, then, but I suppose you would like to go on listening to programmes of that sort ? "

" Well, I do my share of grumbling, but I really get a deal of pleasure from the B.B.C. stuff and I certainly do want to go on listening."

At about this point it strikes him that he has just explained precisely why he will always require a good broadcast receiver.



One of the consequences of the German radio show fire may be to provide an improved television service: the old transmitters were completely destroyed and are being replaced by more highly developed types in a few months' time

Getting Real Enjoyment From Short-wave Listening

Notes on Current Conditions and Interesting Stations to be Heard

By G. HOWARD BARRY

THE past month has been quite good for short-wave reception, although this part of the year is generally associated with a falling-off of signal-strength and interest alike. Outdoor occupations naturally interfere with one's inclination to get on the air, and a few days of slackness and absence from the controls invariably leave their mark !

I do not for a moment suggest that this is a bad thing. On the contrary, I generally become so unfamiliar with my own receiver round about the time of holidays and Radiolympia that it seems incredibly bad when I return to it, and the result is usually that I build a new one.

This year, however, I have made a point of listening for a short time every day—either during the hours of daylight or between 10 and 11 p.m. —and have been able to keep a more or less reliable watch upon the variations in conditions.

America Is Strong

At the time of writing, conditions appear somewhat similar to what they were in May and June. All Americans (particularly the amateurs) are extremely good; the Far East comes through in the afternoons; Sydney, of course, is always there on Sundays; and the remaining continents may be heard in the evenings.

A log from a Glasgow reader indicates that W8XK, W1XK, W2XAF, W3XAU, PRAF, and YV3RC are the best DX stations. I should put W2XAD at the top of the list from my own experience, but apparently this reader did not listen at the times when he would have heard it.

A Canterbury reader has forwarded a log of amateur stations heard on a receiver using a separate reactor valve; his log includes forty or fifty different American " phones. " Cuba and Panama are also represented.

My own listening time has been spent mostly in endeavouring to log new stations. I have avoided the old familiar carrier-waves like the plague, and stuck like glue to any stations heard on dial-settings against which no ticks were to be found on my calibration chart. The result has been a considerable increase in the number of the said ticks !

Taking the 49-metre band, for instance, one can find a tremendous number of weak stations in among the better-known Americans. Most of them are South Americans, although a surprise "bag" one evening was Singapore (ZH1) on 49.92 metres which, apart from atmospherics, was coming over very well.

Panama City (HP5B) on 49.75 metres is well worth listening for, although he does not start up until 1 a.m. Plenty of readers, however, seem to send in comprehensive logs for the period between midnight and 3 a.m., and do not seem to mind burning the midnight watts !

Another station for these people to look for is Port-au-Prince, Haiti (HH2S) on 49.41 metres—just below OXY's setting.

The two South Africans, Johannesburg and Nairobi, are both heard irregularly during the earlier part of the evening. Nairobi is the stronger of the two, but even he requires a bit of finding sometimes. An acquaintance remarked to me a few days ago that a receiver without a super-smooth reaction control would be quite useless for at least half the stations that I succeed in identifying. Certainly one would not be able to resolve Nairobi's carrier-wave nowadays if one had a "ploppy" control.

Stations for the daylight listeners to look for include several interesting newcomers. ZFB at Hamilton, Bermuda, has been heard more than once on 29.83 metres. If you measure your success in terms of the number of different countries heard, this is one that you should not miss.

On the nearby wave of 28.98 metres, the regular broadcast from Buenos Aires is very easily received, daily from 11.15 p.m. onwards.

Star Turn

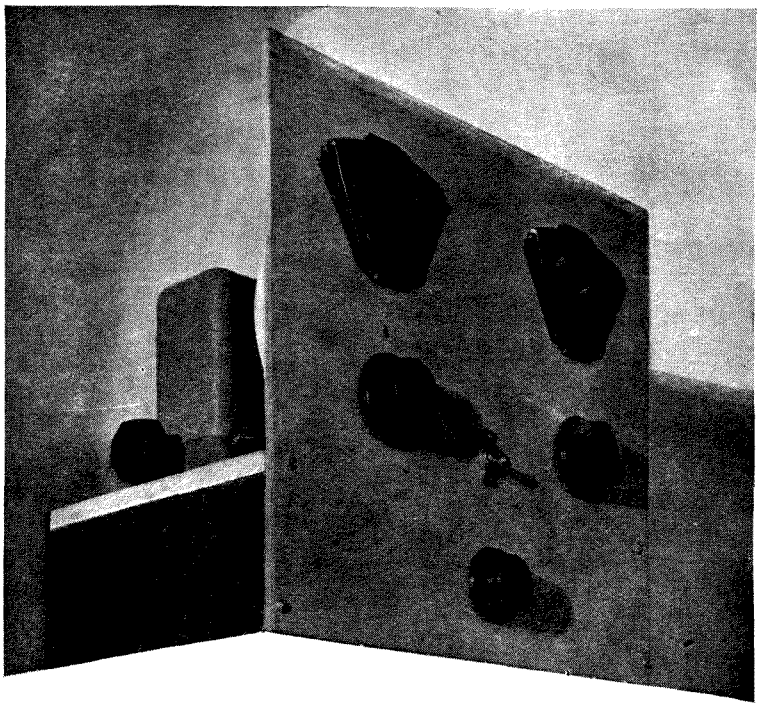
The 19-metre band continues to be the happy hunting-ground of the man who still thrills to the sound of America on the loudspeaker (and who doesn't, even in 1935?). The words " terrific " and " colossal " fail to describe W2XAD's performances on many evenings of late. W2XE, just above him in wavelength, has also come up considerably, but does not seem to put out a regular transmission.

Just above the top limit of the band is a station in Santo Domingo, Dominican Republic, which has been heard broadcasting music, and just below the band is WAE, Brentwood, N.Y., who has been experimenting in the evenings.

Those Wobbulators !

It is useless to spend all one's time within the confines of the international bands, as half the interesting things one hears appear to take place on " bootleg " wavelengths. They are hard to identify, and the chances are that one never hears them again, but it all adds to the fun of the thing.

The 40-metre band, as usual, is sadly marred by horrible imitations of telephony from certain European countries whose amateurs do not appear to have heard of crystal control or any other means of frequency stabilisation. When we try to listen in a band 300 kilocycles wide and find at least six transmissions occupying 50 kilocycles each, the best thing to do is to transfer to 20 metres.



The Minitube Three

Designed by
G. P. KENDALL, B.Sc.

The new midget valves enable some very interesting and useful things to be done in the design of compact receivers without all the usual troubles of cramped layout and inefficient crowding of parts. The Minitube Three presented on these pages combines the virtues of small size and electrical efficiency in a high degree

I ALWAYS think the first thing one wants to know about a receiver is the idea in the designer's mind : why did he produce it, and what particular need was he trying to meet? If one knows these things it becomes so much easier to decide whether the particular design will suit one's own purposes.

Advantages

I like to make a point with my own sets, therefore, of explaining these points clearly at the start. The basic idea of the Minitube Three is, quite simply, compactness to meet the requirements of those constructors who find that the average sort of set takes up too much room about the house.

I have got a suspicion of late that the usual design for home construction tends to be rather bulky and that this may be a drawback to many who might build their own if something a little smaller could be provided.

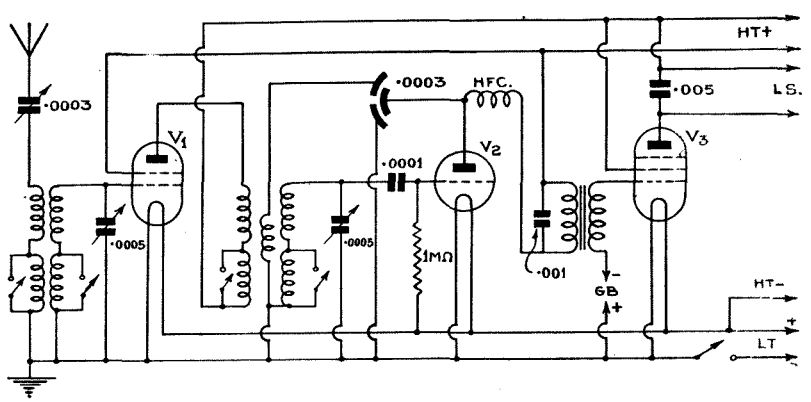
Normally it is very difficult to produce a design comparable in compactness with its commercial equivalent without making it extremely difficult to build ; the arrival of the new midget valves, and the special small components designed for use with them, has radically changed the situation and some quite interesting things have become possible.

Opinions differ as to the proper application of these tiny valves. The obvious thing to do with them is to design something ultra-compact in the way of portables, and I have seen some quite extraordinary feats of compression thus achieved. In view of the limited appeal of the true portable, however, I decided that my own first venture in miniaturism should take a more generally useful form.

Moderate Compression

Accordingly I have designed the little instrument you see in the photographs. It employs a comparatively straightforward circuit—I don't believe in trying to put electrical "inventions" into every design one does—and is laid out on lines of only moderate compression.

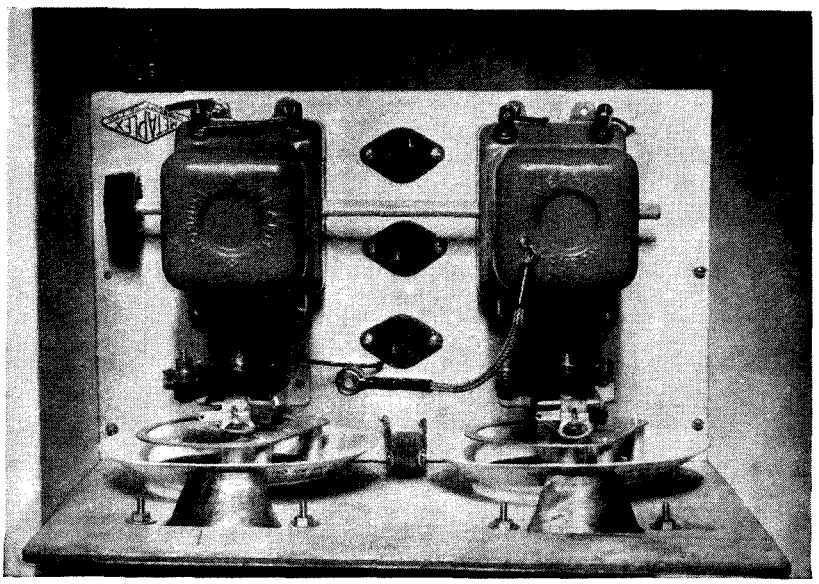
I should explain that quite early



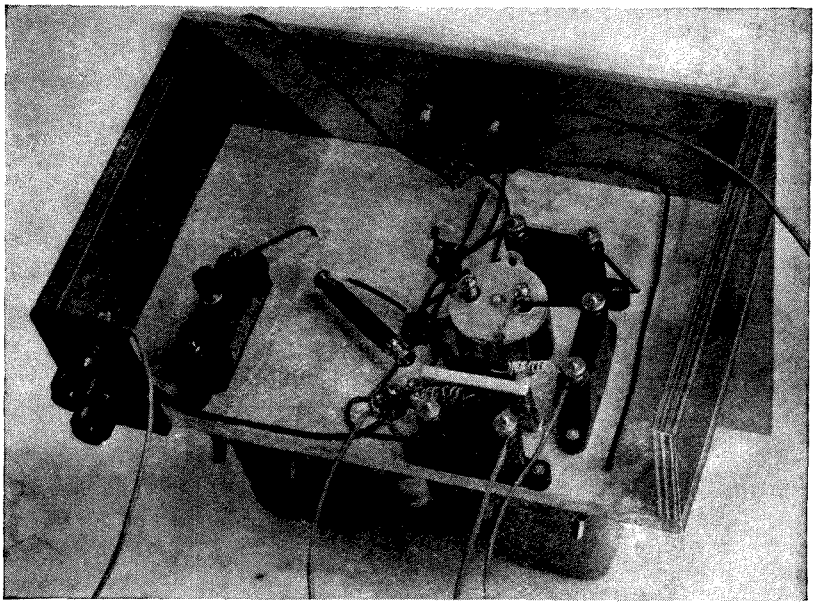
Despite its small physical dimensions, the Minitube uses a full-sized electrical circuit with a hard-working stage of high-frequency amplification, differential reaction, and a pentode output stage giving very satisfactory volume and quality

in the process of design I came to the conclusion that excessive compactness in this case was not likely to be worth the trouble involved for the constructor : extreme compression makes it difficult to preserve electrical efficiency, renders the set harder to build, and raises some very difficult problems connected with adequate " baffling " of the loudspeaker.

The question is really bound up very closely with the matter of cabinet design ; one requires a housing of a certain minimum size to make it reasonably easy to obtain satisfactory bass reproduction and to contain batteries of adequate size, hence there seems but little point in making the receiver itself excessively small. One really might just as well allow oneself the convenience of just reasonable compactness, and that is what I have done with the Minitube Three.



Note the flex lead from the right-hand coil unit. As supplied, this has a tag connector, but it is easy to remove this and solder in its place the special top connector supplied with the midget screen-grid valve



One of the virtues of the Minitube design is that compactness has not been taken to unpractical lengths and there is no awkward cramping together of the components

It is certainly pretty small compared with the general run of three-valvers for the small baseboard of the framework measures only 6 in. by 10 in., yet there is not the slightest sign of cramping and it is extremely easy to build and wire up. Moreover, it requires no special screening other than a metal-surfaced baseboard used with a trifle of cunning, and is yet perfectly well behaved electrically —quite stable and giving a very pleasant balance of selectivity and sensitivity.

The performance of a set of this type perhaps calls for a special word of explanation. No doubt the reader will have noticed that the characteristics of the midget-type valve are not quite so impressive, on paper at any rate, as those of their full-sized counterparts and this fact may well lead to fears as to the results to be expected. On this point I can give definite reassurance : the later midget types are capable of a really good performance.

Possibly some allowance should be made for the fact that the modern set rarely requires to be worked " full out," but the fact remains that the Minitube Three gave me results very close indeed to those of a set using ordinary valves. In this connection, too, one must remember that the midgets are extremely economical to run, and a combination such as the present consume very little more than half the filament current of a normal-size group of three.

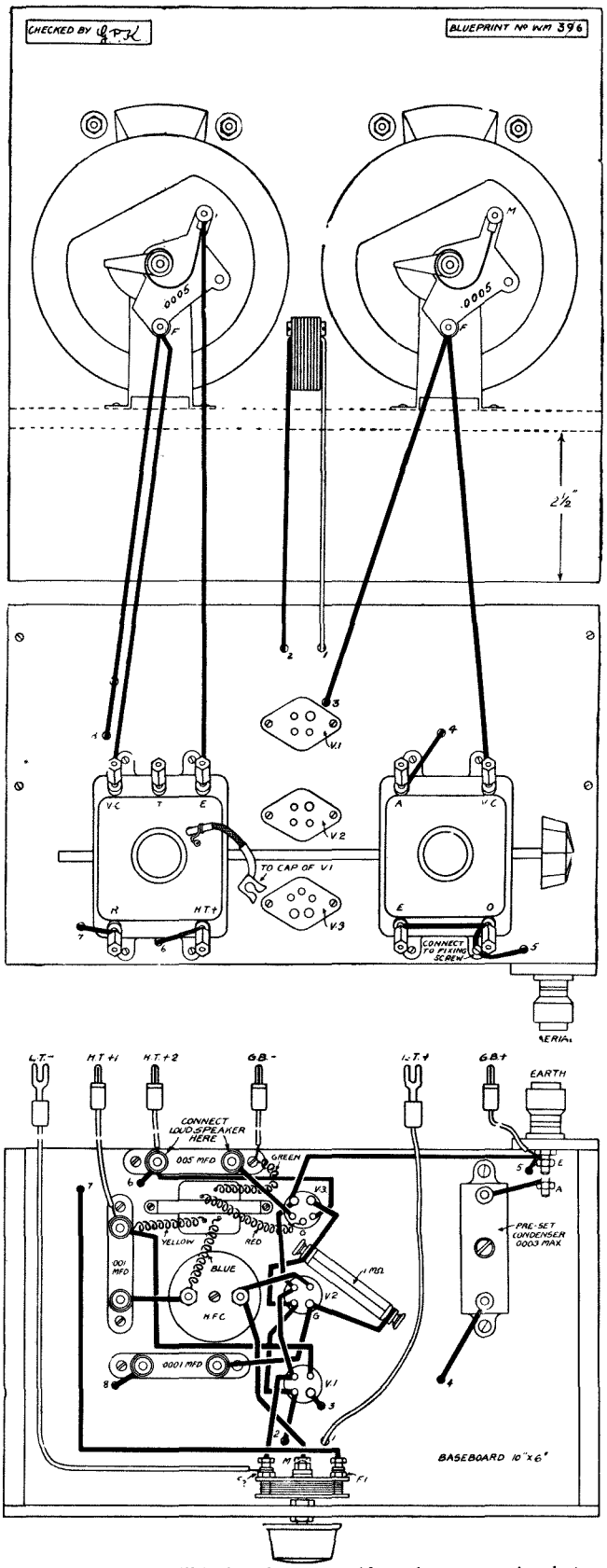
Circuit Arrangement

Before turning to constructional matters it may perhaps be interesting to run briefly over the arrangement of the circuit. First it is to be noted that the coils chosen provide the efficient inductively-coupled form of aerial circuit, and that I have added here an adjustable series condenser of the compression type for the purpose of selectivity control.

Selectivity Control

This will normally be kept at maximum (screwed right down) and only reduced if unusually high selectivity be required. On very small aerials it should of course be shorted out by joining its terminals with a piece of wire in the usual way.

The high-frequency inter-valve coupling is of the transformer type which, in addition to its well-known efficiency, offers the further advantage of enabling one to dispense with the usual high-frequency choke and feed condenser. Besides saving one a few shillings this helps to keep down the overall size.



This scale drawing will be found a clear guide to the construction, but a full-size blueprint can be obtained if desired at half price (6d., post paid) if the coupon on the last page is used before October 31. Address your application to "Wireless Magazine" Blueprint Department, George Newnes, Ltd., 8-11 Southampton Street, Strand, London, W.C.2, and ask for No. WM396

The detector is of quite conventional leaky-grid type with the customary modern values of .0001 microfarad for the condenser and 1 megohm for the leak. The anode circuit contains a straightforward form of differential reaction arrangement, and low-frequency transformer coupling to the output valve.

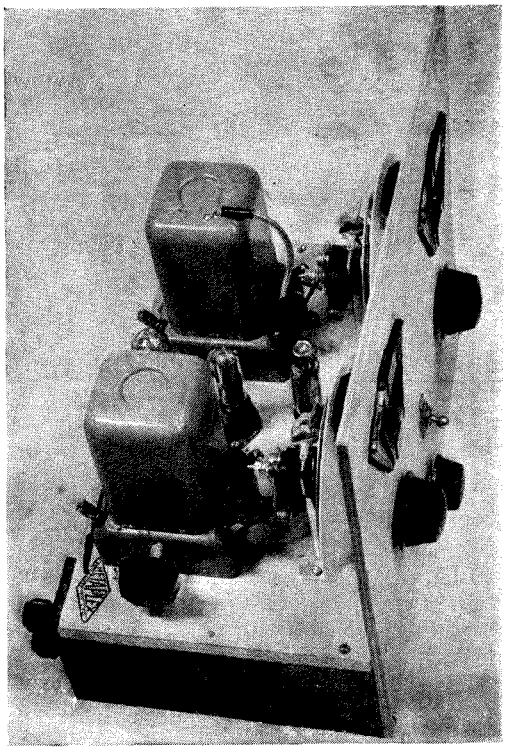
About the Output Stage

A pentode is employed in the output stage with direct feed to the loudspeaker : I doubt whether an output filter would be justified by results in the case of a receiver of this type, apart from the space it would take up. Across the loudspeaker is shunted a fixed condenser of .005 microfarad, which capacity I find gives a pleasant degree of tone-correction in this case

How to Begin Construction

Construction should begin with the drilling of three $\frac{5}{8}$ in. holes for the accommodation of the valve holders. Next the tuning condensers should be mounted on their small brackets and screwed down on the baseboard, after which the positions for the two disc drives can be determined. To mount these involves cutting a couple of rather awkward shaped holes in the wooden front panel, and here even the cheapest kind of fret-saw is a great help.

When the disc drives and condensers have been fitted it will be found that a projection on the moving vanes of the latter fouls the fitting for the dial lights : I suggest that these latter should not be used, since they represent a

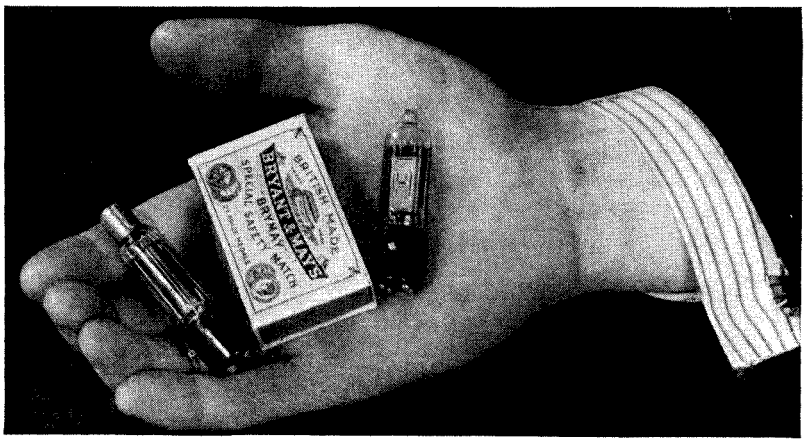


A wooden panel is used and the intention is that this shall be polished to harmonise with the cabinet finish. When finally fitted up the wave-change switch will be controlled from a knob on the side of the cabinet with the aid of a coupling to the rod passing through the coil units

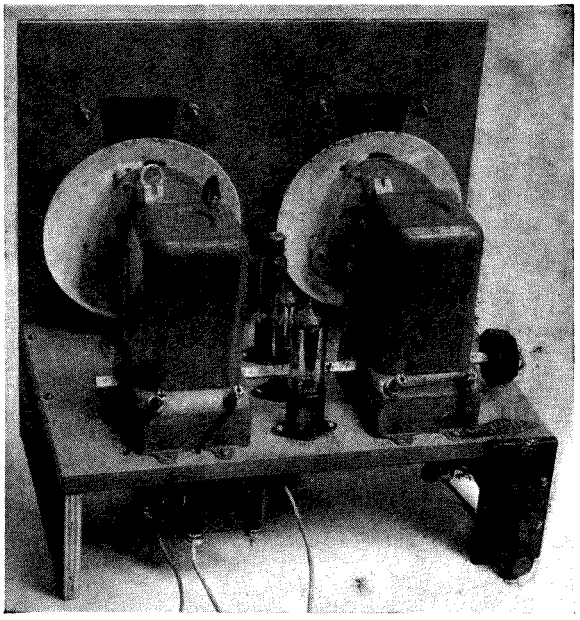
heavy proportionate drain on the filament battery in a set of this economical type.

Accordingly, the difficulty can be overcome by taking a robust pair of pliers and bending the offending part of the dial light holders out of the way : quite a small bend is all that is necessary.

The rest of the assembly work calls for no explanation, but I should perhaps add a word of warning as to the valve holders ; these are of unfamiliar type, and so it is necessary to take a little care to get them attached the right way round by taking note of the position of the



A couple of the Hivac midgets compared with a familiar object. Those actually used in the set are of the type with pins instead of the button contacts seen here



The only terminals required are those for aerial and earth; the loudspeaker is connected direct to the terminals of the fixed condenser, seen near the back of the underside of the baseboard

single thick (grid) pin in the case of the four-pin holders and the two thick filament pins of the five-pin one.

Finally, some miscellaneous practical aspects. It will be noted that the set is fitted with but a single pair of terminals : these are for aerial and earth, the loudspeaker being connected with flex leads direct to the terminals of the .005 microfarad fixed condenser, and all battery connections being made by means of direct flex leads to appropriate points.

Wave-change Control

The wave-change switches of the coil units are controlled by a rod passing through both units. This is intended to be operated via the medium of a short rod and coupling piece entering through a hole in the side of the cabinet when the finished receiver is fitted up.

The grid leak is suspended in the wiring, and so needs no holder : a wire-ended type could obviously be employed if desired. Note, too, that one of the fixing screws of the .005-microfarad fixed condenser is used as a mechanical junction point for one of the lead-out wires of the low-frequency transformer and the grid-bias negative flex : care must therefore be taken to see that this screw is not so long as to go right through and touch the metal coating on the upper side of the baseboard.

To complete the practical instructions : here are the necessary notes on operating voltages. Lead H.T.+1 feeds both the detector anode and the screening electrode of the screened-grid valve, and the voltages here should be adjusted by trial for maximum volume with the reaction control set well back. Lead H.T.+2 supplies the anodes of the other two valves and the priming grid of the pentode and here one should apply the maximum (100 volts.). Grid bias should be about 3 to 4.5 volts.

The reader is now in a position to go ahead with the building of this interesting little receiver, and get it working. In an early issue I propose to show how the whole outfit, including batteries and loudspeaker, can be fitted into a correspondingly compact cabinet.

LIST OF COMPONENTS YOU WILL NEED FOR THE MINITUBE THREE

CHASSIS — s. d.
1—Peto Scott, to specification, upper surface sprayed Metaplex, and polished wood panel 3 0

CHOKE, HIGH-FREQUENCY
1—Bulgin type HF8 ... ... 2 3

COILS
1—Wearite type WLQ 7 6
1—Wearite type WLT 7 6
1—Control rod for above, extra length (as supplied for 3-coil assembly)

CONDENSERS, FIXED
1—T.C.C. .0001-microfarad type 34 1 3
1—T.C.C. .001-microfarad type 34 ... 1 6
1—T.C.C. .005-microfarad type 34 ... 2 0

CONDENSERS, VARIABLE
2—Polar Complex .0005-microfarad 2 6
1—Polar .0003-microfarad, differential type... ... ... 3 0
1—Formo .0003-microfarad, compression type 1 6

RESISTANCE, FIXED
1—Graham-Farish 1-megohm grid leak 10

SUNDRIES — s. d.
2—Polar condenser mounting brackets
2—Polar Discs drives, Perdisco type 10 0
1—Terminal strip, 1½ in. by 2¾ in.
2—Belling Lee terminals, "A" and "E", ... 1 0
Flex, wire, screws, battery plugs, etc.

SWITCH
1—Bulgin, type S80 ... ... 1 6

TRANSFORMER, LOW-FREQUENCY
1—Bulgin Midget type 4 0

VALVE HOLDERS
2—Clix 4-pin, Hivac-midget type ... 1 2
1—Clix 5-pin, Hivac-midget type ... 8

ACCESSORIES

VALVES
1—Hivac XSG 15 6
1—Hivac XD 10 6
1—Hivac XY 16 6

LOUDSPEAKER
1—Goodman permanent-magnet midget, automobile type 1 7 6

BATTERIES
1—Drydex high-tension 100-volt 6 3
1—Drydex grid-bias 4.5-volt, 1041 9
1—Exide 2-volt accumulator, slow-discharge type 4 6

Listeners in this country should have no difficulty in picking up amateurs working in all parts of Europe on the simplest of short-wavers. Our illustration shows a typical German amateur's transmitting den

Calibrating

Specially Contributed by

THE increased interest shown today by listeners in short-wave transmissions impels me to give a few words of advice to prevent the beginner being disappointed at the outset. Although in the hands of the skilled operator there is no more difficulty in tuning in a broadcast on a channel below, say, 50 metres than there is in setting a condenser dial for a concert on a medium wavelength, if the tyro at the start twirls a condenser knob in the haphazard manner often adopted with success in the case of a broadcast receiver, he is certain to miss most of the stations he would like to log.

Careful, and consequently slow, tuning is essential if good results are to be obtained, no matter whether the beginner has purchased or constructed an elaborate superhet or a mere one- or two-valver. There is a knack in tuning a short-wave set that the inexperienced experimenter must do his utmost to acquire from the start.

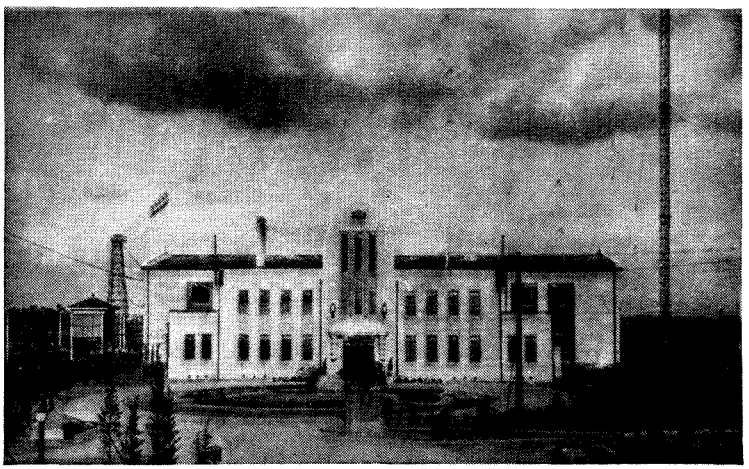
Bear in mind that if speech or music is to be picked up in no case must the receiver be allowed to oscillate; it must be kept just below that critical point. Begin by putting the reaction control at its lowest capacity then, whilst turning the main condenser knob slowly, gradually increase reaction. At a given setting the receiver will begin to oscillate; you will recognise this state by hearing a peculiar but distinctive "rushing noise." Continue to turn the dial slowly, still gently increasing reaction, keeping the receiver in this condition.

When you come across a carrier wave you will hear a curious "squeal" or "cheep." Possibly it may be only a morse transmission, but even so it will give you the necessary intimation. A broadcast telephony carrier wave provides the same kind of warning, but in this event, before you can hear telephony (namely speech or music) the condenser must be slightly turned backwards or forwards until, as it were, you strike the trough of the wave. Ease off reaction carefully and again re-adjust the main tuning dial when the signal should be perfectly audible.

It simplifies the operation if you keep the receiver in a condition of slight oscillation, but telephony cannot be received whilst the set is actually oscillating. If this piece of advice is followed, even the mere beginner will log stations with a simple one-valve receiver.

Many readers doubtless when searching for foreign stations on short waves, pick up at various points of the condenser dial transmissions which they may recognise as emanating from experimental amateurs. As these are definitely confined to a certain number of frequencies it is wise to make a note of the channels in which they may be found. They are roughly classified in the 14, 7, 3.5, and 1.7 megacycle bands, corresponding respectively to 20.84-21.43 metres (14,400-14,000 kilocycles); 41.1-42.86 metres (7,300-7,000 kilocycles); 75-85.7 metres (4,000-3,500 kilocycles), and 150-175 metres (2,000-1,715 kilocycles).

Among these you may come across transmissions, for instance, from South America, where the line between the amateur and the experimental station



The world is literally covered with powerful short-wave broadcasters. Here is a general view of the high-power short-wave station at Nagoya in Japan

Your Short-waver

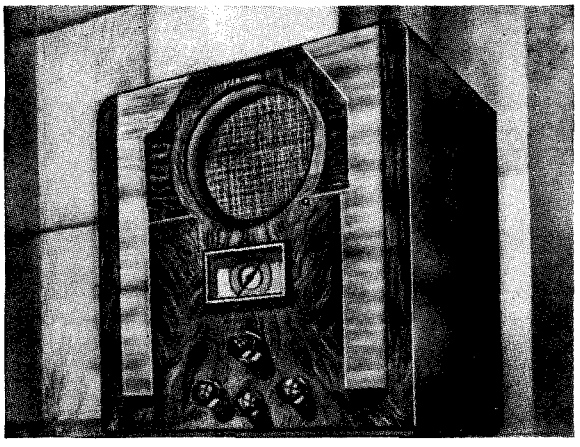
J. GODCHAUX ABRAHAMS, who also Reveals the Art of Tuning a Simple "Straight" Short-waver

broadcasting a regular schedule of programmes is not very clearly marked.

Generally speaking, the question of identification is simplified if the listener has means at his disposal to gauge—even within rough limits—the wavelength or frequency on which a transmission is picked up.

For this reason, when compiling a register of stations based both on those already logged and on a published list containing many you have not yet heard, divide it into as many bands as you can, inserting, wherever possible, the condenser readings with corresponding wavelength or frequency of the transmitter you have definitely identified. You could not possess better landmarks; they will narrow your search and prevent great loss of time, and patience.

As an example : if by chance a broadcast is heard on a reading situated, say, between DJA, Zeesen (31.38 metres) and CT1AA, Lisbon (31.25 metres), according to the time of reception it will not be a difficult matter to



Prices of efficient all-wave receivers have tumbled this last few months. This R.A.P. all-wave superhet, which covers a waveband of from 19.5 to 52 metres in addition to the normal broadcast bands, is for operation off either A.C. or D.C. mains and costs twelve guineas

determine whether it is an Australian or an American transmitter. If the issue then is narrowed down by a process of elimination, it will be possible to state definitely to which particular station the receiver is tuned.

I would, therefore, strongly advise that a search be made at the start for the most powerful stations, of which there are already a number in Europe; the logging of these readings with the accompanying data collected will allow a calibration of the set and thus provide known signposts for the further identification of other signals.

If the short-wave listener, however, wishes to calibrate his receiver to a greater degree of accuracy without resource to the necessity of employing high-grade and consequently relatively expensive instruments for the measuring of the frequency, he can rely on certain short-wave transmissions known to be quartz-crystal controlled and of which the exact frequency is advertised.

In this respect attention may be drawn to the Daventry Empire broadcasts, of which the stability is so carefully watched that the permissible error never exceeds plus or minus one part in 10,000 ; in effect, an even better performance is regularly obtained, namely, an accuracy of 1 in 25,000.

In the list given above, established in sequence of wavelengths, there is a sufficiency of accurately controlled transmissions on relatively high power to afford excellent landmarks for the listener who desires to calibrate a receiver and thus establish the framework of a good log.

With the exception of GSK, Daventry, which the B.B.C. has not yet contemplated bringing into operation, all stations are those on the air daily at specified times, either for the broadcast of speech or music or, as in the case of DIK and DIQ, Königswusterhausen, for commercial morse transmissions, and the Bandoeng stations in connection with a public telephony service. It will be noticed that WWV, Washington (U.S.A), is the only transmitter used solely for the purpose of sending out a calibrated wave at fixed intervals throughout the year.

LIST OF STATIONS SENDING OUT CALIBRATED WAVES

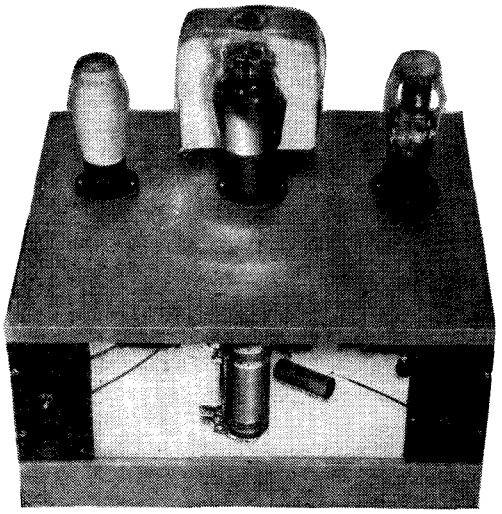
Call	Station	Power (Kw.)	Metres	Kilocycles
GSK	Daventry	10/15	11.494	26,100
GSJ	Daventry	,,	13.934	21,530
GSH	Daventry ...	,,	13.972	21,470
PMA	Bandoeng	60	15.51	19,345
PLE	Bandoeng	60	15.93	18,830
GSG	Daventry	10/15	16,863	17,790
DFB	Nauen	7.2	17.12	17,520.1
GSI	Daventry	10/15	19.659	15,260
DJB	Königswusterhausen	5	19.74	15,200.1
GSF	Daventry	10/15	19.815	15,140
GSE	Daventry	,,	25.284	11,860
GSD	Daventry	,,	25,532	11,750
DIQ	Nauen	7.2	29.16	10,290.1
GSC	Daventry	10/15	31,315	9,580
DJA	Königswusterhausen	5	31.38	9,560
GSB	Daventry	10/15	31.545	9,510
PLV	Bandoeng	80	31.86	9,415
DIK	Königswusterhausen	3.6	38.62	7,767.4
GSL	Daventry	10/15	49.1	6,100
GSA	Daventry	,,	49.586	6,050
WWV	Beltsville (Washington)	35	60.0	5,000

October to March each Tuesday from G.M.T. 19.00-21.00; each Wednesday from 01.00-03.00; from April to September, each Tuesday as above; each Wednesday from G.M.T. 03.00-05.00

How to Suppress Hum

With Particular Reference to the Unicon AC/DC Two

By G. P. KENDALL, B.Sc.



Considerable care was taken in the design of the Unicon Two to provide adequate space and ventilation for the main voltage-dropping resistance. Any cabinet used for the set should be provided with openings in the back (covered with wire gauze or perforated zinc) to maintain this feature

DESIGNING a universal mains receiver capable of giving practically hum-free reception on any and all mains supplies raises a problem that has only one complete solution, and that is to arrange such elaborate and thorough smoothing and interference-stopping circuits that hum is well-nigh impossible on even the worst supply.

That is all very well, but it puts up the cost of the receiver quite noticeably, and doesn't seem a very good scheme from the point of view of the man who has good or even just ordinary mains. It means that he is paying for a group of components that he does not need.

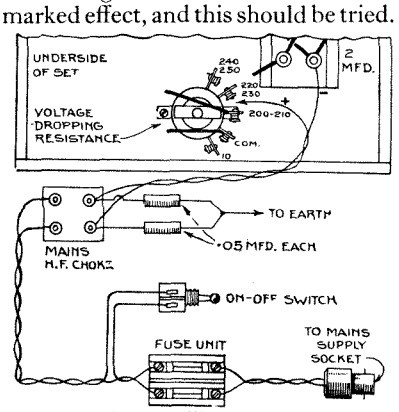
Simplified Circuit First

It seems to me a better idea to start with a simplified circuit, try it out, and then add as required until sufficiently humless results are obtained. In this way it will often be found that the simplest arrangement will serve, and there the matter will end; in the less fortunate cases further components must be added, but this can be done in stages so that one may be sure of stopping when only just enough extra smoothing and so forth has been added.

This method appears to have the further advantage of enabling one to have quite an interesting time in the course of one's experiments, and to learn something about the nature of the mains interference occurring in one's own case.

The first thing to be done is to try to make a good guess at the source of the hum one is setting out to remove. Chiefly, one wants to know whether it is due to a bad wave-form making the supply difficult to smooth, or whether there is a large proportion of really high-frequency impulses in the current. (That's rather a loose way of expressing it, but I don't want to waste time on technicalities here.)

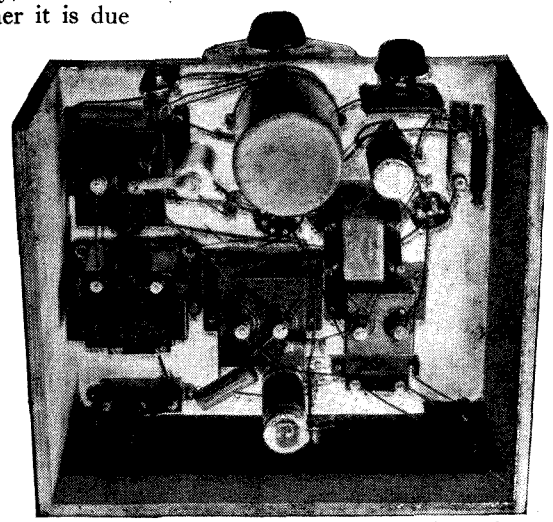
Note first whether the hum is a steady low note, or has a rough and scratchy sound, also whether it varies much from time to time. In the former case it is probable that an increase in the capacities of the main smoothing condensers will have a marked effect, and this should be tried.



Schematic diagram illustrating the connections of various auxiliary devices to be fitted as required when the set is finally placed in its cabinet

In the case of the Unicon Two the procedure is quite simple. I carefully left a good deal of space here and there in the layout for the express purpose of allowing for the accommodation of extra microfarads, and so it will be found quite a simple matter to try, first of all, an additional 4-microfarad unit in parallel with the condenser of similar capacity located near the wave-change switch.

If this makes only a moderate improvement try the extra capacity instead in parallel with the other 4-microfarad unit (the one near the main voltage-dropping resistance). If you get the best effect here, then that is the place for your extra capacity.



This view shows how space has been left in the assembly for any additional microfarads which may be required for hum-suppression

In very bad cases you may find that an improvement results in both positions, but that the hum still remains a little too noticeable: this means that extra capacity is required in *both* places, but I do not think this will often happen.

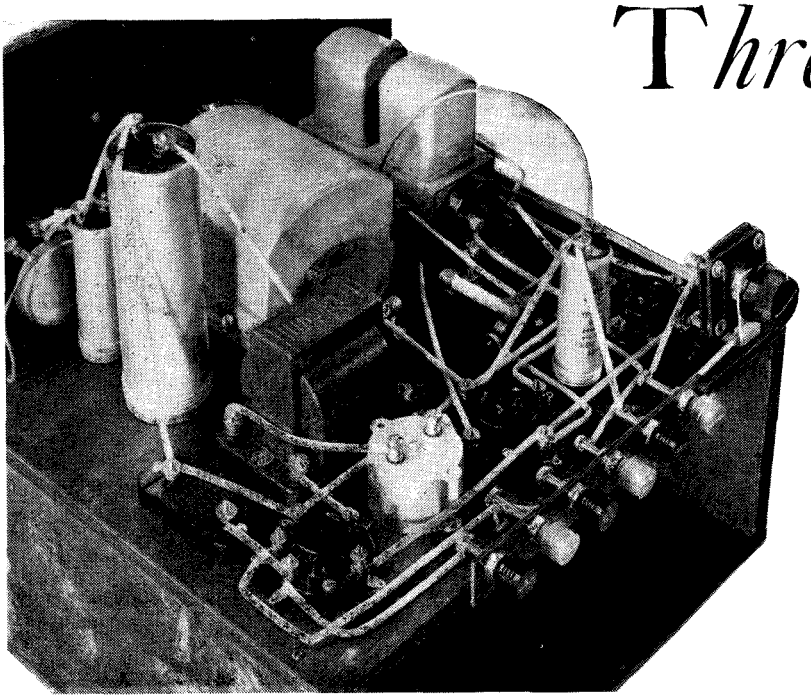
When it does happen you may conclude that you are cursed with a pretty rough mains supply. In such circumstances it may even be necessary to go further and increase the capacity of the present 2-microfarad detector de-coupling condenser and so make this also play a substantial part in the smoothing system, but this is still more unlikely.

Continued on page 230

Operating the Certainty Three

By the EDITOR

A full description of this easy-to-build battery-operated three-valver was published in our September number. It employs a well-tried and simple circuit that can be depended upon to give really first-rate results. We would remind readers that a full-size blueprint of the Certainty Three can be obtained from the Publishers for 1s. post paid.



This view of the Certainty Three shows very clearly the layout of the components and wiring on top of the wooden chassis. The batteries are accommodated underneath

THE novel and business like appearance of the Certainty Three was much admired by the thousands of visitors to the "Wireless Magazine" stand at Olympia last month. "It is a relief," said one reader, "to see a set which does not slavishly follow previous designs and which is obviously efficient at first glance!" "That's the circuit I want," remarked another. "I *know* that circuit is a good one and I like the way you have made it up!"

Modern Make-up

For, as you have noticed already from last month's article, we have taken a well-known and thoroughly reliable circuit—one that has long since passed the experimental stage—and have built it up into a very convenient modern form with certain novelties of construction. Those controls which need not be separately manipulated in order to get the best results, are brought together, while, for the very finest adjustment, it is possible separately to control parts which are often "tied" in such a way that individual adjustment is impracticable.

For example, on the back of the coil unit you will see a switch with lettered terminals. Three of these terminals are connected with the pick-up switching and two with the on-and-off switching of the whole set, while inside the coil unit is a further switch of the multiple variety providing for the change of wavelength from the medium band to the long band and vice versa.

Thus with one knob, the on-and-off switching, wave switching and pick-up switching are all controlled. This not only simplifies control but also wiring, as you will observe from the diagram on page 92 last month.

Of course, one of the great advantages of home construction is that the builder when contemplating a new set, can utilise a number of existing parts from a previous receiver and in this way save a good deal of the cost. At the same time this policy should not be carried too far in an endeavour to utilise *unsuitable* components in a new design, and we would recommend you not to depart from the specified coil unit in this case.

If you have another type of twin condenser with concentric controls well and good, but do not endeavour to build this set if your twin condenser depends only upon the ordinary trimmers for matching.

Question of Ganging

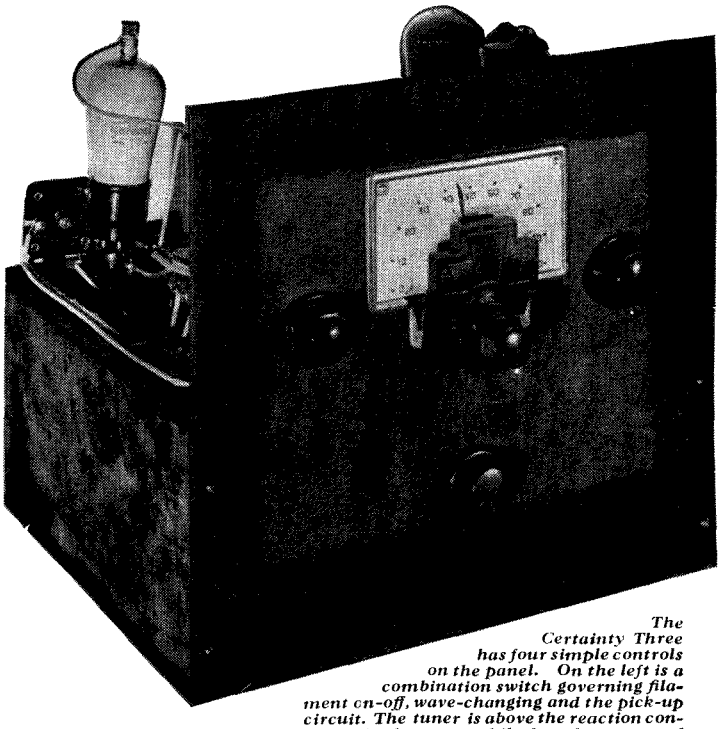
This is not because the coils themselves are not accurately matched, but when, as in this case, you are using reaction in the detector circuit, the tuning can be made so exceedingly sharp that it is unlikely that both coils and condenser can be matched accurately enough with semi-fixed trimmers to give just that final sensitivity that is one of the charms of this receiver.

If, of course, you are prepared to sacrifice this particular virtue, there is nothing whatever to prevent you building it up with an ordinary twin-gang condenser without panel control of the trimming.

Sound Advice

There is no special point about valve holders, fixed condensers, grid leaks and the like, but I would take this opportunity of pointing out that the grid condenser is .0001-microfarad with a 1-megohm grid leak, and *not* .0003-microfarad and 2 megohms—values which have been used in so many sets. There is a reason for the choice of these values and I advise you to adhere to them.

When tuning a set of this kind there are two distinct methods of



The Certainty Three has four simple controls on the panel. On the left is a combination switch governing filament on-off, wave-changing and the pick-up circuit. The tuner is above the reaction condenser in the centre while the volume control is on the right.

receiving a medium strength station. Which method you use is dependent upon the conditions under which you are working. You can, for example, tune in the station in the ordinary way, and when you have picked it up, get the last fine adjustment for best strength on the trimming knob. Then turn the volume down, if it is excessive, by means of the volume control. This method is excellent when there is no interference on the station you want to receive.

Reducing Interference

The second method is very similar, but consists in first of all tuning-in the station and then, if there is interference from adjacent channels, reducing the volume considerably by means of the volume control until the desired station is only just heard. *Then*, and only then, introduce a little reaction by means of the reaction condenser control immediately below the tuning control.

This, of course, will bring the strength up considerably and you should then carefully re-tune by the central knob and trimmer to get the best possible results. Now bring up the station as loud as you can, but without sacrifice of quality, carefully adjusting the tuning with each setting of the reaction, and then once again reduce the volume down to reasonable strength by means of the volume control.

This method takes a little longer to describe than it actually takes to apply, but it so sharpens up the tuning that the interference will in many cases completely disappear.

In fact, with this receiver properly handled in this way you can get tuning comparable in sharpness with many commercial superhets. It is, however, rare that it is necessary to apply this refinement of "reaction tuning," but the advantage is so great on a few occasions that I am sure you will value it.

There is only one other point I would mention, and that relates to the adjustment of the small variable condenser connected to the aerial. This will be seen at the extreme right-hand back edge of the set looking from the rear. This condenser, which is very useful, is of the fully variable type.

Aerial Compensation

The correct adjustment of this condenser compensates for many differences in aerials with which this set may be used.

A good plan for the first adjustment of this condenser is to tune-in to a station at a moderate distance (not the local) with the aerial condenser turned to maximum position (fully to the right in a clockwise direction).

Now slowly reduce the value of this capacity by turning the knob in an anti-clockwise direction until you notice a slight reduction in the strength of the station to which you are listening.

Check the Tuning

Make sure this is not a tuning effect by carefully re-tuning on the central knobs and then make a further slight reduction. If any further reduction of this condenser brings about any noticeable reduction in strength, all over the scale you have reached the best point.

Check up this experiment on various parts of the tuning scale and you will soon find an adjustment which is a good balance for the whole of the band.

COMPONENTS NEEDED FOR THE CERTAINTY THREE

	£ s. d.
CHASSIS	
Chassis and wooden panel as per blueprint	7 6
CHOKE, HIGH FREQUENCY	
1—Bulgin, type HF8	2 3
COIL UNIT	
1—Graham Farish, type AH/G	12 6
CONDENSERS, FIXED	
1—Dubilier .0001-microfarad, type 610	2 6
1—Dubilier .005-microfarad, type 610	3 3
2—Dubilier .1-microfarad type BS 9200	3 6
1—Dubilier 2-microfarad, type BS9202	2 6
CONDENSERS, VARIABLE	
1—Formo twin-gang with dust cover	11 0
1—Polar .003-microfarad differential reaction	3 0
1—Polar .0003—microfarad solid dielectric	2 6
RESISTANCES, FIXED	
1—Amplion 10,000-ohm	1 0
1—Dubilier 1-megohm grid-leak	1 0
RESISTANCE, VARIABLE	
1—Reliance .25-megohm volume control	4 6
SUNDRIES	
Battery leads: plugs: bracket for reaction condenser: anode connector: terminal strips: connecting wire.	
TERMINALS	
6—Clix type B, lettered as follows: A, E, P.U.(2), L.S.—, L.S.	2 0
TRANSFORMER, LOW-FREQUENCY	
1—Ferranti, type AF10	8 6
VALVE-HOLDERS	
2—Benjamin 4-pin	1 0
1—Benjamin 5-pin	7
BATTERIES	
1—Full-O'-Power 120-volt high-tension, type H3	10 6
1—Exide 2-volt accumulator, type PO3	10 6
1—Full-O'-Power 9-volt grid-bias battery	9
LOUDSPEAKER	
1—W.B. Stentorian type 36S, standard chassis model	2 2 0
VALVES	
1—Marconi VS24	12 6
1—Marconi HL2	5 6
1—Marconi PT2	13 6

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

All-wave sets may well be the sets of the future. They present many interesting and instructive problems to designer and home constructor, all calling for effective solution if success is to be achieved. In this special article Mr. Reyner, who is particularly well known to readers of "W.M." for his clear explanations of abstruse technical points, gives a helpful survey of the subject as a whole

Sir Seymour Hicks at Olympia performing the christening ceremony on Pye's new 1936 all-wave receiver

Problems of the All-wave Receiver

THERE are definite indications that what is somewhat loosely termed the "all-wave set" will be in the programmes of many manufacturers this season. The majestic term "all-wave" means, of course, that one or two short-wave ranges are included in addition to the customary broadcast band. The set certainly does cover the majority of wavelengths containing transmissions of entertainment value, and therefore perhaps lives up to its name in practice. Let us examine the modern tendency to see to what extent an all-wave set can fulfil the demands made upon it.

Most of the sets of this type which I have yet seen are superhet receivers. They are designed mainly with a view to their broadcast performance; the short waves are added afterwards by providing coils capable of covering the short-wave range. Although the design must be laid out with a view to the short waves—because if satisfactory tuning ranges are to be obtained the leads from the short-wave coils must be very short—the general policy in the design, apart from this, is to consider the short waves as of secondary importance.

Satisfactory Frequency Changer

If this attitude is adopted the design is made fairly easy. The introduction of special mixing valves has greatly simplified the procedure. The pentagrid or octode is a satisfactory frequency-changer on short or normal wavelengths, a typical arrangement being shown in Fig. 1.

There are in general two difficulties which may arise with this form of circuit. One is that the short-wave

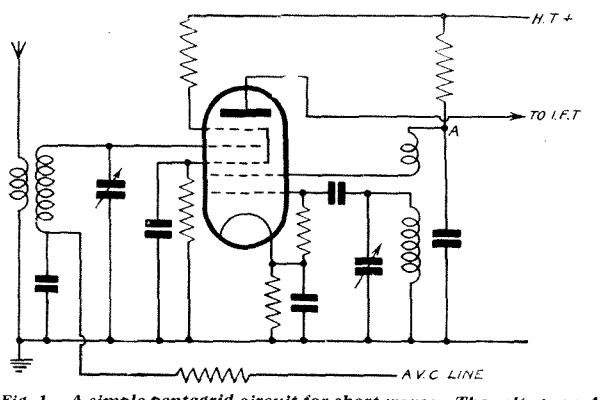


Fig. 1.—A simple pentagrid circuit for short waves. The voltage on A must be well above the voltage on the screen to ensure the most favourable working conditions

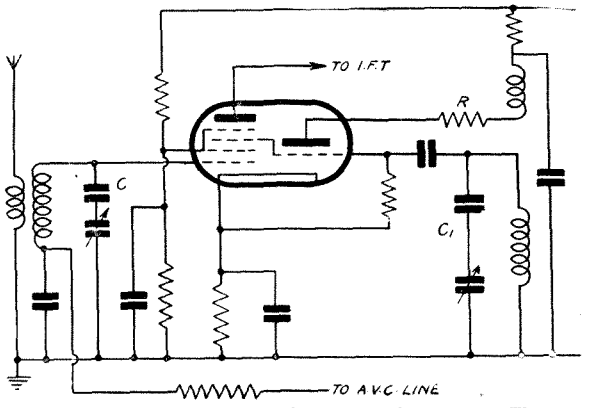
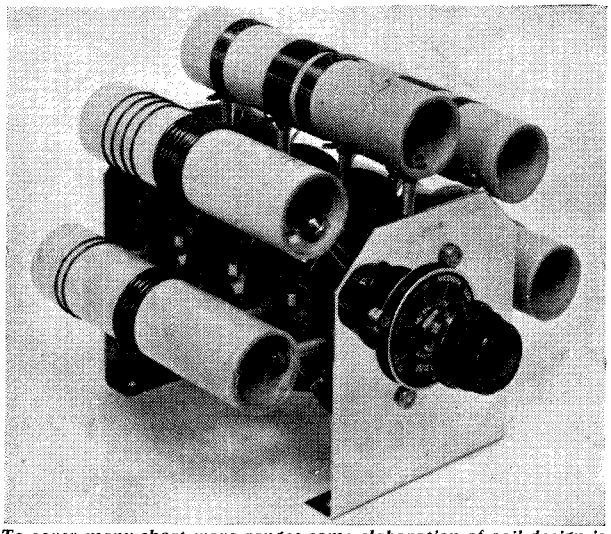


Fig. 2.—Triode-hexode frequency-changer for short waves. The condensers C and C1 serve to restrict tuning ranges and resistance R prevents "squegging"

oscillating circuit may not function, particularly with larger values of condenser. This can usually be overcome by correct choice of the voltages of the oscillator anode and the screen of the outer portion of the valve. It is desirable to maintain the voltage on the oscillator anode well above the screen potential as there is a rapid falling off in the mutual conductance of the oscillator section if the voltage on the oscillator anode is too low.

If this difficulty still remains the defect probably lies in the coils, and we shall consider this aspect of the question a little later.



To cover many short-wave ranges some elaboration of coil design is required; this is the Bulgin switch-controlled unit covering a range of 10 to 90 metres besides the ordinary broadcast bands

The second difficulty is that of " pulling " between the circuits. This is the name given to the interaction between oscillator and aerial circuits, whereby alteration of one affects the tune of the other. Thus the act of tuning one circuit may throw the other off tune.

It will be clear that the oscillator and aerial circuits are not only coupled electronically inside the valve, but there is also a measure of capacity coupling between the valve electrodes. While this is not serious at ordinary wavelengths, it becomes increasingly troublesome as the frequency is raised, and at wavelengths of the order of 15-20 metres definite pulling is often experienced.

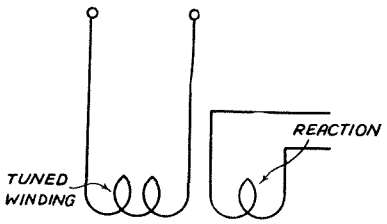


Fig. 4.—In short-wave receivers it is often necessary to take account of mutual inductance effects between the leads running to reaction and tuning coils as well as between the coils themselves

To avoid this the triode-hexode was introduced, this being an arrangement in which the triode generating the oscillation is quite separate from the mixing portion of the valve, although both are mounted inside the same envelope and have a common cathode.

Advantages of the Triode-hexode

The grid of the oscillator is tied internally to a modulating grid on the mixing portion which is otherwise just a plain pentode, so that the oscillator voltages modulate the electron stream of the valve in the ordinary way. With this arrangement it is possible to go down to wavelengths below 15 metres without any troublesome pulling, provided the circuits have been laid out correctly in the first place. Any stray coupling between the aerial and oscillator coils must be avoided, so that the only coupling between them is the electronic one in the valve itself.

Band-pass aerial tuning is not necessary on the short waves. If the normal set has such an arrangement, therefore, one of the circuits can be cut out on the short wavebands. With the modern tendency to use an intermediate frequency around 450 kilocycles, however, it is possible to adopt single aerial circuits even for the normal broadcast waves; this simplifies the design.

The usual padding condensers on the oscillator may or may not be required. In general, some padding will be required on the 40- to 80-metre band, but on the 15- to 40-metre band the oscillator inductance can be chosen so that the error is quite small because the frequency difference is so small, even using 450-kilocycle intermediate-frequency circuits. The signal frequency range would be from, say, 20,000 to 7,500 kilocycles, and the oscillator frequency would thus be 20,450 to 7,950 kilocycles, a change of less than 10 per cent in the middle of the scale.

Maintaining Constant Oscillation

An important point is that of maintaining constant oscillation. With proper care this can be done even when a full .0005-microfarad tuning condenser is used, but a really tight coupling is required. It is helpful to interleave the tuned winding and the reaction winding as shown in Fig. 3. It may be useful, however, to include a series condenser on the short-wave ranges as shown at C and C_1 in Fig. 2. This will limit the effective capacity of the condenser at the maximum position and make the obtaining of even oscillation easier in consequence. If the two condensers are made of unequal capacity they can be made to function as padding condensers as well. To do this the oscillator condenser would be made smaller than that used for the signal-frequency circuit.

Having got the circuit to oscillate over the whole range reasonably and satisfactorily it may still be found that it oscillates too strongly at the bottom of the scale. This will cause harmonics in the oscillator wave-form, which is not very troublesome on the short waves though it will cause an increase in whistles, but if it is too great " squegging " will occur, the circuit falling in and out of oscillation at an audible frequency, and this will give rise to a continuous howl.

This may be avoided by connecting a leak across the

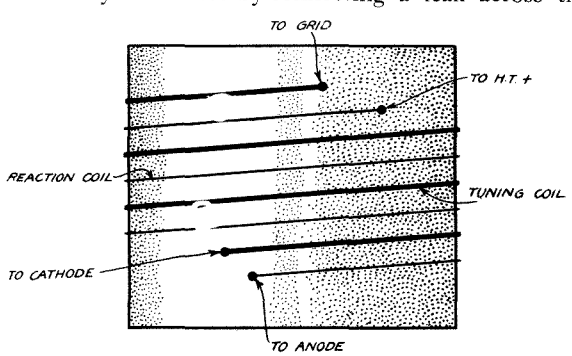


Fig. 3.—It is often helpful on short waves to interleave the reaction and tuned-grid windings

circuit which will have progressively more effect as the tuning capacity is reduced and will thus have the desired limiting action. The grid leak in the oscillator circuit may be made to serve this purpose and should not be more than about 50,000 ohms for this reason. Another method is to include a series resistance in the anode circuit as at R in Fig. 2. This may be cut out on the higher wavelength ranges.

One important advantage of the triode-hexode is that the signal-to-noise ratio is likely to be a little reduced, because the signal has been amplified somewhat before it is mixed. This is an important consideration on short waves, as we shall see.

Apart from the possible change to a triode-hexode for the mixer, an all-wave superhet is but little different from a normal one. The usual intermediate-frequency and detector circuits are used, almost invariably with automatic volume control and in the more up-to-date sets with some form of " muting " as well.

Noise-free Switching Essential

Switching has to be slightly more involved and perhaps here is one of the difficulties in that it must be noise-free. Much ingenuity has been expended by manufacturers and there are several switches on the market capable of giving particularly good results despite the fact that as many as eight circuits have to be changed over.

In view of the comparative ease of making an all-wave set, it is surprising that there is a comparative lack of suitable coils for the constructor. Bulgin is a notable exception, having recently produced a four-range coil complete with switch for both aerial and oscillator sections of a superhet.

In general, however, while there are a number of short-wave coils and an equal or even greater number of coils for the ordinary wavelengths, the combination coil is conspicuous by its absence.

This is a pity for, as I mentioned earlier, the unit

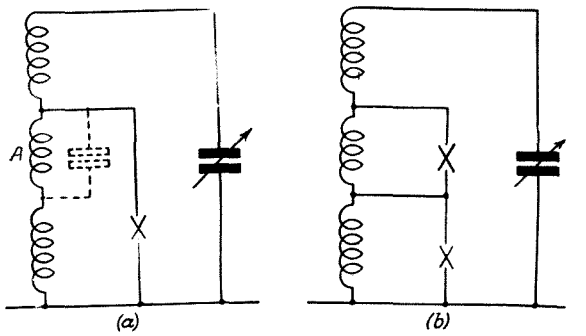
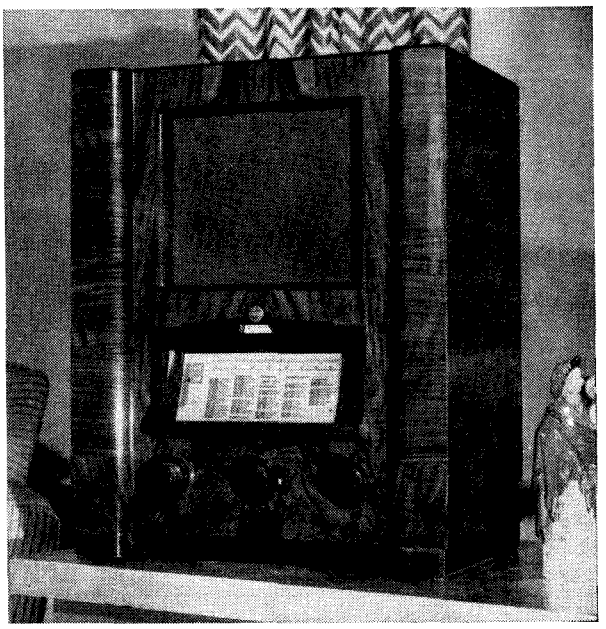


Fig. 5.—For real efficiency on short waves it is often necessary to elaborate slightly on the simple wave-change switching arrangement shown at A and use some such method as B

requires to be considered as a whole. It must be designed so that it can be mounted close up to the condenser with which it is tuned and in such a manner that the leads to the lowest wavelength coil are very short, otherwise the inductance of these leads will not only unduly restrict the wave-range by bringing up the minimum, but they may prevent satisfactory reaction and oscillation from being obtained.

This point of view is quite easily understood by the simple example shown in Fig. 4. The inductance of the leads between the coil and the condenser may be as great, if not greater, than the inductance of the few turns of wire constituting the coil itself. Only the reaction turns



Philips Lamps has produced for the new season an all-wave six-valve A.C. superhet covering a wave-range of from 16 to 50 metres in addition to the normal broadcast bands. Known as the model 575A, the price is £19 8s. 6d.

are coupled correctly to the coil, and it is quite conceivable that the mutual inductance between the reaction-coil leads and the tuning coil leads may be in opposition with that between the reaction coil and tuning coil itself, in which case little or no nett coupling would result.

A further difficulty in coil construction for three or four wavebands lies in the absorption between one coil and the next. This point is illustrated in Fig. 5. It is not sufficient to use a simple switch to short circuit the whole of the coil not in use. This is shown in Fig. 5a and it will be seen that the portion of the coil marked A is still able to tune with its own self-capacity and absorb from the active portion of the coil.

It is necessary, therefore, to short-circuit all the unwanted sections individually, or else to arrange the various sections of the coil so that they do not couple with one another. Various manufacturers have their own ways of achieving the desired results, but it is a factor that has to be considered. It does not arise in an ordinary set where the long-wave coil is short-circuited on the medium wave anyhow.

Absorptions of this sort show up by a loss of sensitivity often accompanied by a cessation of oscillation at certain parts of the set, and if this difficulty is experienced the cause is not very far to seek.

What the Short-wave Enthusiast Thinks

The real short-wave enthusiast will probably jib at the idea of the all-wave set, and it must be admitted that there is some justification. The technique of short-wave listening is essentially different from broadcast listening.

The number of stations capable of being tuned in at good easy programme value on the short waves is not large. The greatest thrill lies in tuning in the weak and far-distant stations and obtaining the best possible results from them. This can only be done by having a set which is designed first and foremost for short-wave reception.

To such a set reception on normal waves can easily be added without much difficulty and, in fact, the

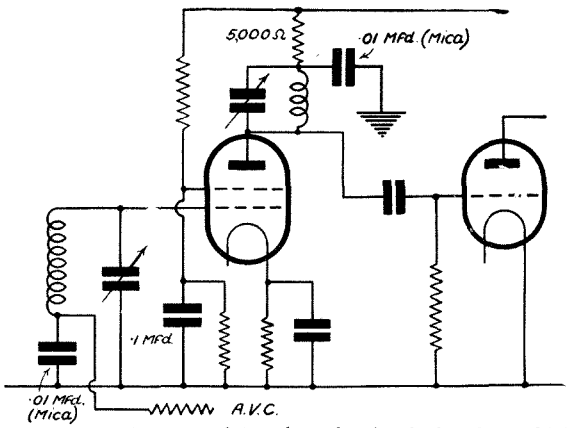


Fig. 6.—A simple form of tuned-anode circuit for direct high-frequency amplification on short waves

broadcast performance would benefit accordingly, but in these days of commercialism it is doubtful whether any manufacturer would go to such lengths.

Importance of Signal to Noise Ratio

Let us see what is wanted. In the first place signal-to-noise ratio is a matter of vital consideration. Therefore a high-frequency stage in front of the first detector is desirable. It is possible to obtain substantial gains even down at 15 metres, so that radio-frequency amplification at short wavelengths is no longer an impracticable proposition. Then a mixer of at least the triode-hexode class (or its equivalent using two valves) should be employed so that efficient mixing without pulling is obtained.

The intermediate frequency can be more or less normal, although the greater band-spread permissible on short waves would make the use of variable selectivity here a useful refinement. Full spread could be used for short-wave reception and the selectivity increased for ordinary broadcast purposes where necessary.

Matter of A.V.C.

Perhaps the most important refinement however is in the matter of the automatic volume control. The fluctuations of signal strength on short-wave transmissions are much heavier than on any ordinary broadcast programme. Consequently effective A.V.C. is necessary. We have already three valves, namely, the high-frequency amplifier, the mixer and the intermediate-frequency amplifier, which we can control, and it would be quite justifiable to use for the detector such a valve as the DDPen, which is capable of giving a control on the low-frequency output subsequent to the detector. This will give four stages of control and result in a level characteristic under all conditions normally encountered.

Such fading, more than can be handled by this arrangement, is almost certain to be accompanied by serious distortion.

We have, however, confined our attention so far to superhets. The question may arise whether this is justifiable. It has been stated that gains of 20 to 30 can be obtained even at 15 metres. Fig 6 shows the circuit which I have used successfully for this purpose. It will be seen to be very straightforward. The coil was wound on a small former and was tuned with a .0002-microfarad condenser. At slightly longer wavelengths the gain increases quite appreciably and it would certainly seem that a new technique of tuned radio-frequency in short-wave and all-wave sets might be developed.

No Insuperable Ganging Troubles

There would appear to be no insuperable difficulty over ganging the condenser control although minor troubles might be expected to arise during the experimental stages. Here again there seems to be a need for a coil and perhaps some enterprising manufacturer will market an all-wave coil having perhaps four or five wave-ranges capable of being used in a tuned radio-frequency stage.

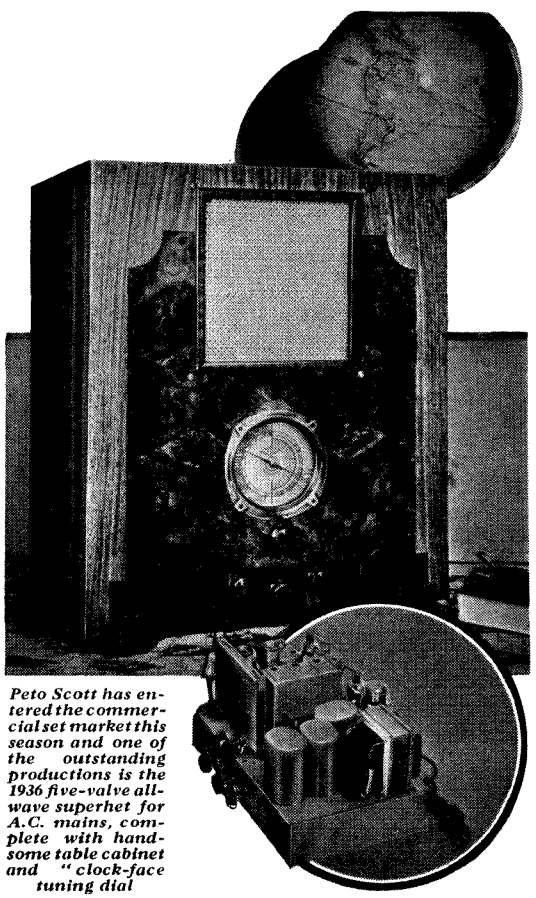
The advantage of the tuned radio-frequency stage particularly on short waves, is the absence of background noise owing to the omission of the local oscillator which, in a superhet, not only heterodynes the signal and produces the intermediate frequency we require, but also heterodynes all the small unconsidered trifles that go by the name of " mush " and causes them to be amplified to the same degree.

If a " t.r.f." circuit is to be successful, however, a good detector with smooth reaction will be required, and for this purpose I would suggest the use of a screened-grid or screened-pentode detector.

Grid rectification must be adopted as otherwise smooth reaction is impossible for the following reason : if an anode-bend detector is employed (and a screened grid anode-bend detector is a remarkably efficient piece of work) the application of reaction causes the anode current to increase.

This immediately causes the anode voltage to drop so reducing the efficiency of the detector, and the circuit falls out of oscillation again so that it is impossible to hold it just on the edge of oscillation as is so desirable.

In a grid detector this difficulty does not arise and it is possible to bring it right up to the threshold, so obtaining large and stable amplification.

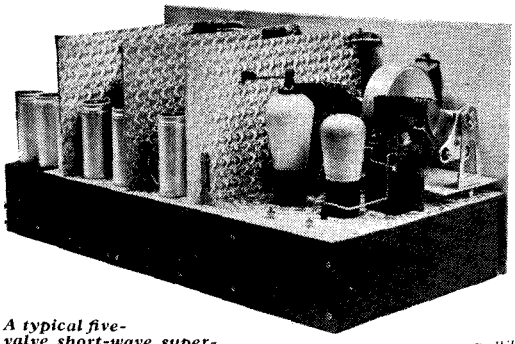


Peto Scott has entered the commercial set market this season and one of the outstanding productions is the 1936 five-valve all-wave superhet for A.C. mains, complete with handsome table cabinet and " clock-face tuning dial

Your Ideal Short-waver

By G. HOWARD BARRY

A very interesting article from our popular short-wave contributor in which he describes the technicalities of the most popular types of receivers, outlines their most glaring troubles and explains methods of curing many of the most common faults



A typical five-valve short-wave super-het built by a member of the D.A.S.D., the German short-wave amateur's organisation. Note that a wooden chassis with an aluminium covered top is used

Gulliland photo

I WAS really asked to write an article on "My Ideal Short-waver," but, after due reflection, I decided that this wouldn't be at all fair to readers. After all, a set that would be ideal for my own purposes would only be suitable for readers who agree with me in everything that I say; and I don't suppose their number is legion!

Everyone has his own idea of what he wants from a short-wave set. Some people, as I have said before, only want loud-speaker reproduction of a handful of powerful stations. Others are simply left cold by the mere idea of receiving the regulars—they just pass over them with a bored expression and look for something else.

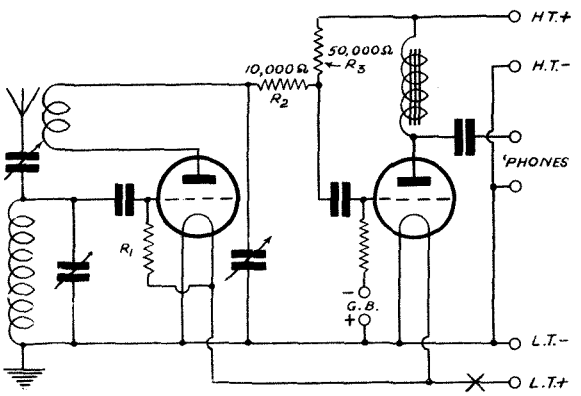


Fig. 1.—Probably the most common form of short-wave receiver, the straight detector-and-one-L.F. type

Some readers there must be, whose dream of bliss is a single-knob receiver that never goes wrong; others there certainly are who want all the knobs that they can possibly have, and any trouble only adds to the fun of the thing as far as they're concerned.

The outcome of all this deep reasoning is that I propose to describe a few imaginery sets, and to outline their probable shortcomings as far as performance is concerned. First of all, let us attack the ordinary detector-and-one-L.F., as shown in Fig. 1, which must be in use in 90 per cent of the short-wave-conscious homes in this country.

It can be very good, or it can be unbelievably bad—and the margin between these two states is very, very narrow. It is mostly a question of components, lay-out, and general workmanship with the wiring, etc. At its best it isn't exactly a luxury receiver, by which I mean that if you expect it to bring in thirty stations on the loudspeaker while you sit back in the armchair and just touch one knob occasionally, you're a confirmed optimist.

If you use a pentode in the output stage, you will probably succeed in putting quite a dozen stations in on the loudspeaker; otherwise it is essentially a headphone receiver.

Now let's pull it to bits (figuratively, I mean!). It's most glaring fault is that it is bound to be touchy about the reaction control. If you don't keep it just on the critical point, either just below or just above the oscillation point, you will miss nearly all the weak stations.

Getting Smooth Reaction

We can make the best of this particular bad job by taking real pains to get reaction as smooth as possible. This means fine adjustment of the detector-anode voltage (whether it is set by wander plugs or by a series resistance); correct choice of grid-leak value for the particular valve (not just *type* of valve) in use; and the abolition of hoots and plops caused by high-frequency getting through to the low-frequency stage.

The latter is assisted by using as small a reaction coil, and therefore as large a "slice" of the reaction condenser, as possible, and by the use of the 10,000-ohm resistance R_2 in place of the more usual choke.

Hand-capacity Troubles

That should dispose of Glaring Fault No. 1, so to speak. The second one, which some readers may think I ought to have put first, is hand-capacity trouble. After investigating some hundreds of cases of hand-capacity and elusive tuning, I am convinced that it is entirely a matter of layout and wiring. If your set is

built from a more sound design and, more important still, if you have really made a sound copy of the designer's original, you simply won't suffer from this trouble.

If nothing cures it, you will have to equip the set with a false front panel and put in short extension handles between the condensers and the slow-motion dials. I don't encourage this practice, because any set ought to behave without its owner having to fall back on devices of this kind.

Sometimes hand-capacity is simply due to the use of much too great a degree of aerial coupling, which usually introduces, also, the other

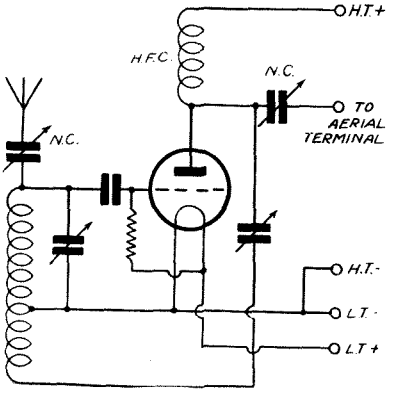


Fig. 2.—A circuit for an autodyne superhet adaptor; this does not find favour with the author, who complains bitterly of second-channel troubles

major fault—dead spots in the tuning. All that I can say about this is that if your tuning control has a kind of "hole" in the middle which disappears when you remove the aerial it's because you couple the aerial too tightly—so don't!

Dead-spots and resonances are sometimes due to bad chokes, but since the Fig. 1 circuit doesn't use one, we need not dwell on that. Another cause, however, is the use of too large a reaction coil which, with the reaction condenser, may actually tune to a frequency within the tuning range. Use as small a coil as possible. With the average ready-made four-pin coil this is looked after for you.

Stable, Sensitive and Selective

With all these things attended to, the receiver of the Fig. 1 circuit can be a very pleasant little fellow to handle—stable, sensitive, and reasonably selective. Its background ought to be pretty quiet, and you should hear on it everything that is strong enough to come above your particular interference-level. What more can you hope for, on *any* set?

Fig. 2 is a little fellow that must be in use in lots of short-wave dens—the autodyne superhet adaptor. In other words, it is a plain short-wave detector, coupled through a small condenser to the aerial terminal of a broadcast receiver with some useful high-frequency amplification in it. The latter receiver is probably tuned to 2,000 metres, or something in that region.

Well, of course, this little adaptor will bring in the louder stations all right; in fact, it will bring them all in twice, to show there's no ill feeling. In fact, if you're really lucky, you may find that the second channel of one falls on top of the first channel of another, and you will be able to listen to two programmes at once!

Seriously, it's a nasty business, and the autodyne type of superhet adaptor ought to be abolished. If you're going to be quite content with listening to, say, W2XAD or W8XK or the Europeans at good loudspeaker strength, then you'll get what you want without going in for anything more complicated. If you want more than this, my advice is: "Forget adaptors, and either use it as a single-valve receiver or just use it as the detector of a big one."

As a third alternative, you may just plug it into the low-frequency end of a broadcast receiver; but, please, don't try to use it as a superhet adaptor. You will need a heptode or a triode-hexode to make a real job of that kind.

I shall be designing a complete short-wave superhet very shortly, and remarks about the frequency-changer can keep for the time being.

Fig. 3 shows a type of set that, for some unknown reason, is not very popular, although it definitely is the receiver *par excellence* for the headphone addict. Not many of us are content to stay at the controls of a single-valver these days, but it's a funny thing that we almost invariably make our second valve a mere unexciting low-frequency stage. I suppose it's just because it's easy.

I have often used a set like that shown in Fig. 3, and *please* note that it *is* a high-frequency stage and not a mere buffer. There is not the slightest difficulty about ganging the two condensers C_1 and C_2, provided that L_1 and L_2 are similar coils with similarly short wiring to the condensers.

Snags in an H.F. Stage

But there *are* snags; fortunate, for it gives me something to talk about. One might think that the first would be instability of the high-frequency stage. It *may* be, but it has never worried me in the least; in fact, I can't say that I know what an unstable high-frequency stage in such a receiver would sound like!

The neutralising condenser used for coupling the first valve to the detector should be set at roughly the same position as that coupling the aerial to the first valve. Don't imagine that this will give a guarantee of accurate ganging—I don't profess to know the capacity of your aerial system.

Easy Tuning

That, however, is a fairly good way to start. If your two controls are separate, arrange those two coupling condensers until you have such settings that the readings of your two main dials are roughly equal when you tune in a station somewhere in the centre of the scale.

Your high-frequency tuning condenser should not have a "pulling" effect upon the detector tuning. That is to say, you should be able to set the first dial anywhere, and to tune in a station on the detector control alone; then, when you swing the first dial, the station should merely increase in volume as you come into tune, instead of wandering off and needing re-tuning.

Now and then you should unhitch the aerial from its coupling condenser and put it straight on to the anode of the screened-grid

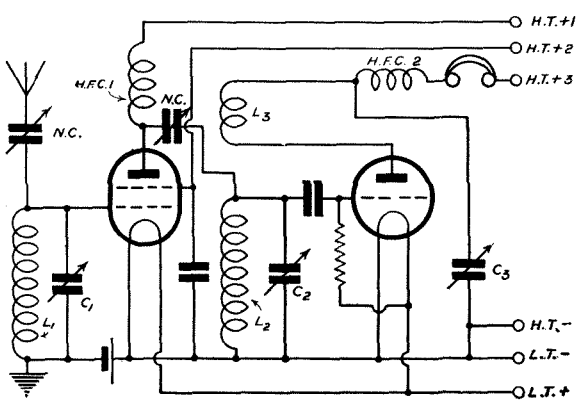


Fig. 3.—A two-valve short-waver with a high-frequency amplifier and leaky-grid detector. There is no difficulty in ganging the condensers C_1 and C_2

valve, carefully comparing signal-strengths with the two settings. This is just to make sure that you *are* getting some amplification.

It may not be very great by the time you get down to 20 metres and below, but on the 31-, 40-, and 49-metre bands it should be very considerable. In fact, there should be little difference in the general effect of the set (with headphones) from that of a detector-and-low-frequency type.

Safeguard Against Troubles

The mere presence of a high-frequency stage, if it is working respectably, should be a safeguard against practically all the troubles that I quoted with respect to the first circuit. Even if it doesn't amplify, it is well worth its keep.

The screen voltage is not unduly critical, but it should be varied while the set is actually operating to make sure that the recommended voltage really is the most suitable. I have come across more than one set of this type that has been disappointing simply on account of bad choice of screen volts.

"Your ideal set" may not bear any resemblance to any of these three simple receivers. If it doesn't, however, it is probably a combination of the first and last, although I know only too well that a complete superhet is one of the most popular receivers nowadays.

To deal with such a set and to cover all the possible faults, however, is right outside the scope of a single short article, and I can only make one or two general remarks.

If you are troubled with second-channel interference (that is, the appearance of all stations at two settings, and a preponderance of squeaks and "yoops"), then you undoubtedly need more pre-selection. I don't see much fun in any superhet that doesn't use a fully tuned high-frequency stage.

If your frequency-changer is a heptode or a triode-hexode, you are not likely to encounter much trouble there. If your intermediate-frequency stages use the popular 450- or 475-kilocycle transformers, there won't be much wrong there, either.

Use Anode-bend Detection!

Second-detector overloading seems to be a fairly common fault, but that is chiefly because some people expect a leaky-grid detector of the general-purpose type to stand the racket of all signals great and small. Use anode-bend for the second detector if strong signals upset things.

General instability on the part of a superhet is generally due to one of the causes already outlined, affecting either the high-frequency stage or the first detector-cum-frequency-changer.

One of these days I will write about "*My* Ideal Set," but it will be something of a surprise to readers, I'm afraid, because my own ideals are somewhat specialised, I'm not particularly easy to satisfy.

Compiled by JAY COOTE

"W.M." *Short-wave Identification Panels*

Metres: 22.35 / 44.71 **SAN JOSE (TIEP)** ***Kilocycles: 13,415 / 6,710***

(Costa Rica)

Power: 500 watts

Geographical Position: 9° 56′ 00″ N.; 83° 52′ 00″ W.

Distance from London: Approximately 5,430 miles

Standard Time: B.S.T. less seven hours.

Announcer: Man.

Languages: Spanish and English.

Call: "La Voz del Tropico."

Times of Transmission (B.S.T.): Daily (except Mondays) 01.00-05.00, 44.71 metres; Mondays 01.00-04.00, 22.35 metres (experimental).

Belongs to the Indo-American chain.

Metres: 22.94 **SUVA (VPD)** ***Kilocycles: 13,075***

Power: 2 kw.

(Fiji Islands)

Geographical Position: 18° 5′ 00″ S.; 178° 28′ 00″ E.

Distance from London: Approximately 11,100 miles.

Standard Time: B.S.T. plus eleven hours.

Announcer: Man.

Language: English

Call: "Radio Suva calling."

Times of Transmission (B.S.T.): Daily (except Sundays) 06.30-07.30.

Belongs to Amalgamated Wireless of Australasia, Ltd.

Closes down with *God Save the King.*

Metres: 25.6 **MEDELLIN (HJ4ABA)** ***Kilocycles: 11,720***

(Colombia)

Geographical Position: 6° 2′ 00″ N.; 75° 49′ 00″ W.

Distance from London: Approximately 4,650 miles.

Standard Time: B.S.T. less 6 hours.

Announcer: Man.

Languages: Spanish and English.

Call: "Ecos de la Montana." Every half-hour call given in English: "You are listening to Station HJ4ABA, Medellin, Colombia."

Times of Transmission (B.S.T.): Daily 23.00-04.00.

Metres: 31.36 **BOMBAY** ***Kilocycles: 9,565***

Power: 4.5 kw.

(India)

Geographical Position: 72° 49′ 16″ E.; 19° 00′ 27″ N.

Distance from London: Approximately 4,470 miles.

Standard Time: B.S.T. plus four and a half hours.

Announcer: Man.

Languages: English (Hindu for native programmes).

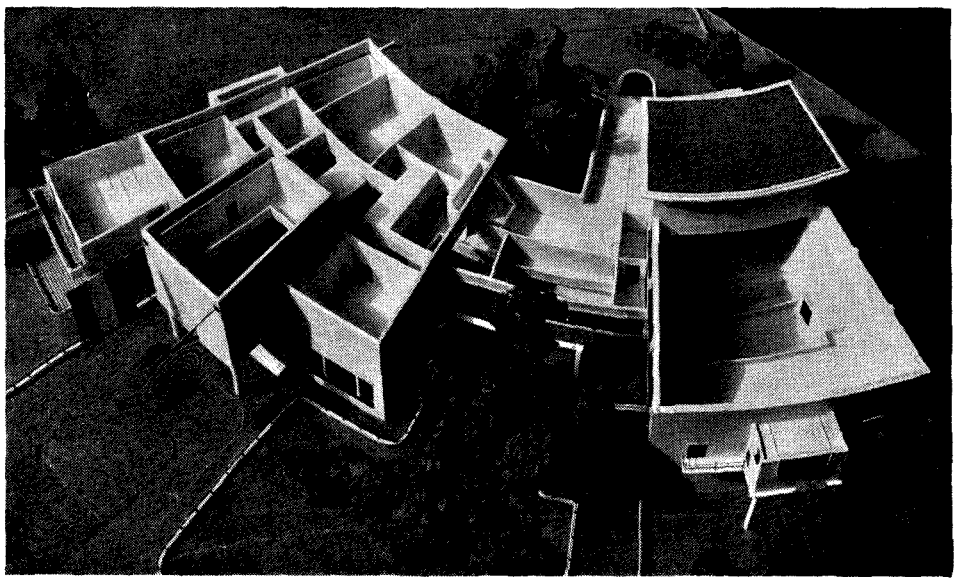
Times of Transmission (B.S.T.): 14.30-16.30 (Sundays), 17.30-18.30 (Wednesdays, Thursdays, and Saturdays). Occasionally works on Mondays.

Opening Call: "This is the Bombay station of the Indian Broadcasting Service, followed by indication of Indian standard time."

Interval Call: "Bombay calling."

Closing Announcement: "This concludes our to-day's broadcast and the Bombay station of the Indian State Broadcasting Service is closing down until to-morrow. (Time, I.S.T. is given.) Good-night everybody."

Above announcement is followed by *God Save the King.*



A model of AVR 'S new Broadcasting House, which is rapidly nearing completion. AVRO is the most powerful of Holland's five broadcasting concerns, having more voluntary subscribers than those of all the others put together

By HANS W. PRIWIN

Radio in Holland

"... for Huizen that is Hilversum, and Hilversum is Huizen!"

THE sub-title of this article is taken from a little poem dealing with the apparently insoluble problem of Huizen and Hilversum, that appeared a few years ago in an English radio magazine. Hilversum changes to Huizen, Huizen to Hilversum : for years this game has been repeated on the first of every quarter and even today there are still many listeners who believe that on April 1, for instance, the Hilversum station is neatly packed into boxes and reconstructed again in Huizen and vice versa.

The solution to this puzzle is really a very simple one, but first we had better say a few things about the organisation of Dutch radio.

Holland is today the only European country with such a paradisical state of affairs that everybody can be a listener without having to pay a penny for the privilege. Radio is free—but those who wish to send a voluntary contribution support thereby one of the private or political radio companies that broadcast their programmes from the two stations, Hilversum and Huizen.

These several radio companies are, of course, competing fiercely against one another—and in the broadcasting world the best means of competition is to own a first-rate transmitter that can be well received at as great a distance as possible.

At the Lucerne Conference—held in the summer of 1933—the Dutch delegates failed to get a second long-wave channel for their country : even the one long-wave already possessed by Holland was the subject of a long and tough struggle at the Conference. As in Holland there are five different radio companies recognised by the State and each demands for itself an equal right to use the greatly desired long-wave station, a Solomon-like solution had to be

If you tune-in to Hilversum and hear real lively and tuneful dance music, you can take it that it is being played by Kovacs Lajos and his AVRO Dance Orchestra—one of Holland's star broadcasting combinations

found : one quarter of a year one group uses the long-wave transmitter at Huizen, and another group has its turn in the following quarter.

Now, as one company, AVRO, was the first to use the Hilversum studio, the name Hilversum has become bound up with the AVRO programmes. For this reason AVRO, even at the quarterly wavelength change-over, retains its well-known "Hilversum calling" although using the long-wave station at Huizen. It is not, therefore, that the stations have changed their wavelengths, but merely that there has been a change of radio companies using the transmitters.

This all seem a trifle complicated, but I hope nevertheless that I have solved the Hilversum-Huizen mystery.

The different interests represented by Holland's private radio companies make the organisation anything but simple. The Home Office has the right to censor all broadcasts. The Ministry of Waterways, strangely enough, also has its say in the matter and, finally, a short time ago there was founded a company, Nozema, which has taken over the two stations, Hilversum and Huizen, and is lending them out by the hour to the different broadcasting companies. Since the State holds 60 per cent of the shares in Nozema and the other 40 per cent are held by the radio companies, the State here, too, holds a key position.

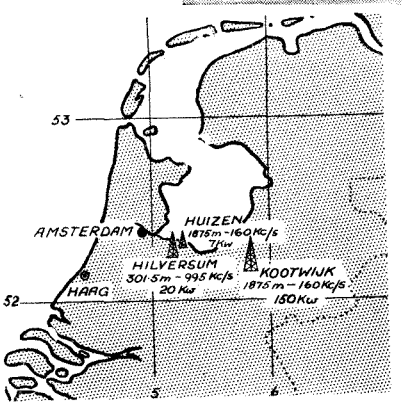
Of the five different radio companies, AVRO is the most important. AVRO is an abbreviation of "Algemeene Vereeniging Radio Omroep" (General Union Radio-Broadcasting), which has its studios at Hilversum. Although, as I have already mentioned, Dutch listeners are not taxed by the State, AVRO has been able to obtain some 200,000 voluntary subscribers.

This is clear proof of the quality of AVRO programmes and of the objectivity of this company which—unlike the other companies—represents no political or religious views.

AVRO listeners pay an annual voluntary contribution of 3.25 guilders (about 9s. 6d.). The company's total income in 1934 amounted to 716,300 guilders (£100,000). Out of this revenue is borne the entire costs of organisation and publication of the official magazine "Radio Bode," which has a circulation of more than 250,000 copies. The company has to pay a fee to the State of two guilders (5s. 4d.) for every broadcasting hour.

The four other companies together have about the same number of listeners as AVRO alone. They are KRO, the Catholic corporation; VARA, the Union of Worker-Radio-Amateurs; NCRV, the Christian corporation, and VPRO, the Liberal-Protestant corporation. From their names you can tell at once the political or religious convictions that the companies represent. This is also of course made very clear in their programmes. Thus, the religious societies, for instance, broadcast *no* dance music. This, by the way, is done best by AVRO.

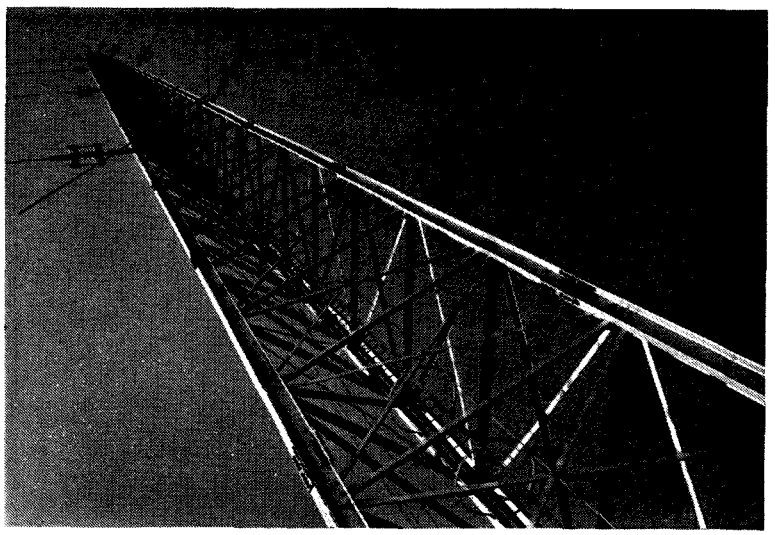
The imposing entrance to AVRO's administrative buildings in the Keizergracht, Amsterdam



A map of Holland, showing the positions of the three main broadcasting stations

A big part is being played in Holland—as also in Switzerland—by "wireless-hire" companies which distribute radio programmes by means of cables to their subscribers. These companies get their programmes either direct from the local broadcasting companies or else, when it comes to foreign programmes, by receiving them by means of gigantic receivers after which they are amplified and relayed by wire to subscribers who have thus a daily menu composed of the programmes of all well-defined European broadcasters without having to do anything more than instal a simple loud-speaker.

The great importance of these wireless-hire companies in Holland is being



An impressive photograph of one of the new aerial masts at the Hilversum station. The mast is of the latest type and is actually the aerial—no wires being employed at all

proved by the number of their subscribers which has already passed the 300,000 mark. Since these wireless-hire companies have to pay the State 50 cents per subscriber annually, once again the State is able to make a nice profit without moving a finger.

If we wish to study the Dutch programmes we cannot do better than to study AVRO's, to which many listeners abroad constantly tune in. The management of the whole concern is in the hands of Director Willem Voigt, who has contrived to put his organisation on such a modern footing that in the course of a few years it has taken an easy first place.

The AVRO programmes are made up under his direction. Of them the famous Mengelberg concerts are best known to foreign listeners. They are transmitted at regular intervals and, in company with the English Proms., the Viennese Symphonic and Berlin Philharmonic concerts, are the high spots of European concert life. These Mengelberg concerts are given by the " Concert Hall " orchestra and, according to AVRO's latest statistics, were heard last year during 78.3 broadcasting hours. Taking a concert to last two hours, this represents about 40 Mengelberg concerts in one year !

Music takes up easily the biggest part of Dutch programmes. In the AVRO programmes, serious music takes up 81.5 per cent of the total, 75 per cent of VARA's, 70 per cent of KRO's, 60 per cent of NCRV's and about 18.7 per cent of VPRO's. This last company, which greatly stresses its Protestant character, seems to be out of place in these statistics ; but then the chief part—56.7 per cent—of its programmes is made up not of music but of the spoken word—church services, religious talks and readings.

A very big part of the musical programmes is filled by gramophone records of which AVRO alone has broadcast no less than 12,400 during 720 broadcasting hours, and finally we must not forget dance and cabaret music to which Holland, in the last few years, has contributed a famous exponent, Kovacs Lajos, who is employed by AVRO and broadcasts excellent dance music in the English style.

In spite of his Hungarian-sounding name, Kovacs Lajos is a worthy Dutchman. Some time ago this fact caused a great sensation when a Dutch law was passed greatly reducing the appearance of foreign broadcasting artists. It was then that they found out that the fiery son of the Puszta was really a child of the Dutch canals, who had only taken his gipsy name for the sake of originality.

Mengelberg and Kovacs Lajos are the two best items of the AVRO programmes and it is mainly to them that AVRO owes a number of listeners as big as that of all the other companies put together.

The technical position of Dutch radio at the moment is this : besides the two stations at Hilversum (20 kilowatts) and Huizen (7 kilowatts) there is a 150-kilowatt transmitter at Kootwijk constructed by Philips that started operating a short while ago and is to replace the old transmitter at Huizen. Huizen's voice will therefore be heard only in cases when it is being used as a reserve transmitter.

How Kootwijk will be received in the course of the next few weeks is of course still very problematical, since the new Roumanian station, Brasov, is working on the same wavelength (1,875 metres).

The whole broadcasting concern is to be reorganised in the course of the coming month and wireless licences are also to be introduced—when, is still uncertain. If, however, we think of the many unsuccessful efforts which have already been made in this direction, an unprejudiced observer can well imagine that Holland will still continue to be the listeners' paradise and that wireless licences are likely to remain for a long time yet no more than a happy dream of the Dutch Ministry of Waterways,

I must mention the close connection between Holland and her colonies in the East Indies which has had a great influence on radio. With praiseworthy initiative, a private company, the Philips Co., has erected in Eindhoven a large short-wave transmitter from which special programmes for the Dutch East Indies are sent out several times a week.

AVRO, on the other hand, intends to start this month regular transmissions of Indian programmes from the short-wave station at Bandoeng (Java). These will be received in Holland and relayed to the Dutch stations.

Holland has its favourite announcers. This is A. Weitzel, probably the most popular of them all

The man who has made AVRO the leading broadcasting organisation in Holland—Willem Voigt

Kovacs Lajos, leader of AVRO's popular dance orchestra, described by our contributor as Holland's Henry Hall !

This article gives an interesting insight into the problem of realistic reproduction from the musician's viewpoint. The author's condemnation of the unthinking use of the so-called straight-line amplifier is echoed today by the majority of competent authorities, for it is now realised that one should rather aim at providing means of compensating for the non-linearity of the associated loudspeaker and radio circuits, room effects, etc. Our contributor's methods of achieving such compensation may not, perhaps, appeal to the technical purist, but they will direct attention to one of the day's most vital problems

Norman Long, the famous radio entertainer, seems quite satisfied with the tone of this new Portadyne A.C. superhet receiver

Simple Multiple Tone Control

By NOEL BONAVIA-HUNT, M.A.

EVERYONE would like to feel that his wireless set and his gramophone are both capable of producing high-quality speech and music. But this is not enough, for a set may be *capable* of producing good results when conditions are favourable, yet may sound disappointingly bad on other occasions.

Author's Own Problem

The truth has been borne in upon us that transmissions are not dependable, and recordings vary tremendously. Then there is the difficulty, now more generally recognised than it was a year or two ago, of preserving the correct balance of bass and treble registers at the greatly reduced volume level required in the average living-room. This is a problem which I have made especially my own and the object of this article is to show how it can be solved.

Those who contend that a straight-line frequency-response amplifier meets any situation that can possibly arise are welcome to their own views; but this attitude will not satisfy the musician whose immediate criticism is that the reproduced version is totally different in balance and quality from the original.

Personally, I am unable to tolerate the musical effect of a straight-line amplifier for more than a few seconds: it gives me excruciating pain after more than a minute's listening. I want more bass, less middle, less treble, and a great deal more warmth in the tone. This is speaking quite generally, without entering into minute details.

When I say less middle, I refer to the frequency band covered by 150 to 500 cycles, and not to the frequencies above this; in other words, to the lower middle register rather than the upper. The bass register should be regarded as consisting of all the frequencies below 150, though this is only an arbitrary division of the musical scale.

For the purpose of clear thinking on this matter the following divisions will prove very helpful to students of quality:

Bass Register: From 25 to 150 cycles.
Lower Middle Register: From 150 to 500 cycles.
Upper Middle Register: From 500 to 1,000 cycles.
Lower Treble Register: From 1,000 to 3,500 cycles.
Upper Treble Register: From 3,500 to 8,000 or higher.

It must be pointed out that the lower middle register is, among others, constantly drawn upon by musical composers for what is known as "close part-writing." That is, chords are written in which the constituent notes are close together in pitch, and unless each separate note in this particular register is clearly defined in both the transmitted and the received version the result is a confused muddle of sounds.

"Bass Part"

Notes below 150 cycles are usually —though there are exceptions to this rule—more or less separated from the close texture of the massed chords and function as a "bass part." The upper treble register is mainly responsible for the harmonic colouring of the various musical instruments, and the 3,500 cycle limit of the lower treble register marks the upper extremity of the

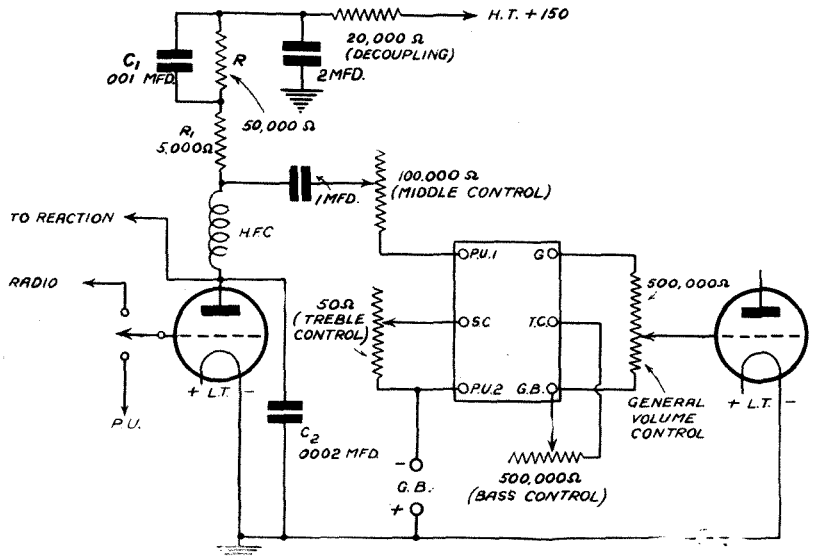


Fig. 2.—The theoretical circuit of the tone-control system recommended by the author; the bass and treble controls work independently of each other and the main volume control has little effect on the whole of the response curve

fundamental scale, that is, of notes actually *played* by instrumentalists.

An exception to the latter occurs in the case of the organ, the highest note of which is approximately 8,000 cycles; and this is due to the fact that the harmonic notes are artificially produced by organ builders to compensate for the comparatively meagre harmonic development of the foundation tone of the organ.

Some Imperfections

Unless one has some idea of how these various groups of notes are handled in the production of music it is not possible to tackle the problem of low-frequency amplification with any hope of success. With imperfect microphones, amplifiers, transmitters and loudspeakers *and* the necessity of reducing the volume level several decibels below that of the original, it is small wonder that receiving sets should cause some disappointment to their owners, especially if the owner happens to possess a discriminative ear.

"Warm Tone"

I have a friend who is "cursed" with such a faculty. His ear is extremely sensitive to slight variations of tone quality. He likes what he calls a "warm tone," yet he is just as keen on "crispness" and clear definition of all the parts that make up the piece he is listening to. He likes plenty of bass, and he insists on a good balance between bass and treble.

Using the ordinary methods of low-frequency coupling he failed to get what he wanted. He, like hundreds of others that I know of, had spent many months trying out all kinds of couplings, valves and loudspeakers: all to no purpose as far as he himself was concerned, though the dealer did not agree with him!

Now I propose to spend the remainder of this article in describing the means by which I succeeded in solving his problem. He is completely satisfied.

We will assume that the low-frequency amplifier consists of first, second and output valves with their coupling circuits. If the detector valve is of the leaky-grid or anode-bend type it will also be the first low-frequency valve and will count as such in the amplifier. We will also assume that the coupling between the second low-frequency valve and the output valve (that is, the last two valves of the amplifier) is either by means of a parallel-fed transformer or a push-pull transformer (if two valves in push-pull are employed).

Most Important Stage

The important stage as far as tone control is concerned is the first, that is, between the first and second valves of the amplifier. Now there is one very obvious problem which the gramophone pick-up introduces—the problem of bass compensation. It is not sufficient to boost the bass register; it is equally necessary to reduce the middle register *at the same time*. Otherwise, the reproduction does not come out clearly defined, and it quickly loses its appeal to the ear.

Fuss About Top Response

Some people are at the present time making a lot of fuss about the treble register. It must be borne in mind that it is worse than useless to keep up the treble response at the expense of quality. Amplifiers and (it must be added) loudspeakers designed merely to *extend* the frequency range with the laudable object of attaining what is called "high-fidelity" reproduction do not necessarily solve the quality problem:

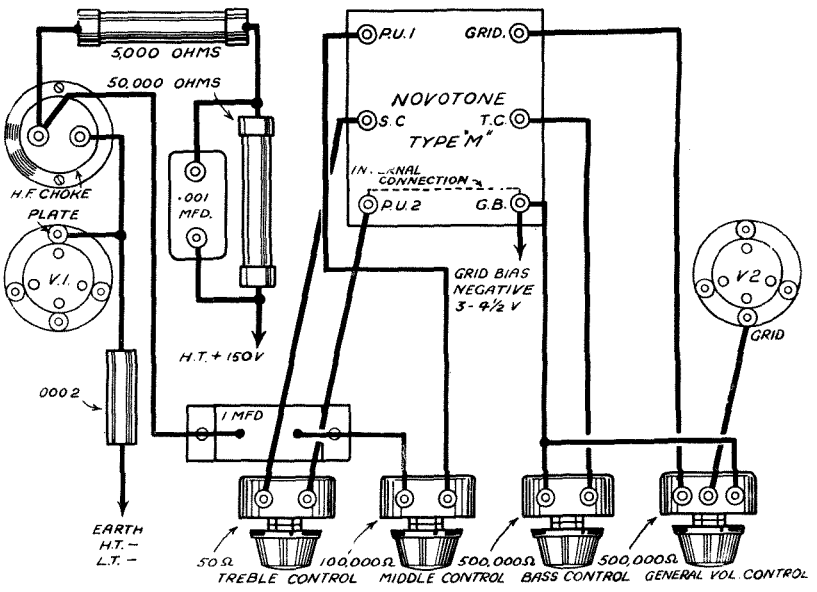


Fig. 1.—How the author arranged his friend's receiver with the four tone-control knobs on the panel to enable him to get quality suited to his own particular whims. The Gambrell Novotone plays a large part in the arrangement

they may destroy what little quality the receiver happened to possess.

These extreme upper frequencies sound very, very differently in the real performance: via the loudspeaker they are sometimes awful. They frequently abstract the "warmth" from the tone, to my ear, and rather than lose this essential feature I would prefer to sacrifice some of the top register. However, we can safely run up to 7,000 or 8,000 cycles, and design the amplifier so as to preserve a "warm" quality of tone at the same time.

Tone-control Unit

It is well known that the Novotone, invented by Dr. N. W. McLachlan and manufactured by Gambrell Bros. and Co., provides ample compensation in the lower register, and at the same time boosts the treble register up to 5,000 cycles, leaving the upper middle register more or less unaffected. This small component, known as type M, is fitted with both treble and bass controls, terminals being provided to enable resistances to be shunted as required.

It is, however, very desirable that some control of the lower middle register should be arranged for, and this is fortunately quite a simple matter. It was this particular control that so appealed to my friend, for it enabled him to thin out the reproduction in the right part of the spectrum without reducing volume to too low a level.

Amplifier Design

All that is necessary is to design the amplifier so that full volume is rather in excess of what is normally required for the room, and this is easy enough when three valves are in use and the valves are carefully selected with this end in view.

The reader is now referred to Fig. 1, in which the complete set of controls are shown. On my friend's panel the four knobs are arranged in a horizontal row! He can amuse himself rotating one or the other at will, and he can get just the tone he wants. As a rule, the most useful control would be that labelled "Middle," though the more correct appellation would be "Lower middle control."

Assuming that pure resistance coupling (comprising a 50,000-ohm resistance in the anode coupled by a .1-microfarad condenser to a .25-megohm grid leak) would provide a high standard of reproduction for this stage, he hooked this up for purposes of comparison. To his surprise, both speech and music came through purer and with better definition when the Novotone was switched into circuit.

Speech with the general and middle controls at their optimum setting was extraordinarily realistic, consonants emerging in the right ratio of strength to vowels. An ordinary single diaphragm permanent-magnet moving-coil loudspeaker was employed.

Fig. 2 gives the theoretical diagram of the circuit, and a study of both Figs. 1 and 2 should make everything quite clear to the reader.

It must be pointed out that the bass and treble controls act independently of each other, while the middle control affects the whole of the response curve to a certain extent, the lower middle register being most affected. The general volume control reduces all frequencies uniformly, or nearly so, the upper register being somewhat attenuated when the potentiometer is turned down to a point below the 250,000-ohm value.

A little experience is all that is required to operate the controls to give the best balance of tone, and each one of the four knobs will at one time or another be found extremely useful.

The resistances R and R_1 in the anode circuit of the first low-frequency valve and the coupling condenser C have been carefully designed to suit the impedance of the primary winding of the Novotone, while the shunt condenser C_1 has been introduced to flatten out the usual upper peak occurring in the characteristic curve of most pick-ups.

Since this condenser does not seriously impair frequencies below about 7,000 cycles, it can safely be left in circuit for the radio side, though there is nothing to prevent its removal if desired. The high-frequency choke and by-pass condenser C_2 are included on the assumption that the first valve is being used as a radio detector.

Queries of Interest

This selection of questions and answers taken from our post bag has a direct bearing on everyday practical problems. Readers asking these questions have, of course, received their replies through the post

S. T. I. (Liverpool) expresses interest in the interference-neutralising scheme described by P. Wilson in our last issue, but wonders whether difficulty will not be encountered from phase differences in the various signals.

Mr. Wilson is now working on this problem, and finds that the phase-difference questions are actually very complicated. It appears that there may be wide differences in actual practice; but, fortunately, the matter is simplest in the case of signals of adjacent frequency, and it is with these that one is primarily concerned.

◈ ◈ ◈

N. N. C. (Durham) has noted references to silver-plated coils for short waves, and asks whether this is merely an excuse for high prices or actually a means of increasing efficiency.

The basic idea is that the higher frequency currents tend to travel more and more over the surface of the conductor, and use the interior hardly at all; it therefore becomes helpful to coat the wire with a metal of lower resistance than copper when such a course is practicable. The conductivity of silver *is* a little better than that of copper, and so it is often used in those cases where one is aiming at the highest possible efficiency.

◈ ◈ ◈

W. T. U. (Penhurst) raises the old question of soldered versus screw-down connections, and asks whether we can justify a statement that it pays to solder a tag to the end of each lead, even when the tag must be gripped under a terminal nut.

At first glance, the suggestion may appear absurd; as our correspondent remarks in his letter—if you must use a screw-down connection, why not let it be direct to the end of the wire? Actually, there is a sound reason for the method, and that is to be found in the fact that a nut screwed down upon a wire of any thickness is far more liable to come loose in time than one tightened down upon a thin flat solder-tag. There is, in fact, much to be said for the method so long as the constructor is really proficient with his soldering-iron.

The German family listens in to a 1936 Telefunken receiver. The set, which employs three valves plus a rectifier, costs 163 reichmarks for A.C. and 183 marks for A.C./D.C. working—roughly £13 and £15 respectively at the present rate of exchange

Radio News from Abroad

Collected by JAY COOTE

ALGERIA

NOTWITHSTANDING complaints by listeners that broadcasts from Radio Alger are not of sufficient power to cover the district, the authorities have postponed the reconstruction of the station, although promised for some time, until 1937 in view of financial difficulties. It is then planned to increase the power to 100 kilowatts.

ARGENTINE REPUBLIC

Since 1934 the power of some of the Buenos Aires transmitters has been increased, and broadcasts from the following stations are now being heard between B.S.T. 02.00-04.00 ; Radio Prieto (LS2), 252.1 metres ; Radio El Mundo (LR1), 280.4 metres ; Radio Splendid (LR4), 303 metres ; Radio Belgrano (LR3), 315.8 metres ; Radio La Nacion (LR6), 344.8 metres, and Radio Excelsior (LR5), 361.4 metres. The air line distance between Buenos Aires and London is roughly 6,930 miles.

BULGARIA

As broadcasting has now been taken over by the State the Radio Rodno private transmitter at Sofia will shortly be closed down. It has been planned to erect a 100-kilowatt station in its stead at Vakarel, some short distance from the capital.

FRANCE

Radio Lyons, one of the first stations to be erected by a private owner, will shortly broadcast its programmes through a new 25-kilowatt transmitter being completed in the neighbourhood of the Tour de Salvagny. The channel to be used is 215.6 metres (1,392 kcs.).

GERMANY

Alterations have been made in the musical interval signals used by the Leipzig and Cologne studios. The former has adopted three chords in D major, which are played *ad lib.* by means of an electrical device. The Cologne signal, so far, is still a temporary one.

GREAT BRITAIN

In addition to GED, Croydon, which may be heard in constant touch with civilian aircraft, listeners may pick up transmissions from a number of Air Ministry wireless telephone stations. The transmitters using the 862-metre (348 kc.) channel are : GED, Croydon ; GEB2, Hedon (Hull) ; GET, Newtownards (Belfast) ; GEM, Manchester ; GEN, Portsmouth ; GVC, Jersey (C.I.) ; GER, Abbotsinch ; GEL, Aldergrove, and GEG, Lympne. Other stations are in course of establishment.

HUNGARY

To permit the tuning of musical instruments when an orchestra is playing in the studio at Budapest, the engineers have devised a new opening and interval signal which can also be heard by the waiting musicians. Upon pressing a button, the conductor can switch on a normal A for as long as required; when desired it can be relayed to outside concert halls where it is broadcast via loud-speakers.

INDIA

In addition to broadcasting stations under construction for installation at Madras, Allahabad, Delhi and Lahore, the Government of the Nizam of Hyderabad has also decided to install transmitters at Hyderabad and at Aurangabad. These are to be of the most modern type and are being made at the Marconi works.

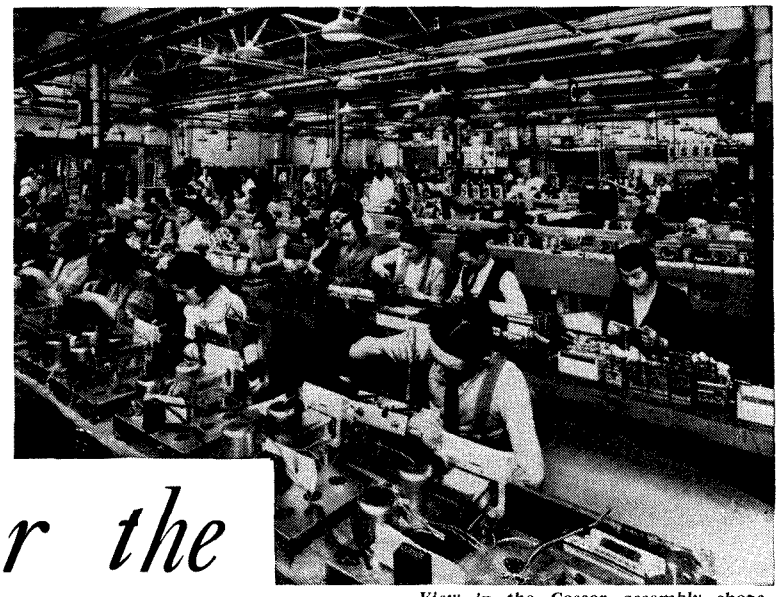
NORTH AFRICA

Since the closing down of the Tunis transmitter, dwellers in Tunisia have had to turn for their broadcasting programmes to France or Spain. It is now reported that the military authorities have lent a small station at Bizerta, which is now operating daily on 209 metres. The power is shortly to be raised to 250 watts. Times of transmission are B.S.T. 12.30, 13.15 and from 20.30 to 22.30.

NORWAY

The newly-constructed Porsgrund relay station may now be heard testing on 352.9 metres (850 kc.).

Aims and objects of this section: the Technical Editor explains his ambitions, then goes on to deal with that useful device, the improvised ohm-meter. How to fit one up, choose the component values, and work out a calibration by simple arithmetic



View in the Cossor assembly shops. When sets are put together with care and skill like this they do not often come into the serviceman's hands

Hints for the Service Engineer

Conducted by G. P. KENDALL B. Sc.

IT is probably scarcely necessary, but I must allow myself a few lines in which to draw attention to the fact that Mr. Tyers has done another excellent piece of work for us in designing his modulated high-frequency oscillator. To possess a really good " signal generator " is the natural ambition of everyone with servicing work to do—an ambition that not all can afford to gratify—and here it is in a form anyone can copy with very little trouble and the absolute minimum of expense.

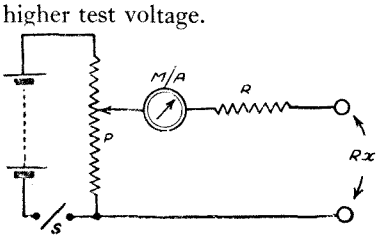
Inexpensive Quality

Just because it costs very little to build I hope no one will imagine that it will not give all that can be expected of the very best type of oscillator ; on the contrary, its wave-form is excellent and its constancy equal to all normal demands. All that it lacks, when built, is a calibration, and that is easy enough to provide for oneself.

By degrees I am aiming at building up quite a range of designs for servicing equipment of the same inexpensive but efficient type; with the aid of Mr. Tyers and others I hope to put even the small-scale worker in the enviable position of being able to acquire really scientific and adequate gear at a cost within the most modest means.

To help the less affluent worker to possess such equipment seems to me to be something well worth doing, for it should tend to increase the general efficiency of the profession and enable us to give the public better service.

Now I had better start on those promised ohm - meter questions before I find myself short of space again. Last month, if you remember, we had just got as far as a mention of the problem of measuring comparatively high resistances, and I had indicated that with the simple system under discussion this necessitated a higher test voltage.



The simple circuit of the ohm-meter device discussed on these pages and in those of previous issues

The simple and most generally useful combination for all low- and medium-resistance checking is the one we have so far been considering —a known resistance of 10,000 ohms and a voltage of 10. This, however, suffices for reasonably close measurement only up to about 20,000 ohms; from that point up to 40,000 it gives a roughish check only, while from 40,000 to 100,000 it serves merely to check that a resistance is within about 25 per cent. of its rating.

General Check Work

For very much of one's general test work this is very useful; it enables the resistances that really matter to be properly measured, and a good enough check to be applied to those not as a rule at all critical. Such a check-over serves at any rate when one is merely seeking the cause of some definite misfunctioning of a receiver.

For Higher Values

To deal with higher values with the same accuracy as that available on the low ones, calls for both a higher known resistance and an increased voltage; some such combination as 100,000 ohms and 100 volts becomes necessary. This will enable resistances up to about 1 megohm to be measured, but of course the size of the battery is not such as to encourage one to carry it around much. Probably this range is better regarded as one to be covered by an instrument kept

Ohm-meter Calibration Table

Current	Equivalent Resistance	Current	Equivalent Resistance
.4	115,000	2.8	7,850
.5	90,000	2.9	7,240
.6	73,000	3.0	6,660
.7	61,400	3.1	6,130
.8	52,500	3.2	5,620
.9	45,500	3.3	5,150
1.0	40,000	3.4	4,700
1.1	35,450	3.5	4,280
1.2	31,660	3.6	3,890
1.3	28,460	3.7	3,510
1.4	25,700	3.8	3,160
1.5	23,300	3.9	2,820
1.6	21,250	4.0	2,500
1.7	19,400	4.1	2,195
1.8	17,770	4.2	1,900
1.9	16,300	4.3	1,630
2.0	15,000	4.4	1,360
2.1	13,800	4.5	1,110
2.2	12,700	4.6	870
2.3	11,700	4.7	640
2.4	10,800	4.8	420
2.5	10,000	4.9	205
2.6	9,200	5.0	0
2.7	8,500		

permanently installed in the workshop or test lab.

Before we go into details, let us refresh our memories with the essential features of the suggested piece of apparatus. I am showing the circuit in a diagram on these pages, and it will be seen to consist of a battery, a means of adjusting the voltage, a milliammeter, a known resistance, and a pair of terminals to which the unknown resistance is to be connected. (The switch is naturally optional: one could just as easily pull one of the battery plugs.)

The voltage adjuster is the potentiometer P, and this *must* be of quite low resistance. A value of 1,000 ohms should be regarded as the maximum, and care should be taken to adjust the battery voltage in such a way that the potentiometer can be kept turned round almost all the way to maximum. By using a well-tapped battery it is usually possible to make sure that not more than 20 or 30 ohms of the potentiometer is included between the slider and the end of the resistance element.

It is to be remembered that the piece of potentiometer in question is common to the measuring circuit and is therefore a potential source of error; only by keeping it small can this error be minimised. It would in this sense be desirable to use a potentiometer of even lower value, but this would involve a perhaps unjustifiable drain on the battery.

What one actually does is to turn the potentiometer round to the maximum setting, short the "unknown resistance" terminals (marked RX on the diagram) and then vary the battery voltage by means of a wander-plug until one finds the lowest voltage that will just send the milliammeter needle off the scale at the top; the potentiometer is then adjusted to bring the needle precisely to the 1-milliampere reading, whereupon the circuit is ready for use.

To calibrate the device one must know the value of R accurately, but it is possible to obtain almost any of the leading makes with a guaranteed accuracy of five per cent. or even closer if desired, so this presents no difficulty. (By the way, if you expect to deal much with quite low resistances of the order of 100 ohms you want R to be known to about one per cent. for good results.)

Just Arithmetic!

With the aid of Ohm's Law one then calculates the total resistance indicated by the current at each division of the meter scale. This is the total of the known and the unknown resistances together, which we will call $R+R_X$. We know R, so we next do the little bit of subtraction involved and so produce a series of figures which constitute a calibration for our ohm-meter.

Labour-saving Table

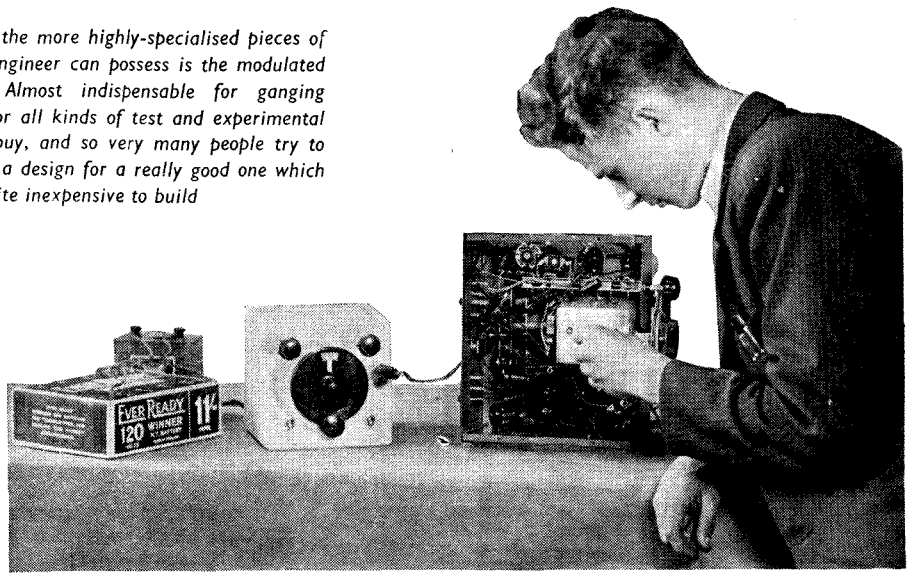
The arithmetic is very simple with 10 volts and a known resistance of 10,000 ohms. It is not quite so simple when one has to use some odd-scale meter that chances to be in hand: one of the commonest of these is the one reading 0-5 milliamperes, and since I happen to have the figures for such a meter when used with 10,000 ohms and 50 volts, I am including them in these notes in the hope that they may save someone some hard work.

The sort of de-luxe equipment to make a service engineer's mouth water: a portable outfit incorporating the ever-useful Weston Analyser, sundry special gadgets and conveniences, and a type 962 oscillator.

As we go to press details of the new Wearite range of servicing test apparatus arrive: space will not allow me to say much about this interesting collection. There is a modulated oscillator covering all the usual broadcast and intermediate frequencies on the fundamental without the use of harmonics, priced at £6 15s.; a very handy looking meter unit at £6 17s. 6d.; a frequency meter of the interrupter type at £4 15s.; and a "Multimeter" priced at £4 5s.

Building a Self-contained Modulated Oscillator

One of the most useful of all the more highly-specialised pieces of apparatus which the service engineer can possess is the modulated high-frequency generator. Almost indispensable for ganging operations; highly desirable for all kinds of test and experimental work; yet very expensive to buy, and so very many people try to get along without it. Here is a design for a really good one which is easy and quite inexpensive to build



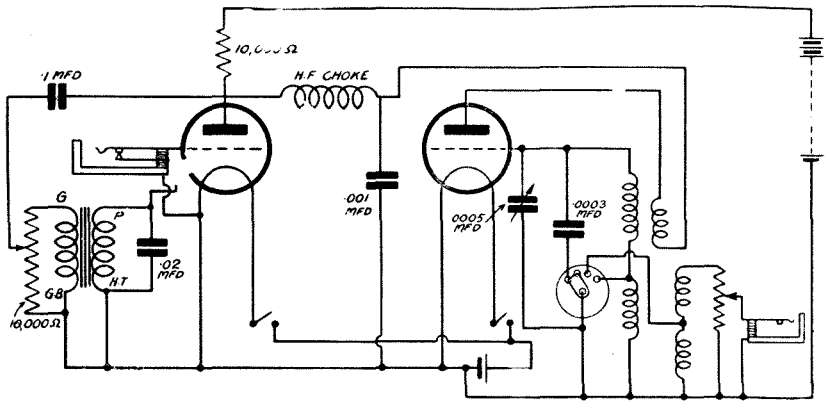
Designed by
PAUL D. TYERS

LITTLE useful service work can be carried out on the modern receiver without the aid of a signal generator. A signal generator, as the name almost implies, is in reality a miniature transmitter. When a signal generator is very simply constructed it is generally referred to as a modulated oscillator.

Fundamentally there is no difference between a signal generator and a modulated oscillator, but the term signal generator implies a precision instrument by means of which accurate measurements can be made. For most service work, a modulated oscillator will suffice because accurate measurements are not required.

This being the case, many designers seem to have abandoned any attempt to make the simple generator as useful as possible. The fact that it is not employed for accurate measurement as a rule is no reason why it should not be given a sinusoidal output. I have examined many modulated oscillators in which the output is little better than a badly cut up carrier.

The use of such an oscillator is rather difficult and it may give fallacious results. Because one is not interested in accurate measurement it does not mean that one can take liberties right and left in the general design of the circuits.



The complete circuit showing the high-frequency oscillator valve (right) and the audio-frequency generator (left). The jack in the grid circuit of the latter enables external modulation to be applied if desired

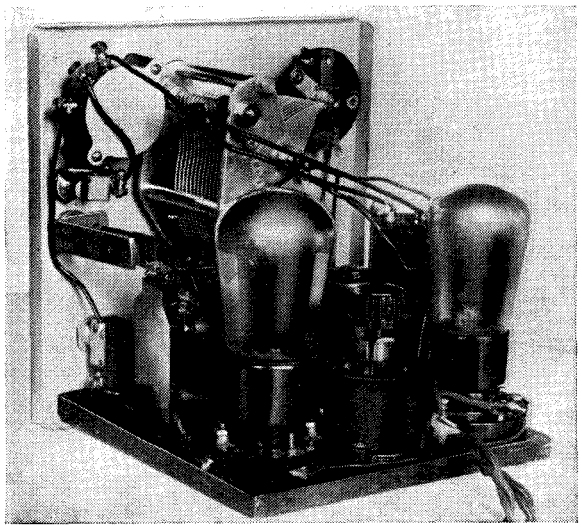
Importance of Wave-form

There are one or two rather important points which have to be considered in the design of any modulated oscillator. In the first place, it really is important for the wave-forms of both the radio- and audio-frequency oscillators to be as nearly sinsusoidal as possible. A bad wave-form makes the oscillator very difficult to use, and it is not easy to obtain accurate ganging.

When one is concerned with sensitivity it is also important for the oscillator to be adequately screened, otherwise there may be a bad stray pick-up. A signal generator

is very elaborately screened, properly designed copper screens of the double type generally being employed. Such precautions, however, are not necessary in a simple modulated oscillator, and for most service work an oscillator built in any type of metal case will be suitable.

Finally it is important to fit the oscillator with an attenuator which will enable the output to be cut down to a very small value, as too large an output will mean that it cannot be used with a sensitive receiver under certain conditions.



The exact layout of the parts is not important so long as undue liberties are not taken, but the placing shown here leads to simple assembly and wiring

The design of a modulated oscillator is absurdly simple because it consists of nothing other than an oscillating valve tunable over the usual ranges together with the modulating means. This most conveniently comprises another valve oscillating at an audio frequency. It is extremely simple to make two small battery-driven valves give a sinusoidal output and cause the audio-frequency valve to modulate the radio-frequency valve without distortion, but for some reason or other few people seem to trouble to do this.

Simple Construction

The design suggested in the following columns utilises a triode for the radio-frequency oscillator, the oscillation being obtained by ordinary regenerative circuits. The inductances are simply wound on paxolin tube together with the coupling coils. The oscillator is tuned by a good-quality condenser fitted with a suitable dial free from backlash so that the calibration holds good.

The output is modulated by what is in effect an ordinary constant current or choke-control circuit. Use, however, is made of a resistance for this purpose in order to save space and expense. The internal modulation is derived from a back-coupled audio-frequency transformer.

The output is taken through what is frequently referred to as an attenuator, although such a term is a little complimentary. It is actually in the attenuator that the chief difference lies between a modulated oscillator and a signal generator. All that is required for service work is some device which will attenuate the output voltage from the oscillator, and an ordinary potentiometer is quite satisfactory for this purpose.

This potentiometer, however, cannot be accurately calibrated, but the setting will obviously give some rough indication of the sensitivity of the receiver. The more sensitive the receiver the lower will be the input voltage required to produce a given output.

Movement of the potentiometer control, however, varies the input impedance and the output impedance and, in fact, all conditions. It should be understood that an attenuator is a device which maintains the constants of the circuit.

Attenuator Considerations

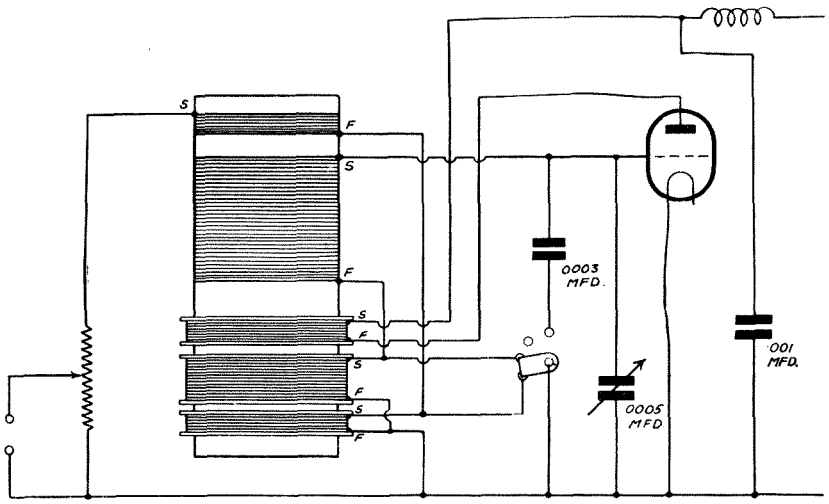
This very desirable condition is brought about owing to the design of the attenuator pad or network, and the calibration of the attenuator only holds good so long as it is connected to definite terminal impedances for which it is designed.

Although a proper attenuator contains only a few shillings worth of materials in the form of non-reactive resistances, an attenuator that is reliable at radio frequencies costs very many pounds to buy. This is due to the fact that the resistance network is not only a difficult device to produce, but is also far from easy to design. The use of a proper attenuator is therefore out of the question in the present instance.

Importance of Screening

The stray field from the oscillator is eliminated by the use of a metal screening case, and readers who build up an oscillator on the suggested lines are ill-advised to dispense with this case, which can be obtained quite cheaply. The internal layout of the components inside the case is of very little importance.

It may be advisable to refer to some of the constructional points in detail. It will be observed that two grid windings are used for the three wavebands, the intermediate



This diagram of the connections of the high-frequency oscillator valve provides a key to the start-and-finish sequence of the coil windings

range being obtained by switching into circuit a fixed condenser. The coupling coil is split into two parts, one being adjacent to the earth end of the grid coil and the other adjacent to the long-wave coil, whilst there is a common reaction coil between the two tuned circuits.

Special Switching

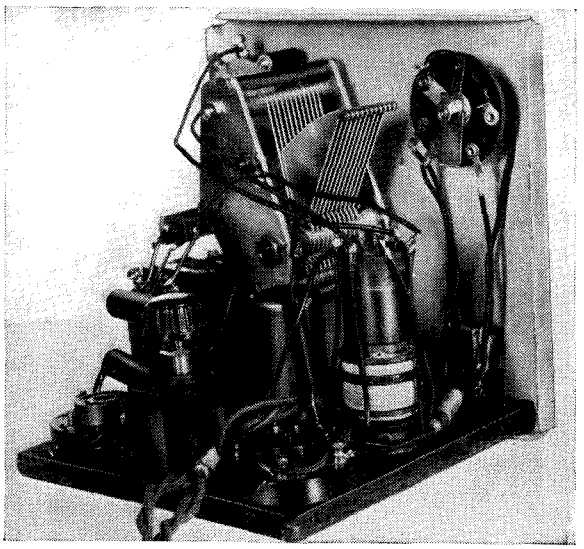
Switching is accomplished by modifying a standard four-position rotary switch. The first position short-circuits the long-wave coil and also the long-wave coupling coil. It will be seen from the photograph that the switch has a very wide blade which can be made to engage two contacts.

In order to give a locking position an additional hole is drilled in the paxolin so that the locking detent engages this in the appropriate position. The adjacent hole normally used to locate the switch in the second position is filled up.

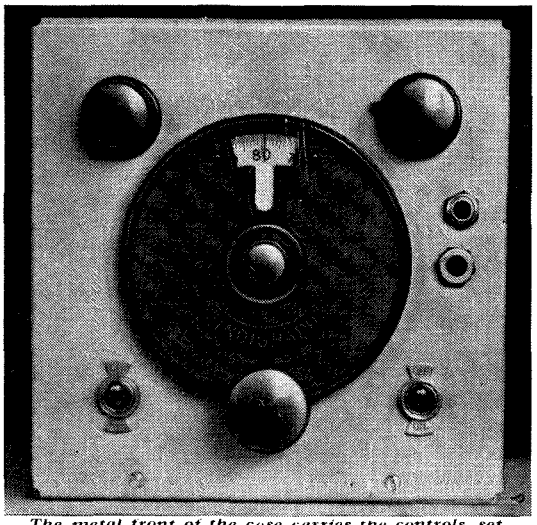
It will be seen that jacks are used both for the output and the external modulation input. A single-open jack delivers the output, and an open-close insulated type is used for internal and external modulation. The insertion of the external modulation plug disconnects the grid of the modulator valve from the top of the internal modulating circuit, that is the winding of the low-frequency transformer.

It is most important, therefore, to use a jack in which the tip and the associated contact are quite insulated from the frame. The remainder of the circuit calls for no comment.

The chief point to observe in wiring the oscillator is to ensure that all the leads are quite rigid and that there is no possibility of movement in the radio-frequency circuit, which would obviously affect the calibration. The windings suggested in the accompanying table for the tuned circuits are such that with the recommended high-tension voltage and the recommended valve there will be little chance of the valve overdriving and producing a bad wave-form.



The potentiometer controlling the reaction effect in the audio-oscillator circuit is mounted inside the unit in the position shown here



The metal front of the case carries the controls, set out as follows: top left, wave-range switch; top right, output strength; bottom left, audio-frequency on-off switch; bottom right, main on-off control. The two jacks provide the necessary inlet and outlet points. (See circuit diagram)

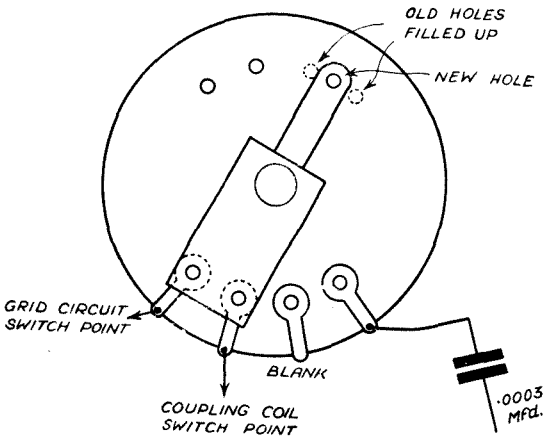
Some care is necessary, however, in the case of the audio oscillator. The audio note is obtained by back-coupling the low-frequency transformer and tuning one of the windings with a fixed condenser to give a suitable modulation note. A shunt reaction system is used and it will be noted that regeneration control is provided.

In an ordinary commercial design this control would not be made available, but it is quite possible that readers will utilize any particular low-frequency transformer available.

Regeneration Control

As the constants of the transformer are unknown and as the transformer is not really designed for use as an oscillator it is obvious that some means must be provided for controlling the amount of regeneration. Accordingly use has been made of a potentiometer to control the feed-back from the anode. The correct adjustment of this potentiometer is that which just enables the valve to oscillate gently.

Under these conditions the valve will generate sufficient audio-frequency voltage at the anode to give a useful percentage modulation on the anode of the high-frequency valve.

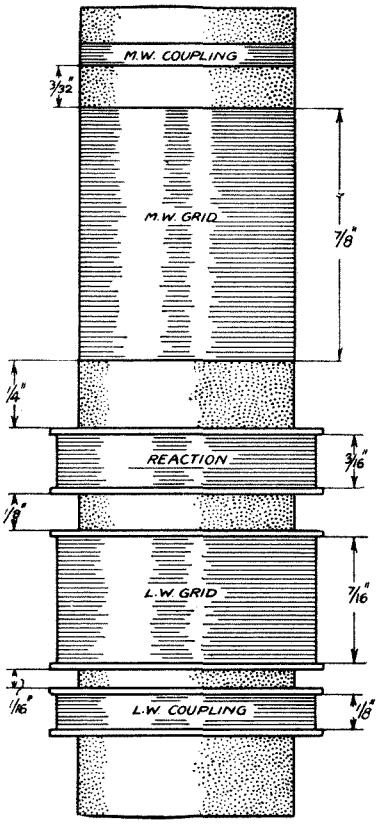


This sketch shows how the special wave-change switch is arranged and connected

An oscillogram taken from the actual oscillator shows that the wave-form given by this combination is extremely satisfactory.

Internal modulation can be used for set alignment work and also, of course, comparative sensitivity measurement. When it is desired to examine the fidelity it is necessary to take an audio-frequency response and use is then made of an external audio-frequency source, such

How to Wind the Coil



The coil is wound on a small piece of 1-in. diameter tube; note carefully the spacings between the windings

Coil	Turns	Wire
M.W. Grid ...	91	36 S.W.G. Enamel
L.W. Grid ...	300	34 D.
Reaction ...	95	38 D.S.C.
M.W. Coupling	12	36 S.W.G. Enamel
L.W. Coupling	20	34 D.S.C.

as that obtained from the variable audio-frequency oscillator described in the July " W.M."

Dummy Aerial Needed

The output of the oscillator is taken by means of a plug and jack. The jack should be connected to the receiver under test through a length of screened cable which includes a dummy aerial, since the low-resistance-potentiometer attenuator should not be connected to the aerial and earth terminals of a set. The dummy aerial consists of a very small inductance, a low resistance, and a small capacity all connected in series.

When working with a sensitive receiver it is advisable to keep the oscillator as far away from the set as possible, because the oscillator has a definite amount of stray field owing to the fact that it is not of the double-screened type.

The calibration of the oscillator is a very easy matter. For all test work the wavelength of the British stations can be taken as quite accurate. A large number of points can therefore be obtained on the medium waveband by the ordinary zero beat method. I would strongly advise carrying out the calibration in conjunction with a receiver employing an ordinary straight reactive detector circuit.

The various British stations should be tuned in and the oscillator should then be switched on with the modulation turned off. The oscillator will give a beat note with the carrier of the received station. The oscillator should then be adjusted until zero beat is obtained, when the oscillator setting will be that of the wavelength of the particular British station being received.

The long-wave range can be similarly calibrated. Stations such as Oslo, Droitwich, and Kootwijk form three useful long-wave points.

The intermediate-frequency range is calibrated by means of harmonics. However pure may be the output of the oscillator valve there will always be a certain harmonic content, the first harmonic being the strongest. For example, if one sets the oscillator to 3,000 metres, that is 100 kilocycles, one obtains a comparatively weak first harmonic at 1,500 metres or 200 kilocycles.

A simple oscillating receiver is therefore set into oscillation and tuned to exactly 1,500 metres by means of the long-wave range on the oscillator. The oscillator is then switched on to the intermediate waveband and adjusted to the neighbourhood of what is imagined to be 3,000 metres.

At the exact setting a very weak beat note should be heard corresponding to the first harmonic at 1,500 metres. This setting then gives the 3,000-metre or 100-kilocycle point. Other points are similarly obtained all over the range.

Wave Harmonics

If for any reason a reactive detector receiver is not available and use has to be made of a superhet, the calibration must be carried out with extreme care as there is a strong possibility of harmonics from the oscillator in the superhet giving false readings. I recommend calibration by means of heterodyne beats with the modulation switched off because the setting is so accurate and a faint whistle is easily heard.

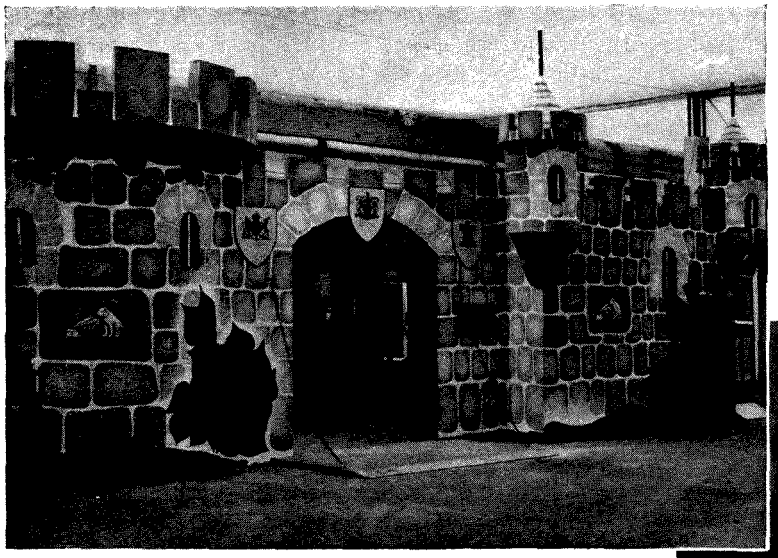
The design of the oscillator is such that there is substantially no shift in the wavelength with the modulator valve switched on. This is one of the main reasons for employing a separate modulating valve, because many self-modulating systems not only give a very bad wave-form but also a strong shift in the setting. Even the setting of the radio-frequency attenuator will sometimes so modify the constants of the circuit that the setting is also shifted by this variation.

Battery Precautions

No means have been incorporated to prevent the possibility of radio-frequency energy being transferred via the batteries, which are connected by a multiple cable. This procedure is necessary in the case of a standard signal generator, but the stray field actually caused by this particular oscillator is such that these extra precautions are not warranted. It is important, however, to keep the batteries well away from the receiver being examined.

LIST OF COMPONENTS FOR THE SELF-CONTAINED MODULATED OSCILLATOR

BASEBOARD ASSEMBLY
1—Baseboard, 6 in. by 6 in.
CHOKE
1—Wearite high-frequency.
COIL
1—Specially constructed (see diagram).
CONDENSERS, FIXED
1—.0003-microfarad, tubular type.
1—.001-microfarad, tubular type.
1—.02-microfarad, tubular type.
1—.1-microfarad, tubular type.
CONDENSER, VARIABLE
1—Cyldon .0005-microfarad straight-line-frequency.
RESISTANCE, FIXED
1—Erie 10,000-ohm.
RESISTANCES, VARIABLE
1—Bulgin 500-ohm potentiometer.
1—Wearite 10,000-ohm potentiometer, baseboard-mounting.
SWITCHES
2—Bulgin toggle on-off switches, type S80.
1—Bulgin four-position rotary switch, type S118, modified.
SUNDRIES
1—Igranic Indigraph dial.
1—Bulgin single open jack, type J2 or J3.
1—G.E.C. insulated open/close jack.
1—Burne-Jones screening case.
TRANSFORMER, LOW-FREQUENCY
1—Varley Niclet, ratio 3.5:1.
VALVE-HOLDERS
2—Clix 4-pin.
VALVES
1—Mullard PM1HL.
1—Mullard PM2A
BATTERIES
1—High-tension, 80-120 volts.
1—2-volt accumulator.



Castles at Radiolympia! The H.M.V. offices at this year's show were housed behind this mediæval facade. It cost many hundreds of pounds to construct and in it many hundreds of thousands of pounds worth of orders for H.M.V. radio were taken

Umpteen valves! Visitors to Radiolympia were given the opportunity of inspecting the complete range of Marconi receiving valves, in and out of bottles. The display ranged from huge triode power valves to battery midgets no larger than a big acorn!

Between Ourselves

By BROADCATCHER

Are Sets Too Cheap?

ONE could hardly come away from Olympia without having formed the impression that by far the most frequently seen set on the stands was the all-mains superhet priced at something between eleven and twelve pounds. Sets at much the same price were shown by a few manufacturers last year; but this time almost every firm of set makers seemed to be making a feature of them.

I have tried out one or two of these moderately-priced sets of good make and they seem to be very good value for money. There will undoubtedly be a huge demand for them, *but I do hope that the public will not get the idea that twelve pounds is as much as anyone should pay for a receiving set.* If you can afford more, a few extra pounds spent on more ambitious apparatus will be found to have been well invested.

A Little More, How Much It Is!

Don't think that I am trying to run down these moderately-priced superhets. Far from it; I am sure that they will be a boon and a blessing to those of limited means. But for twelve pounds or so you cannot possibly obtain all the refinements that can be introduced into the wireless set to-day. Wonderful things can be done with three or four of the modern "portmanteau" valves and a rectifier; such a team can produce good sensitivity and selectivity and a reasonable volume with good quality and almost entire freedom from second-channel interference, and effective automatic volume control. And those things, after all, will probably satisfy the bulk of listeners.

But with additional valves and more elaborate circuits wonderful refinements can be introduced. There is, for instance, quiet automatic volume control, which means freedom from unwanted noises as you pass from station to station; there is high-fidelity reproduction, which means that the set can handle a very wide range of audible frequencies; there is the huge reserve of undistorted output in the big set, which means that it can handle loud sounds and *fortissimo* passages as they should be handled.

These are just some of the refinements which are to be found in more highly priced sets and for those who can afford the extra outlay I am sure that they are well worth while.

Umpteen-valvers!

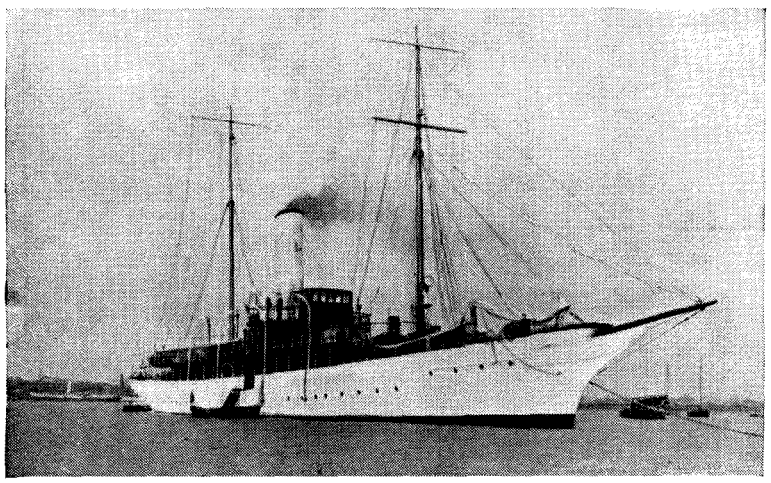
For myself, I would very much like to see some of our leading makers introducing purely wireless sets (as distinct from radiograms) containing anything from ten to a dozen or more valves; the kind of set, I mean,

which is to be found in so many households in the United States. Naturally they would be rather expensive but I haven't the least doubt that they would find a ready market in this country.

Effortless Efficiency

If you have ever handled a big set of this kind you will know what I mean when I say that it gives you the impression of doing its job with the utmost ease. Operating it gives one the same feeling of effortless efficiency as when driving a powerful modern car.

Don't run away with the idea that every valve in a



Rumour is current that Marchese Marconi is conducting experiments of a revolutionary nature in connection with ultra-short waves and television aboard his famous yacht "Electra"

set containing a dozen or more is employed for the purpose of boosting up the strength of radio-frequency and audio-frequency oscillations. You couldn't possibly have anything like this number of valves in cascade in efficient circuits, for the overall amplification would be too great to be usable. Actually many of the valves are passengers so far as amplification is concerned. They do small but important jobs of quite different kinds.

Odd Jobs

One of them, for instance, may be used untuned just for the purpose of coupling the aerial to the set. If you think for a moment you will see the beneficial effect of its presence upon ganging. Then there is usually a separate oscillator valve, and "creeping"—or oscillator wobble—may be prevented by means of an oscillator amplifier. One valve may work as a "squelch," whose business is to cut out between-station noises by putting the low-frequency part of the set out of action until signal strength reaches the level produced by an incoming transmission powerful enough to make for good reproduction.

Some stages of the set in which less ambitious apparatus would have single valves may incorporate push-pull arrangements. There are several other uses for valves which at first sight seem to do little, but actually do a great deal.

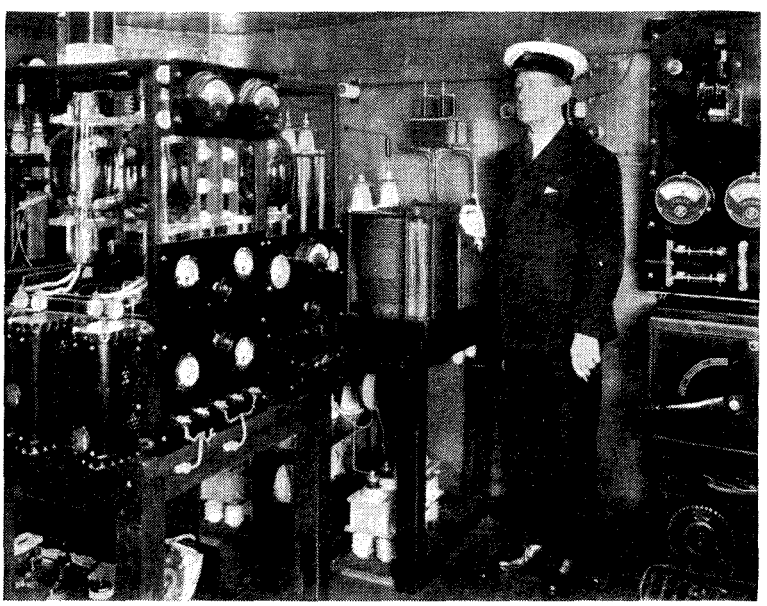
I suppose that the circuit of the biggest superhet if cut down to bare essentials would hardly contain more than six or eight valves; but as many as sixteen can be used profitably for those little refinements that have such marked effects upon performance.

All-wavers

A good many all-wave sets are in evidence this year, and my belief is that this kind of set is going to become increasingly popular in the future. Somehow or other short-wave reception has not so far caught on amongst wireless folk in this country as it might have done. All sorts of reasons have been suggested, but I think that the truth is that attempts were made to popularise it rather too early in the history of short-wave broadcasting.

A few years ago when it first came to the fore, the number of high-powered short-wave stations was comparatively small, and a great deal had still to be discovered (we haven't reached finality yet) about the best wavelengths for use not only at different hours of day and night, but also at different seasons of the year. The result was that there was often very little to be heard when the short-wave set was brought into action, and those who had been led to believe that there was always something to be picked up from distant places were disappointed. During the last sunspot minimum there were long spells in which conditions were thoroughly bad for short-wave reception.

Then the receiving sets themselves were often not too easy to handle, especially if they were of the straight type requiring very fine tuning and critical adjustment of reaction. Not a few of them, too, were subject to body-capacity effects which made tuning something of an adventure and in many cases no proper provision was made for adjusting the set to suit the characteristics of different aerials.



Marchese Marconi photographed in his laboratory aboard his yacht. He is seen standing near short-wave transmitters which form part o fthe vessel's equipment

At the end of August Berlin held its annual radio show. Unlike the British exhibition, demonstrations on a large scale were given and huge crowds thronged the many halls and gardens to see and hear the latest developments. Above is seen one of the exhibition halls, while on the right is the huge tower of the Berlin Funkhaus with crowds taking meals in the fine gardens. It was a matter of great regret that one of the halls was completely gutted and the tower damaged by a fire which broke out during showtime.

Today matters are very different. There is hardly a civilised country in the world that has not one or more high-powered short-wave stations—remember that on the short waves 10 kilowatts is a big output—and there is probably no hour of the day or night at which broadcasting is not taking place.

We know a great deal more about optimum wavelengths, and since there is no coil changing to be done in the up-to-date all-waver, it is the easiest thing in the world to switch over from one short-wave band to another. Tuning has become as simple as it well could be, and short-wave conditions are improving rapidly as we move towards another sunspot maximum. That is one of the curiosities of the short waves: reception on them is at its best near the time when there are most sunspots, though reception on the medium and the long waves is then at its worst.

The owner of an all-wave set can therefore rise superior to conditions and be sure of hearing stations at great ranges at times when the set confined to medium and long waves only can give but a poor account of itself.

Ninety Days

What do you think of the ninety-days guarantee now being adopted by so many set manufacturers? It's something, of course, that guarantees are being standardised; but I can't feel that ninety days is sufficient. I have asked a good many non-technical wireless listeners how it strikes them, and in almost every instance the reply has been to this effect: if a manufacturer believes in the reliability of his set he ought to be able to give a much longer guarantee than three months.

Many people have told me that they would much rather pay a little more for their sets and have a really sound guarantee covering them for twelve months. I think there is something in that, and it suggests an idea. Why not give the purchaser the option of insuring his set against breakdowns of all kinds for twelve months by paying, say, an extra 5 per cent, or 1s. in the pound, on the original price? If manufacturers find such a scheme unworkable for one reason or another it may commend itself to enterprising retailers who have thoroughly sound service men in their employ.

Civic Horror

Hitherto the wireless valve has had nothing but boons to confer upon humanity; but now I hear rumours of a horrid threat to our peace for which it is entirely responsible. One Midland town—Chesterfield, if I remember aright—has been trying out a thermionic town-crier. Most old towns have their human criers, who are picturesque objects in their toppers, three-cornered hats or other fancy millinery, and the robes of office which they gird about them when they go forth about their business.

The ringing of their bells, their cries of Oyez! Oyez! and the strings of words, often completely unintelligible, which pour from their throats of brass, are by no means offences to the ear. In any event, being but human, they cannot keep it up for long. But just think of a town-crying motor-van complete with microphone, record-playing table, and a 100-watt amplifier!

Hateful Voice and Strong Pressure!

The thing would speed untiringly about the streets lifting up its hateful voice for hours on end and life in our towns would become a noisier business than ever. I sincerely hope that the Town-Criers' Union (if there is one, and if there isn't there ought to be) will bring the strongest possible pressure to bear upon city fathers who are toying with the idea of installing one of these mechanical monstrosities.

As we have had an outbreak of death rays in Europe this summer I thought it would not be long before

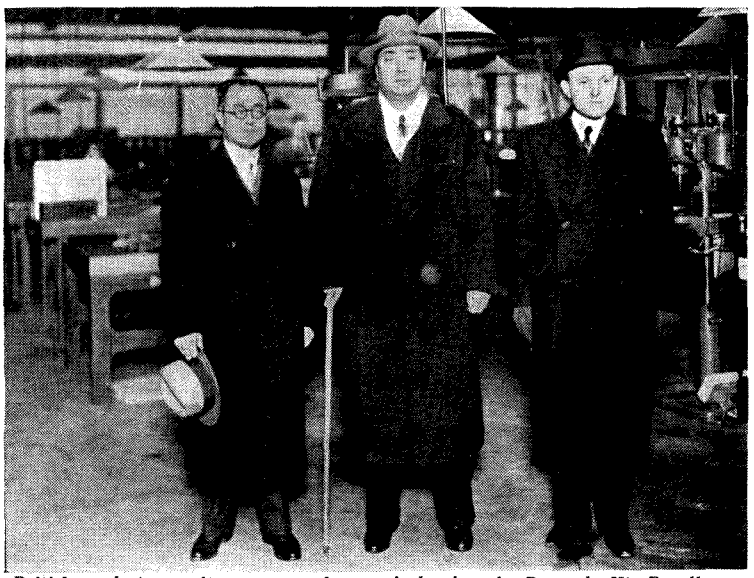
America produced something of the kind. The American invention appears to be something much more than a mere rumour, for it is being developed by the Navy Department, which corresponds to our Admiralty. It isn't strictly speaking a death-ray, for it doesn't stop motor-cars, or bring down aeroplanes in flames, or paralyse human beings.

Is it Infra-red ?

What it does apparently do is to enable guns to be trained in the dark on to a distant enemy ship by means of a ray that is completely invisible to the eye. During recent tests searchlights were used instead of guns. The darkened searchlight was made to move with the invisible beam, and as soon as the target had been picked up the searchlight was switched on. In every case its beam was found to be right on the target though the range was in no case less than five miles.

A Boon to Ships

It is not stated whether the ray belongs to the ultra-violet or the infra-red class. Both are invisible, the former because the vibrations are too rapid for the human eye, and the latter because they are too slow. Whichever it is, I hope that its possibilities will be directed towards peaceful rather than warlike uses. Such a thing would be a boon to shipping, especially if the infra-red rays are used, for these have no difficulty in penetrating fog.



British-made transmitters are used extensively abroad. Recently His Excellency Yu-Fei-Peng, China's Vice-Minister of Posts and Telegraphs, and Mr. P. F. Foo, Chinese Ambassador in England, paid a visit to the Marconi Chelmsford works where several transmitters are being built for erection in China

Mr. Baird, of television fame, realised a long time ago the potentialities of infra-red rays as an aid to mariners, and he obtained very promising results from their use.

Television Held Up

At the time of writing work upon the new television building at the Alexandra Palace seems to have come to a standstill. When it was decided to take over a part of the Alexandra Palace for the London high-definition station it was realised that extensive demolition and rebuilding would be necessary. It was some time before the work was put in hand, and one delay seems to have followed another.

We are now told by the P.M.G. that the London station will not be in action before the beginning of next year, and I can't help thinking that this state of affairs reflects little credit on those responsible for it.

A Lost Opportunity

When the Television Committee's report was published at the beginning of this year we could have added considerably to our national prestige by starting the world's first regular service of high-definition broadcasting. The Baird station at the Crystal Palace was there, complete to the last small detail. Its service area was not problematical; field strength measurements had been made in profusion, and the exact extent of the district covered was known. Why then should not transmissions have been started—from this station whilst the other was building ?

The trouble was that two rival companies were concerned and that the Committee had recommended that their systems should be used alternately. One concern was completely ready; the other was not. For the life of me I cannot see why the Baird apparatus should not have been used for a temporary service.

Amateur experimenters would have spent thousands of pounds upon apparatus, and firms contemplating the manufacture of television receiving apparatus would have had immediate opportunity of making a practical study of the reception of both sound and vision upon the ultra-short waves.

It is still not too late for the Crystal Palace station to be brought into action pending the inauguration of the Alexandra Palace station if only the listening and would-be looking public will let it be realised that they will not stand further delays.

A World Broadcasting Conference

Hitherto it has been possible to organise broadcasting on what may be termed a Continental basis. In Europe, for instance, the allocation of wavelengths is governed by agreements made between countries which have produced successively the Geneva Plan, the Prague Plan, and the Lucerne Plan. The Federal Radio Board looks after this kind of thing in the United States of America, and in conjunction with the Canadian broadcasting authorities it has been able to arrive at an agreement for the whole of North America.

But it is realised now that in the very near future the whole organisation of wavelengths, numbers of stations and power output must stand on a much broader basis. It will have to be a world affair. Next year a World Conference of broadcasting authorities is to be called, and one hopes that good results will follow.

In the days of low-power broadcasting stations no one realised that such a thing as inter-continental interference could take place. But once stations rated at 100-kilowatts had become common and while there were many whose power output ranged from 150 to 500 kilowatts, heterodynes at enormous ranges began to be observed. Though you may find it hard to believe, several of the heterodynes on European stations with wavelengths between 250 and 300 metres that occurred persistently last winter were due to U.S.A. transmitters.

Wireless Magazine October 1935

Principles of Natural Colour Television

By MORTON BARR

It is only natural that after we have obtained fairly good results with black-and-white television reception our attention should turn to receiving television pictures in their full natural colours. Here MORTON BARR discusses the nature of colour and the response of our eyes to light of different wavelengths. He also describes experiments already made with natural-colour television

THE colour of pure or monochromatic light depends upon the frequency, and its brightness upon the amplitude of an ether wave, the length of which is measured in millimicrons, a micron being the millionth part of a metre, and a millimicron a thousand times less. The wave must not be less than 380 or more than 720 millimicrons long to be visible at all, the frequency of pure yellow light, which lies about midway between the two extremes, being roughly 500 million million cycles a second.

Visible Range

The whole stretch of visibility occupies only a very small part—not quite an octave in all—of a vast band of ether vibrations extending down past the ultra-violet to the so-called cosmic rays, and up beyond the infra-red to the 20,000-metre waves used in wireless.

By contrast a tuning-fork vibrating 256 times a second—corresponding to a middle C on the piano—produces a pressure-wave in the air approximately 4 ft. long.

Colour Mixtures

Although it is usual to refer to the single lines shown on a spectroscope as pure or monochromatic light, it is doubtful whether such a thing really exists outside theory. Every colour, as we know it, covers a band of waves, though the narrower the band is made the nearer one gets to the ideal monochromatic effect. In practice, colour changes imperceptibly from one tint to another as the wavelength increases or decreases.

Again, various mixtures of wavelengths produce different colours. A red ray of light combined with a green one, for instance, gives a brilliant yellow, although the pure yellow light derived from a sodium flame cannot be split up into red and green components. On the other hand, a mixture of red and green pigments produces a dirty brown.

This may sound rather confusing, but it is due to the difference between the objective colours produced by spectrum analysis from sunlight, and the physiological colour sensations produced by the action of the eye on the brain.

Newton showed that white light can be split up by a glass prism into seven different colours—namely, red, orange, yellow, green, blue, indigo and violet. Nature had previously anticipated this discovery—though men did not realise it at the time—by painting the rainbow with exactly the same series of colours drawn from the rays of the sun as they passed through drops of rain.

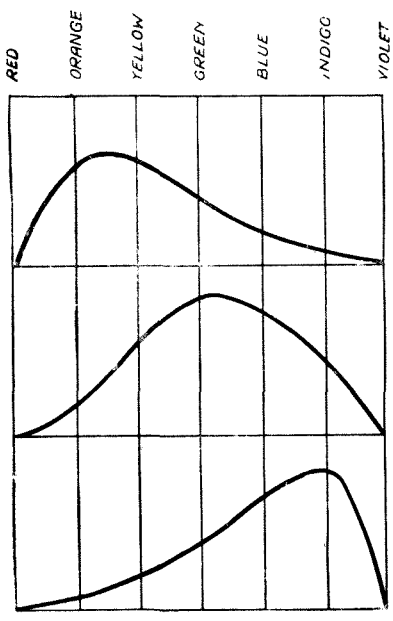


Fig. 1.—Three curves showing how the eye responds to the three primary colours, red, green and violet

Colour Absorption

Newton also proved that the seven rainbow colours, when mixed in their proper proportions, will recombine to form "white" light. From this he argued that a red rose owes its colour to the fact that the petals absorb all the colours from white light except the red, which they reflect back into our eyes. Similarly, a piece of red glass allows only the red rays to pass through, and stops all the others.

Actually, there is still some doubt as to the validity of Newton's conclusions. If we assume that white light is produced by electronic vibrations, then in any incandescent substance, no matter how small, there must be present electrons oscillating at all the possible "visible" frequencies. Otherwise dark lines would appear on the spectrum corresponding to the absent frequencies.

Modern Views

But, in point of fact, no dark lines are to be seen. The very smallest particle of solid matter which can be raised to white heat gives a full and continuous spectrum. This has led to a suspicion that the "colours" produced when white light is refracted by a prism may, in fact, be "manufactured" inside the prism by a selective action due to the molecular formation of the glass itself.

Finally, of course, there is the new

quantum theory which regards light, not as a wave-form, but as so many packets or photons of corpuscular energy. But whatever view may be taken of the ultimate nature of light and colour, it does not alter those facts based upon the results of actual experiment.

Both the eye and the ear are subject to certain physiological limitations. The ear, for instance, is quick to detect changes in the frequency or amplitude of sound, even in the complex chords of an orchestral rendering: but at the same time it cannot always be taken as a reliable guide of what one may call the physical make-up of sound.

Subjective Response

The sound wave, as such, does not pass beyond the ear. That which reaches the brain is a purely subjective response, which may be interpreted differently by particular listeners. The same physical or objective wave will produce in one person the painful sensation of a discord, in another the indifferent effect of a mere noise, whilst a third, who is deaf, will hear nothing.

In the same way, one person may be colour-blind to one part of the spectrum, and a second to another part, both being affected in varying degrees over the whole range of colours. Again, every eye has its "blind" spot, and we are all subject to the "lag" or persistence of vision, which makes it possible to produce the effect of smooth motion from a series of "still" pictures.

P. E. Cell Limits

Most photo-electric cells suffer from a defect similar to that of colour-blindness. Those used in the early television experiments were specially sensitive to the infra-red rays—which lie outside the colour range.

In consequence, they showed the face pallid and devoid of any shading due to colour. Red lips came out dead white on the screen, and there was no perceptible difference in dress colourings. A cigar could not be distinguished from a stick of chalk.

According to the Young-Helmholtz theory of colour sensation, the eye is provided at the back of the retina with a bundle of sensitive cones or rods, which respond directly to three "primary" colours—violet, green, and red, as indicated in Fig. 1. All other colours are formed by stimulating the eye simultaneously; blue, for instance, from green and violet, and yellow from red and green.

Look intently for a few second at, say, a blue disc suspended against a white screen, and then withdraw the disc. The eye will see in its place a patch of yellow. The reason is that the "blue" rods of the optic nerve have, for the moment, become too tired to respond properly. The eye, therefore, receives white light from the screen robbed of its blue component, which gives rise to the "complementary" appearance of yellow.

This effect only lasts as long as the blue rods are out of action. As soon as they have recovered, the yellow disappears and the normal white colour of the screen is restored.

On the other hand, the artist who has to deal with pigments only recognises red, yellow, and blue as the primary colours. He mixes yellow with blue to get green. Actually, his yellow contains a trace of green mixed with the yellow, whilst the blue paint similarly contains a trace of green. When the two are mixed the blue and yellow combine to produce the physiological effect of white, leaving the residual green alone in evidence.

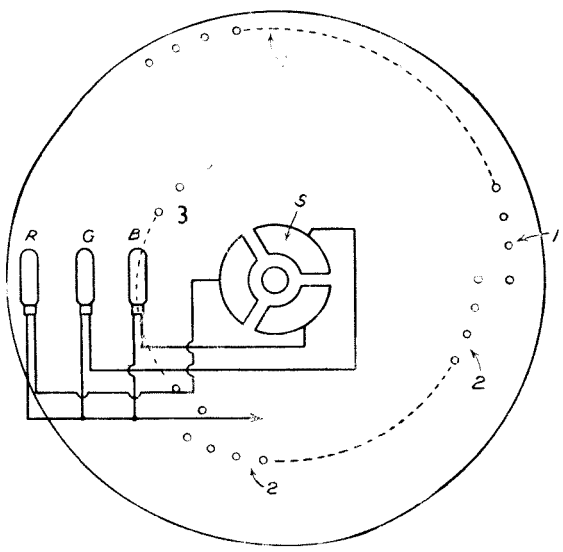


Fig. 2.—Illustrating the basic arrangement for three-colour scanning by means of the disc system

In order to televise an object in its natural colours, it is scanned in rapid succession by three differently coloured lamps—red, green, and blue, shown at R, G, B, in Fig. 2, each looking through its own spiral line of holes marked 1, 2, 3 on the scanning disc. The parts of the object which are naturally of a red colour will then scatter or reflect back to the photo-electric cell most of the light from the red lamp R, absorbing or neglecting the light from the other two lamps.

Reception Methods

The same applies to the blue parts of the object, which reflect the light from the lamp B, but not from the lamps R and G. Similarly with the green parts which throw back the light from the lamp G alone. A switch S is used to light up the blue, green, and red lamps in their proper sequence.

At the receiving end, three separate sets of spirals are again formed on a single scanning disc, each set being fitted with red, green, or blue lenses or filters. The red spiral is in action only when the red signals are being received, and similarly with the green and blue spirals. The result is that the picture appears on the screen dressed in its "natural" tints, just as a coloured picture is produced by the three-colour process of printing.

Composite Screens

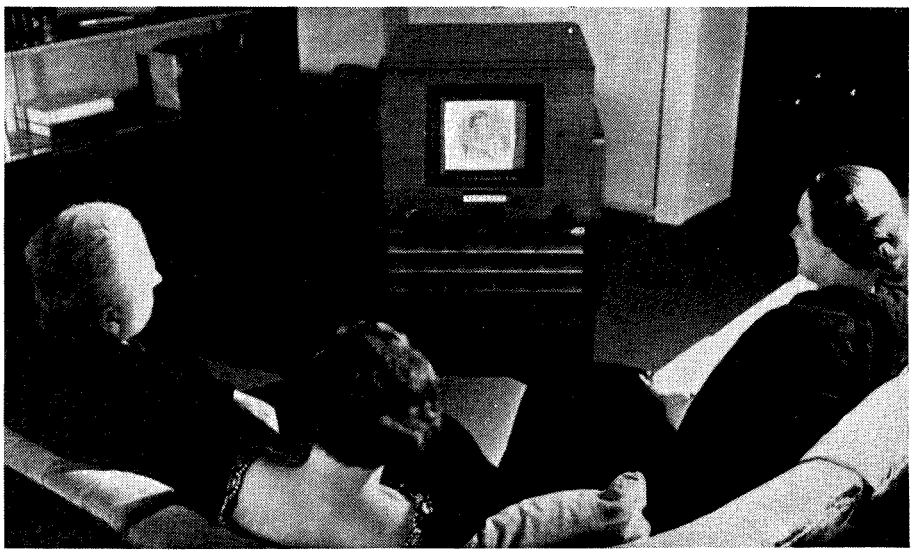
In cathode-ray television the same effect is secured by using a composite fluorescent screen. This consists of alternate narrow strips (*a*) of potassium bichromate to give the red, (*b*) of calcium tungstate to give the blue, and (*c*) of zinc silicate or sulphide to give the green components of colour.

When one attempts to make an estimate of the probabilities of colour television in the near future one must first realise that the problem is closely bound up with definition; all simpler colour systems involve some sacrifice of definition or freedom from flicker unless higher modulation frequencies can be used.

To understand why this should be one has but to visualise the simpler form of three-colour scanning in operation: what would be single line to a black-and-white scanner must be covered three times by the colour transmitter.

Television for the Busy Man No. 2

By PERCY W. HARRIS, M.I.R.E.



Television at Berlin's latest radio show. Our illustration shows the new Telefunken combined sound and vision receiver, notable for its three simple controls

The Simple Arithmetic of Television

In this month's contribution to his popular "Busy Man" series, Mr. Harris deals with some further interesting points about the vital process of scanning, and explains some of the little-understood aspects of the wavelength-definition question

TOWARDS the end of last month's article I made reference to what we may call "the simple arithmetic of television." A short chat about these figures will not come amiss at the moment, for it will help us to understand the importance of a number of television problems which are so airily dismissed by non-technical writers.

Effects of Modulation

In "Wireless For The Busy Man" we saw how an alternating current of very high frequency—say one million per second—could be made to vary its intensity at an audible frequency. When the intensity of this high-frequency current changes in value, say one hundred times per second, the waves radiated will bear the same fluctuations of strength and the receiving circuit tuned to the million frequency will have in it a high-frequency current which rises and falls one hundred times per second.

If the circuit is *not* tuned to a million cycles there will be no building up or resonance effect, and therefore neither the high-frequency current nor the accompanying low-frequency modulation as it is called will produce any appreciable effect in the receiver.

There are two matters I want to make perfectly clear at this juncture the first being that it is the *high* frequency or carrier frequency to which the circuit is tuned, and not the low or modulation frequency. Tuning, or resonance, can only be applied in a wireless receiver when there are several waves of the same frequency to give a building up or cumulative effect. This is the first point I want to emphasise.

The second is that if you want to superimpose this modulation frequency upon a high frequency, or carrier, the maximum modulation frequency must obviously be lower than that of the carrier wave or frequency itself. It is both a practical and theoretical impossibility to modulate a carrier wave at a higher frequency than its own.

Now let us come back to the practical side of television to see what frequencies we have to deal with. Let us take first the ordinary broadcast band, working on the assumption that with the present arrangement of stations throughout this band no two stations can come closer than 9,000 cycles from one another and that the maximum frequency that any one station can use for modulation is 5,000. What kind of a picture is it possible to get with these frequencies?

Low-definition Picture

Calculation shows us that the maximum definition possible is that which is given by sub-dividing the picture into thirty lines. This actually is very coarse in detail and is that given by the "low-definition" television transmissions which the B.B.C. has been sending out experimentally for the last two or three years.

Not Entertaining

Such pictures have little or no entertainment value, flicker badly, and are very tiring to the eyes, but they represent the maximum definition possible if we are to use the ordinary broadcast band and a modulation frequency which will not interfere too much with other stations.

Now if we were to increase the modulation frequency on the broadcast band to give a better picture,

not only should we cause serious intereference with other stations, but the tuning curve of the receiver used for this form of television would have to be so wide and include so many frequencies, that not only would the station we desire to receive be tuned in but also a number of other stations on each side, causing an interference sufficient to ruin the reception of the picture.

If good high-definition television, or television with plenty of detail in the picture, is to be obtained we must do something else—we must, in fact, find some way of using high-modulation frequencies so as to give sufficient detail without causing interference.

Wavelength for High Definition

The solution to this problem comes by using the very short waves below ten metres in wavelength, for here we deal with tremendously high carrier frequencies, and there is much more " room."

Take, for example, the wavelength of 10 metres and compare it with 300 metres. The frequency required in the transmitter to radiate a wavelength of 300 metres is one million, and as we have seen in the previous series this wavelength of 300 metres will set up in the receiving circuit tuned to it a high-frequency current of a million frequency.

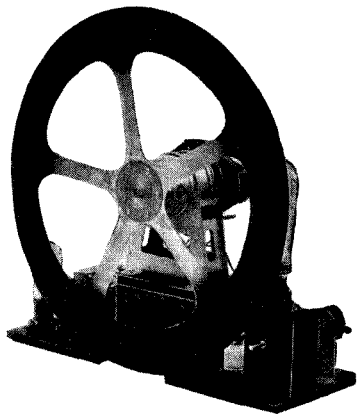
In the case of 10 metres the frequency is 30,000,000, or, put in more technical language, 30 megacycles. Between 10 and 5 metres there is a space of 30,000,000 cycles, for the frequency corresponding to 5 metres is 60 megacycles. If we now desire to organise a number of television services in this waveband and want really high definition, we can modulate each carrier wave or radiation with a frequency as high as a million and still get in no less than fifteen stations.

Where Experts Differ

When we come to consider what frequency is required to give a particular amount of detail we begin to tread rather difficult ground, and experts differ somewhat. They do not differ, however, on the *minimum* frequency required—that at least half a cycle is required to define the minimum unit area.

The Television Committee has decided that the 240-line picture shall be sent out in the first experimental transmissions, and that the pictures are to succeed one another at a minimum rate of 25 per second. The wavelength used will probably be in the neighbourhood of 6 or 7 metres for the vision, with another wavelength very near to, but just out of interference range of the vision, for the accompanying sound.

There is, of course, no special theoretical reason why the sound should be transmitted on the short waves, and it could be just as well sent out on the medium or even the long waveband. For general convenience in design of the receiver, however, it



A simple form of disc receiver operating on the spiral-perforation system described by Mr. Harris in this article

has been found advisable to have both on the short waves.

And now we come to a very practical point. Once we have decided upon the degree of definition and have chosen the wavelength for this transmission, any considerable change to a still higher degree of definition must necessarily bring about a further reduction in wavelength.

The wavelengths round 6 and 7 metres present quite enough difficulties at the moment, for they carry very badly compared with those of the medium and long waveband—their range is at the moment very restricted. With the power of station it is proposed to erect it is doubtful whether an effective range of much more than 30 or 40 miles will be obtained, which means, of course, that we must have a number of stations distributed throughout the country.

Wavelengths much shorter than 6 or 7 metres have still further limitations, and receivers would require more valves to get the same signal strength, which necessarily would put up the cost. For this and many other reasons it is advisable that we should stick to this particular definition for some time to come.

But just what is 240-line definition and to what does it correspond ? The best way to judge this is to examine the average newspaper illustrations (not book or magazine illustrations, for books and magazines use a much finer definition than is possible with newspapers). The average newspaper block has some sixty to eighty lines of dots to the inch, so that if you take an ordinary newspaper illustration and cut out of it a piece measuring about 4 in. by 3 in., this will give you about the amount of detail that a 240-line television transmission can give.

Picture Definition

Of course, the television picture will be much bigger than 4 in. by 3 in., but it will have no more *definition* than I have just indicated. With bigger pictures your definition will resemble that given by the newspaper illustration enlarged up to whatever is the size of the receiver picture. I have seen excellent television pictures about 9 in. by 12 in., which would mean a magnification of about three times on the newspaper illustration to which I have referred.

The definition of a television picture differs slightly in appearance from that of the newspaper illustration. In the newspaper the picture is made up of a number of dots, separated from one another, as you will see if you use a powerful magnifying glass. Only in the very black portions of the picture do the dots run together; in the light portions they may be very small. The spacing between centres of dots is, however, the same all over the picture.

Made Up of Strips

A television picture is made up of a series of horizontal *strips*, the intensity of light in each horizontal strip smoothly varying or rising and falling from point to point. There are no sharp edge dots horizontally, but only a kind of ribbon of light of varying intensity and shading, for actually we are looking at a travelling point of light varying in intensity, the image of which lingers in our eyes long enough to give the illusion of continuity.

Now that we know, so to speak, where we are in television and have grasped the idea of how the picture is formed in units, what it looks like, and what degree of definition we can reasonably expect when the service

starts, let us consider the practical side of the question starting with scanning at the transmitting end.

There are a number of different ways of scanning a subject, although the result of a scanning is the same when it is translated into modulations of our transmitting carrier wave. Let us imagine that we are in a television studio and desire to televise the head and shoulders of a man in evening dress standing in front of a white background. One of the earliest and simplest methods was to illuminate the head and shoulders of the man with the strongest white light possible.

Early Scanning Methods

A series of lenses were set into a whirling disc in a spiral line in such a way that a series of strip images were formed behind the lens disc. The first lens, for example, would first of all form an image, behind the disc, of the top left-hand side of the picture, as the lens moved so points immediately below it will be focused behind the disc until we reached the bottom of the picture.

The second lens, slightly staggered, then took up the task and traced the next and immediately adjacent vertical strip. A third lens began at the top, but a little more to the right as soon as the second lens had finished at the bottom, and so forth until lens after lens formed an image each of its own strip. At any given moment the amount of light concentrated by each lens behind the disc depended upon the amount of light reflected from the subject. There would be, for example, a lot of light from the white collar and practically no light from the black jacket, and an amount of light of about midway intensity between these two limits for the skin of the face, and so on.

If now all these points of light progressively scanned are made to fall upon a photo-electric cell we can convert the variations of light into variations of electric current. A photo-electric cell is a device operated by light. Certain substances have been found to emit a stream of electrons or, in common parlance, an electric current, when light falls upon them, and none whatever in the absence of light.

The intensity of the electronic emission, or electric current, depends upon the strength of the light, and if we make one of these substances into the form of a plate or flat surface of reasonable size and seal it into an evacuated glass bulb, connecting it to the necessary battery and apparatus, we have a device the current flowing through which will faithfully follow the variations of light falling upon the plate.

A photo-electric cell, therefore, was placed behind the lens disc, and as the image was scanned point by point by means of these lenses, so the current varied in strength. These variations of strength of current were superimposed upon the high-frequency current of the transmitter and went out as modulation of the carrier wave.

At the receiving end the waves were reconverted into electric currents, the receiver was tuned to that particular wavelength, and modulation of strength appeared in the output circuit. These modulations were made to vary the intensity of the light of a special receiving lamp and by methods which we shall explain later (for example, a whirling disc synchronised with the transmitting disc) the picture was reformed.

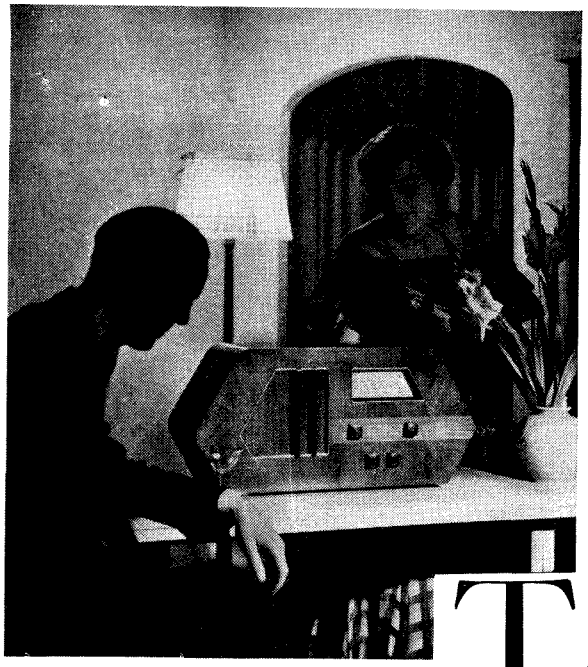
Warm Scanning!

Now there is one very big difficulty about this form of scanning. In order to get sufficient light to operate the photo-electric cell in this way the subjects were nearly burned up! In fact, it was quite impossible for a human being to stand the terrific intensity of heat and light necessary in the early experiments, so dummies were used. Later, Mr. Baird introduced what is called "light-spot scanning," which represented a very great improvement in many directions.

Light-spot Scanning

Instead of illuminating the whole subject with a flood of intense light, a very powerful spot of light was made to traverse the subject. In a pitch dark room the spot of light started at the top left-hand side, ran downwards, started at the top of the next strip, ran downwards, and so forth until it had covered the whole picture. Although this spot of light was terrifically intense it did not stop at any given point long enough to irritate the eye or burn the body, and the photo-electric cells could be deposed all round the room, or wherever was convenient so as to pick up the reflected light. Remember that although the intensity of the light concentrated in this spot was uniform, the photo-electric cells only picked up the light *reflected* from the subject. Thus a white collar would reflect the major portion of the light, whereas a black coat would reflect practically none of it. This enormously simplified the problem of illumination of scanning and indeed spot-light scanning has proved extremely effective even in high-definition television.

High-definition scanning by the moving-spot process in a modern television studio. Alma Taylor is seen here being "shot" in close-up at the Baird station



The most unusual-shaped set at the Show—the McMichael 235, a four-valve A.C. superhet seen here in pleasant surroundings

The Set Buyer at Olympia

By the "WM" Set Selection Bureau

RADIOLYMPIA, 1935, has come and gone. Many of us have walked round the miles of stands gazing on surely the grandest array of radio cabinets ever seen. We made one special tour of the Show with the sole object of picking out representative types of sets, and the most interesting of the many unusual exhibits.

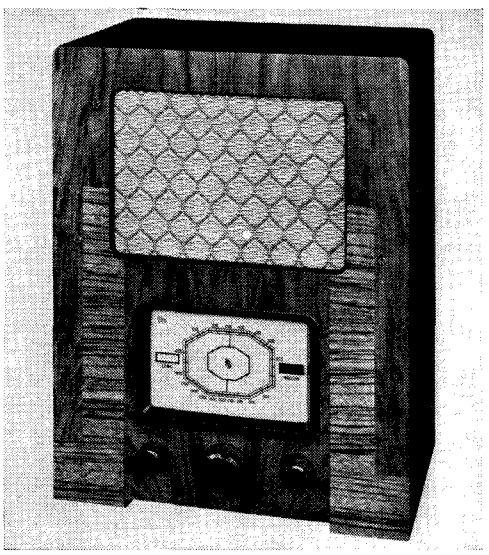
We have a soft spot for console receivers; they are usually quite small and one need not worry about finding a table to match the set. Besides being really good-looking, these sets can be stood in quite an out-of-the-way corner in the room. Two splendid examples are the Marconiphone model 240 and the H.M.V. model 341.

The Marconiphone outfit is, in effect, a return to old times; the circuit is a straight A.C. three-valver of the high-frequency amplifier-detector-output pentode variety with a fourth valve as rectifier. Such a combination with careful handling will give adequate selectivity enabling some thirty stations to be received with little interference and with quality of a very high order.

H.M.V.'s 341 console employs the same chassis as the model 340, a test report on which appeared in our June issue. Actually this is a three-valve superhet; extremely sensitive with a very satisfactory daylight range; and with nice quality. (Marconiphone 240, £13 2s. 6d.; H.M.V. 341, £15 15s.)

A development in superhet design making for better quality is the provision of variable selectivity, usually operated by a switch, which to a small degree lessens the selectivity and improves quality immensely. Notable examples of this practice are to be found in the new G.E.C. range of "High-fidelity" receivers, one of which, we hope, will be reviewed in these pages next month.

Continuing our tour of the Show, the Marconiphone company's new car-radio outfit selling at twenty guineas attracted our attention as being a definite advance in car-radio design. The equipment consists of three simple units, and it can be installed in any car employing a 12-volt lighting system. One unit houses a six-valve superhet chassis, the second contains the loudspeaker and the vibrator unit, while the third unit consists of the remote control for fitting to the steering column.



One of the new K.B. receivers, showing the Fototune dial. Note the two apertures where the station names appears

The tuning-dial is of the new clock-face variety marked in metres, and the degree of illumination is adjustable. Considering its size the consumption from the car battery is really quite small, being in the region of 5 ampères. The price includes noise-suppression equipment, but excludes aerial and fitting charges.

On the Ekco stand our attention was drawn to the new 22-guinea Ekco radiogram for A.C. mains with its three-way sound-diffusion system. Ekco tells us that in the past the cabinet has provided some of the "bass," but now with better loudspeakers and a very carefully designed set, they find that the best results, from a quality point of view, are obtained with the two sides of the cabinet cut away and filled in with a gauze material. One therefore does away with cabinet resonance and the sound reaches the room from the opening on the front and from the two sides.

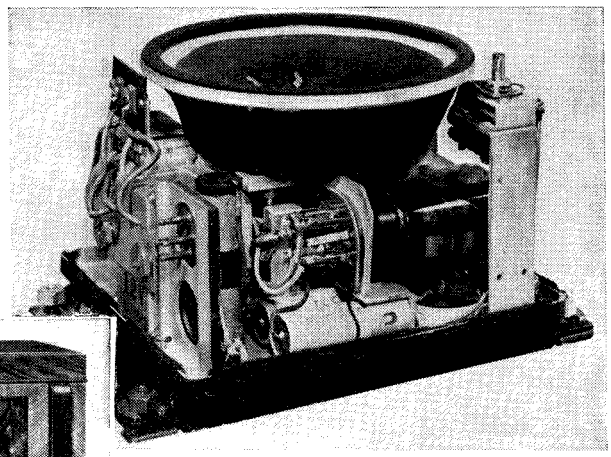
Whilst talking about radiograms we were bound to take notice of the new Ferranti Gloria radiogram—one of the

most handsome to be seen at the Show. Many will remember our test report earlier this year on the Gloria chassis, which we described as being in a class on its own. At forty-five guineas one undoubtedly gets the best that British brains can produce. As a matter of technical interest the output stage consists of two triodes in push-pull giving a speech output of 6 watts.

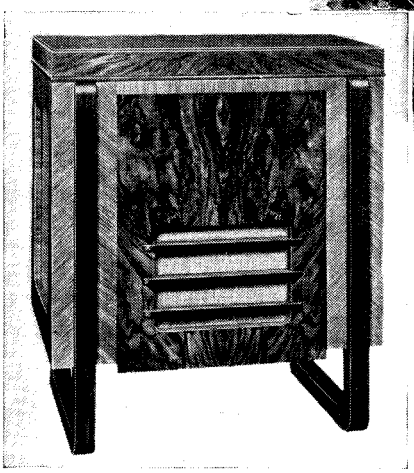
A deal of comment has been passed on the new Aerodyne remote tuning system called "Aeromagic." This is one of the "big hits" of the show. How it works is too long a story to tell here, but what it does is extremely fascinating. One has in addition to the set and its controls a small portable tuning panel on which are a tuning scale, marked in wavelengths and stations, and three knobs.

One is a combined on-off swith and volume control functioning in the usual way. When the second button is pushed the pointer on the scale starts moving — the direction, left or right, being controlled by the setting of the remaining control. When this pointer comes to a station that gives good entertainment value it stops and one can listen to a programme. When a change is wanted the button is pushed again the the pointer starts moving until it comes to the next good signal, and so on. One can sit in an armchair and tune to all the best programmes the set will offer by merely pressing a button.

The Aeromagic receiver is a seven-valve superhet. The possibilities of such a tuning system are very great. We dream of the future when there is one set stored in an out-of-the-way corner of the home with an extension loudspeaker and control unit in all the important rooms. At the moment the cost is comparatively expensive, being twenty-three guineas including the set and control unit.



Showing the loud-speaker and vibrator unit of the new 20-guinea Marconiphone car-radio outfit. The compactness of the unit can be gauged by comparing the size of the valve with the loudspeaker

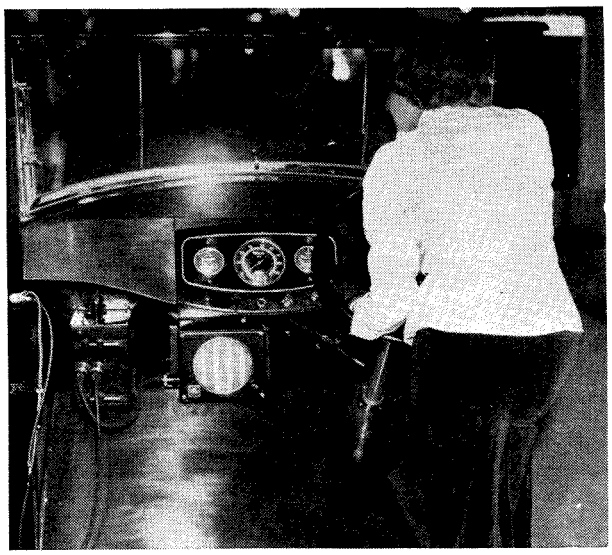


Ekco's big hit of the season is the introduction of three-way sound diffusion. This radiogram has its wooden sides replaced with a gauze material

For really simple tuning the biscuit goes to K.B. for their "Fototune" dial. This consists of a large clock-face dial marked in wavelengths with two translucent screens, one on each side. To select any particular station you turn the dial to its wavelength, and when you are correctly tuned in the station name appears on one of the screens. A push-pull action of the tuning control changes from long to medium waves, or vice-versa.

As we forecast in past issues, the all-waver has taken new set buyers by storm. On the opening day of the Show, Pye sprung a surprise by releasing a new

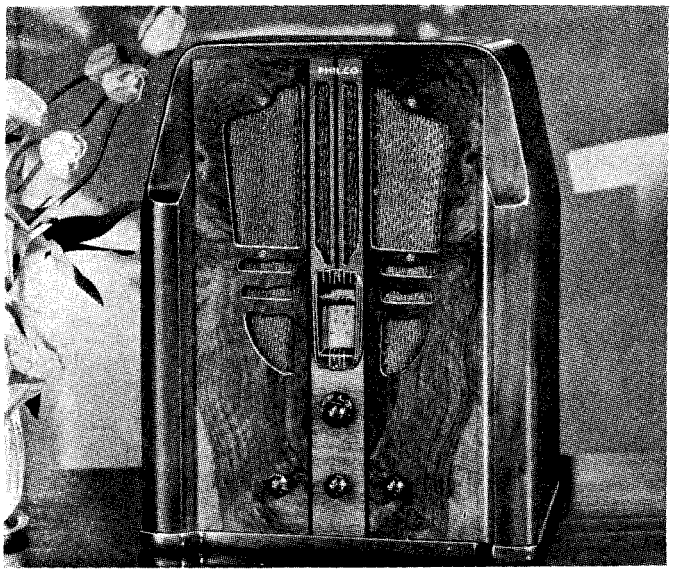
(*Continued on page* 240)



Marconiphone displays its first car-radio outfit in this novel setting at Olympia. Note the neat layout of the set and loudspeaker units

Visitors to Olympia seem extremely interested in the neat appearance of the new H.M.V. 15-guinea A.C./D.C. superhet console receiver

Philco 1936 Empire Receiver



A remarkably fine A.C. all-waver made by Philco, the model 98, has come through our tests with high honours

THIS new model 98 is, undoubtedly, one of the finest table receivers we have had the pleasure to test. It is an all-waver for A.C. mains covering from 17 to 52 metres on the short waves, 174 to 565 metres on the medium, and 857 to 2,068 metres on the long. Six valves plus a rectifier are used, a push-pull output stage being incorporated to give a hefty undistorted output of 5 watts.

There is full automatic volume control; shadow tuning; three-point tone control; provision for gramophone pick-up—all this housed in a cabinet some 15¾ in. wide, 19¼ in. high, and 12 in. deep.

As you can see from the illustration, the cabinet has quite attractive lines, though one can hardly call its appearance ultra-modern. However, it is solid and that, after all, is the most important thing when it is called upon to house a loudspeaker delivering a 5-watt output.

Controls are four in number and very simple to master. Immediately below the escutcheon is the main tuner, with a small knob superimposed giving a slow-motion drive with an 80 to 1 ratio. We noticed the value of this control on short waves.

Of the three other controls, the knob on the left is the combined on-off switch and volume control; in the centre the wave-change switch for the three bands; and on the right the three-position tone control which, in effect, controls the amount of top-note response.

We found that the maximum-top position gave exceptionally brilliant quality of reproduction; some listeners may like the rather "woofy" reproduction of the other two settings.

The wave-change switch controls the illumination of the tuning scale, only the band to which the set is tuned being illuminated. Calibrations are based on frequency and not on wavelengths or station names. This method of scale marking is undoubtedly the best method providing the calibrations are accurate. The accuracy here is such that the scale can be set to the frequency of any medium or long-wave station with the set off, and then when the set is switched on only a minute adjustment of tuner is necessary.

Tuning by kilocycles is perhaps strange at first to those accustomed to the more familiar methods, but changes of station wavelengths make no difference to a scale marked in this way. Anyway, Philco give the dial readings of some 250 short-wave stations and about 90 medium and long in their instruction book; on the other hand, you can get them any day from a newspaper by simply dividing the number of metres into 300,000 to get the frequency.

One word about the interior layout. Only a glance is necessary to see that the job is engineered and that high-class materials are employed.

Our tests endorse Philco's statement that this set brings glorious adventure to the home. Any night, using only a small 20 ft. outdoor wire slung down by the side of the house, we could log four or five American stations which provided entertainment—concerts and talks really worth listening to, as far as quality and strength of reproduction were concerned. With the Philco list of short-wave stations one can spend hours touring the world at ease; North and South Americans were logged as easy as Europeans.

Many Sunday mornings were spent listening to amateurs in all parts of Europe chatting away to each other. We honestly can say that the short wave-band on this model 98 provided 24-hour entertainment.

On the broadcast bands the most noticeable feature was the splendid way the model 98 enabled foreigners to be logged in daylight, though many, of course, with some background noise.

At night one only had to turn the dial slowly, and then station after station rolled in, all giving perfect entertainment. It was a treat for us to find a set with such knife-edge selectivity, entirely hum-free, and so easy to operate.

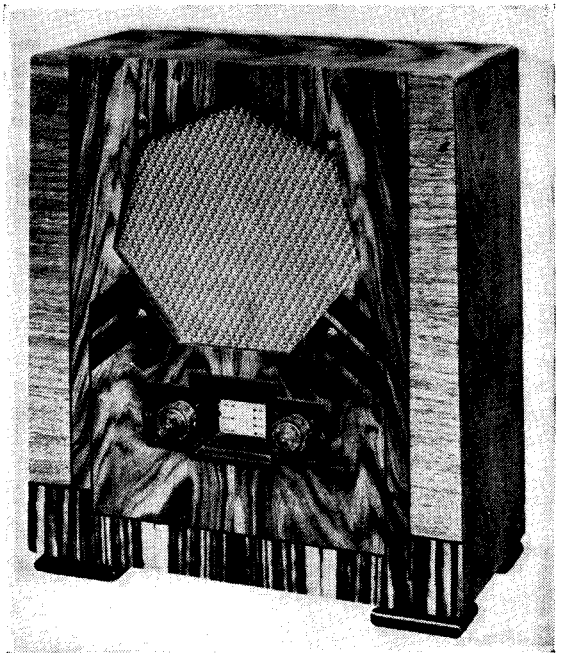
Tuning is made particularly easy by the shadow tuner at the top of the escutcheon. All one has to do to ensure that a signal is correctly tuned in is to adjust the tuning control until the dark band on the frosted screen is as narrow as it can be made.

We have no hesitation in recommending this model 98 as an outstanding example of the best in all-wave radio.

BRIEF SPECIFICATION

BRAND NAME: Philco.
MODEL: 98.
PRICE: £22 1s.
VALVE COMBINATION: Seven-valve (including rectifier) all-wave superhet receiver for A.C. mains operation. The combination is a radio-frequency amplifier (78E), combined oscillator and first detector (6A7), intermediate-frequency amplifier (78E), second detector, low-frequency amplifier and A.V.C. (85), and two pentodes in push-pull (42E's). The rectifier is a type 80. All Philco valves.
POWER SUPPLY: Standard A.C. mains voltages.
MAKERS: Philco Radio and Television Corpn. of Gt. Britain, Ltd., Aintree Road, Perivale, Greenford, Middlesex.

Columbia Superhet Battery Grand



"... we must give credit to the simple design of the cabinet; of solid walnut with two combination controls on either side of an illuminated scale"

COLUMBIA has re-entered the set market with four receivers — three versions of a four-valve A.C. superhet (table, console and radiogram) and this five-valve battery superhet under review.

The circuit used is up to the minute in every respect, and is one that can be relied upon to give satisfactory results in every locality, night or day. In brief, the arrangement consists of a high-frequency amplifier—the signals are fed to the grid of this valve through a high-impedance aerial-coupling transformer, one half of which functions as a second-channel suppressor.

This H.F. amplifier is tuned-anode coupled to the S23 screened-grid valve, a combined detector-oscillator. There is one stage of intermediate-frequency amplification, the output from which is rectified by the diode part of the HD21. The triode portion of the HD21 is used as the first low-frequency amplifier and feeds the Q.P.P. output valve. The grids of the H.F. and the I.F. amplifiers are controlled for A.V.C. by negative bias supplied by one half of the double diode of the HD21.

BRIEF SPECIFICATION

BRAND NAME: Columbia.

MODEL: 1006.

PRICE: £11 11s.

VALVE COMBINATION: Five-valve superhet with high-frequency amplifier (Marconi VS24), combined detector-oscillator (Marconi S23), intermediate-frequency amplifier (Marconi VS2), second detector, first low-frequency amplifier and A.V.C. (Marconi double-diode-triode HD21), and Q.P.P. output valve (Marconi QP21).

POWER SUPPLY: 175-volt high-tension battery combined with grid bias and 2-volt 30-ampere-hour accumulator.

MAKERS: Columbia Graphophone Co., Ltd., 98-108 Clerkenwell Road, London, E.C.1.

The set chassis fits into the bottom of the fine walnut table cabinet—a point we were quick to notice is that all valves are very accessible, being mounted in line along the back. At the top there is ample space behind the permanent-magnet moving-coil loudspeaker for the 175-volt combined high-tension and grid-bias battery and the 2-volt accumulator, of the jelly-acid type.

On the back of the set chassis are four sockets; aerial and earth, and pick-up (2).

As far as appearance goes we must give credit to the simple design of the cabinet; of solid walnut with two combination controls on either side of an illuminated scale marked in wavelengths and stations. The volume control is on the left with the combination switch for filament on-off, wave-changing and gramo-radio superimposed on the face of the volume control.

On the right is the main tuner with a local-distance switch similarly mounted as the switch on the opposite side.

The set arrived at our lab. with the valves and batteries packed separately. Instructions for connecting up are so clearly explained that we feel that one who knows little about the "works" of radio sets would find no difficulty whatsoever in installing the model 1006.

Wave-ranges covered—we noted—are ample for modern requirements, the medium waves covering a band of from 200 to 560 metres, and the long waves from 1,010 to 2,000 metres.

The average consumption from the high-tension battery appears from our measurements to be very reasonable; we should put the average at about 10 milliamperes, rising somewhat on large signals.

Total consumption from the accumulator is near enough 1 ampere—this figure including the current taken by the pilot lamp. This means that the accumulator provided will give roughly 30 hours' service.

Our tests were made in South London using the standard outdoor aerial and earth. Sensitivity, we found, was especially good. The limits of station-getting appeared to be governed only by proportion of interference. On the medium waves we tuned-in about fifty stations, though interference, caused by stations wandering from their allotted channels, spoilt a dozen of them. The set's selectivity is outstanding; any pair of adjacent high-power stations could be separated.

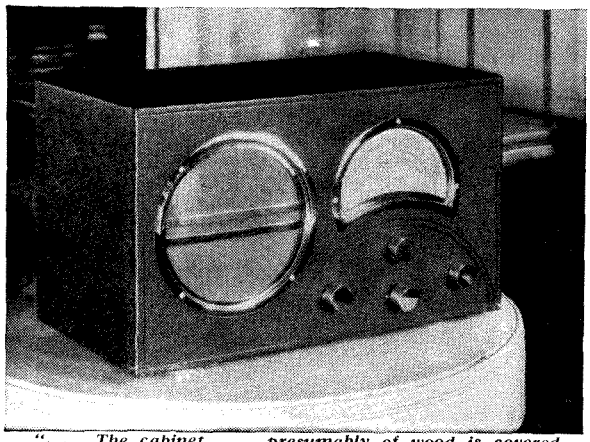
Long waves provided us with equally meritorious results. There is little background noise to worry listeners, though we must admit that on the more distant stations it was rather troublesome. We were extremely pleased to note that A.V.C. had been incorporated and our tests showed that this functions well.

The model 1006 has one great advantage. The stage of high-frequency amplification before the oscillator-detector does give a highly satisfactory daylight range. We made a test of its capabilities in this direction and found that we could log nine medium-wave foreigners in broad daylight. We consider this a very good performance.

Quality well up to standard for a battery receiver with Q.P.P. output; plenty of volume—well over 1 watt—and nicely balanced tone.

Altogether, at its very low purchase price, this Columbia model 1006 must be considered an excellent proposition for the battery set user.

Marconiphone Model 235



". . . The cabinet . . . presumably of wood is covered with black morocco with all controls chromium plated"

THOSE who profess to know, say that the straight three-valve of the H.F.-Det.-Pen. variety is incapable of giving good results in our so-called overcrowded ether. Let us make it clear now that we do not agree. We believe—and we are speaking on behalf of the Set Selection Bureau—that the modern straight three is still a good proposition for the listener who is content with a dozen or so alternatives to his local programmes.

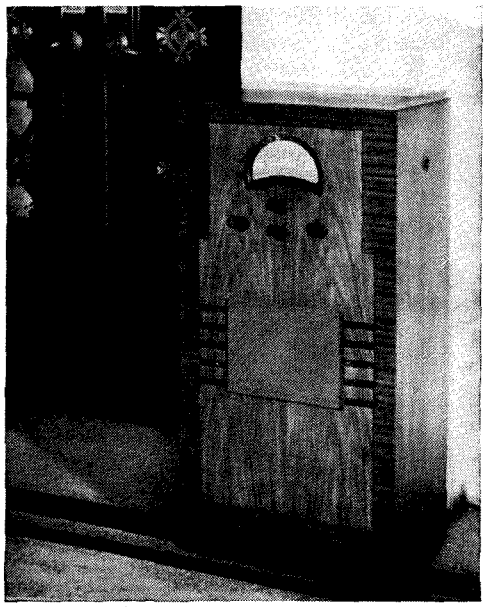
This Marconiphone 235 under review—released the opening day of this year's Radiolympia—has put up a really outstanding performance in our lab. First of all, a very brief description of the set. Its cabinet is one of the few new and original designs seen at this year's show. It is presumably of wood and is covered in black morocco, with all controls, escutcheon plate and loudspeaker-fret surround, chromium plated.

The tuning dial is of imitation mother of pearl behind a glass panel with the names of nine long and twenty-four medium-wave stations engraved thereon in black. There is no pointer : when the set is switched on, a circle of light appears with a fine black line across its centre. As the tuning control is turned, so the centre of light moves across the scale.

As our illustration shows, the outfit is really a good-looker : its size is 16½ in. wide, 10 in. high and 9 in. deep. Inside there is a small set chassis on the left embracing two coils and a two-gang condenser, on the other side is an energised moving-coil reproducer having a 6-in. cone.

Our main test was made with the set under most exacting conditions—the sort of conditions that would make it by no means easy for a set of this type to give an outstanding account of itself. We hitched it up to a 70-ft. outdoor aerial, using the most sensitive of the two tappings provided on the back. Incidentally we used a good earth, which is to be strongly advised.

A glance at the controls—main tuner above wave-change switch in the centre, reaction on the left and volume on the right—and we started. Our big and powerful local, London Regional was tuned in—dead on the mark at marvellous quality—goodly proportions of both top, middle and bottom—with up to 2 or 3 watts if wanted. Going up—with the reaction control advanced until the set was just off oscillation point and adjusting the volume with the right-hand control—our next signal *entirely free* of interference, though not at full volume, was Berlin on 356 metres. After that, from Milan upwards, the set's performance at night-time was little short of the standard we would expect from a four-valve superhet. Altogether we logged sixteen stations from London Regional upwards giving entertainment—and there was *no background noise*.



The console version of the Marconiphone 235. Known as the model 240, this fine-looker is undoubtedly splendid value for money at £13 2s. 6d.

BRIEF SPECIFICATION

BRAND NAME: Marconiphone.
MODEL: 235.
PRICE: £8 18s. 6d.
VALVE COMBINATION: Three-valve (rectifier as fourth) receiver of the straight kind for operation off A.C. mains. The combination is a screen-grid high-frequency amplifier (Marconi VMS4B), detector (Marconi MH41) and pentode output (Marconi N41). The rectifier is a Marconi U12.
POWER SUPPLY: A.C. mains, 200-250 volts, 50-100 cycles.
MAKERS: Marconiphone, Ltd., Radio House, Tottenham Court Road, London, W.C.2.

Below London Regional, Toulouse was nearly clear, Brussels No. 2 being the first station to be really clear. Frankfurt below and Bordeaux above were the limits of London National's spread, which is really quite satisfactory.

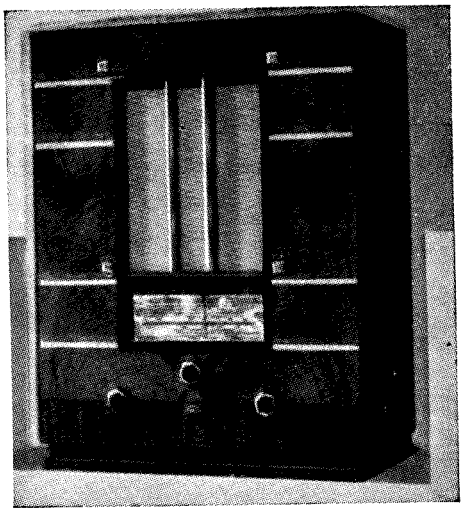
The most outstanding performance of this 235 was in daylight. Here its showing was indeed better than the small superhet. No fewer than nine medium wavers were logged, the most sensational of which was Stuttgart, logged at midday at a strength only just below comfortable listening.

One word about long waves—very sensitive, and no tricky operation was needed to separate Droitwich, Radio Paris, and Kootwijk, though we must mention that Radio Luxembourg's whistle was a little stronger than usual.

We feel that this set deserves more than usual praise. The man with limited means has a really cheap set here which will give him good service and extremely high quality of reproduction, though, as we have tried to point out, with selectivity just below that of an ordinary small superhet.

Wireless Magazine, October, 1935

Ferranti Lancastria A.C. Superhet

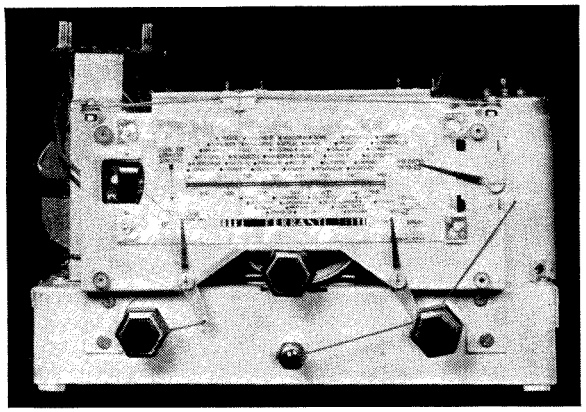


". . . Really attractive figured walnut cabinet . . . this Ferranti receiver is a thoroughly good outfit and one which we can confidently recommend"

NOMINALLY this Lancastria is a three-valve superhet, though it is sheer foolishness to call it so, for it consists really of three combination valves doing the work of six. The most sensible designation is a six-stage superhet; then we know where we stand. Actually these three valves put up a magnificent show.

One has only to think of *six-valve* supers of three seasons ago and then test this latest Ferranti receiver to realise the amazing way radio has developed.

For the modest outlay of twelve and a half guineas one gets a superhet with a 2.5-watt output stage feeding into a large moving-coil loudspeaker having a 7-inch cone; variable tone control; automatic volume control; mains aerial; visual tuning indicator; noise-suppressor switch; a switch for cutting out the interior speaker in favour of an external model; the now famous Ferranti all-in tuning dial; all housed in a really attractive figured walnut cabinet some 14 in. wide, 18 in. high and 9 in. deep.



". . . The all-in tuning scale on which one can see whether the station being received is correctly tuned in, tone-control setting, together with a calibrated scale in wavelengths and stations"

On the front of this cabinet pride of place is given to the all-in tuning scale on which one can see whether the station being received is correctly tuned in, tone-control setting, together with a scale calibrated in station names and wavelengths.

Below this scale is the tuner with the small tone-control knob underneath, to the left the combined on-off switch and volume control, while to the right is the wave-change switch.

Any proof needed of Ferranti craftsmanship can be obtained by a glance at the interior—real sturdy construction, sensibly arranged and with all metal work such as the chassis and screening cans of good solid metal, nothing is skimped.

Our first tests were made at night using our standard outdoor aerial. Really we have no comment to make. The set behaved as a good superhet should; thirty or forty stations were logged on the medium band, all giving good listening. One simply turned the dial; when a station giving a pleasing programme was found, the tuner was carefully adjusted so that the needle on the left of the dial was at its lowest point.

We keep a standard receiver without A.V.C. so that we have a check on prevailing fading conditions. The night this Ferranti Lancastria was under test, conditions were bad, and except for sudden disappearances of a station for a second or two, the general strength level of signals received was remarkably constant—a sure sign that the automatic volume control was functioning well.

We were more than satisfied with the long-wave performance; it was decidedly above the average. Working from the bottom of the scale our "bag" included Croydon and Heston, Oslo, Leningrad, Kalundborg, Luxembourg, Warsaw (with a slight whistle) Motala, Droitwich, Berlin (almost clear), Radio Paris, Moscow, Lahti (badly mutilated) and Huizen. Except for the two mentioned, all were at full strength and quite clear of any form of interference. This is a record for a long-wave performance on any receiver yet tested this season.

This fine long-wave performance was checked over during an early morning test during which Moscow and Berlin were without a doubt the star performers. We found no great difficulty in logging plenty of medium-wavers during daylight, though many were rather troubled with background noise. However, in the early morning, Brussels No. 1, Hilversum, and Radio Normandy were logged fully up to our idea of entertainment value.

BRIEF SPECIFICATION

BRAND NAME: Ferranti.

MODEL: Lancastria A.C. Consolette.

PRICE: £13 2s. 6d.

VALVE COMBINATION: A.C. superhet comprising a combined oscillator and first detector (Ferranti VHT4), intermediate-frequency amplifier (Ferranti VPT4), combined second detector, power output and A.V.C. (Ferranti PT4D), and a full-wave rectifier (Ferranti R4).

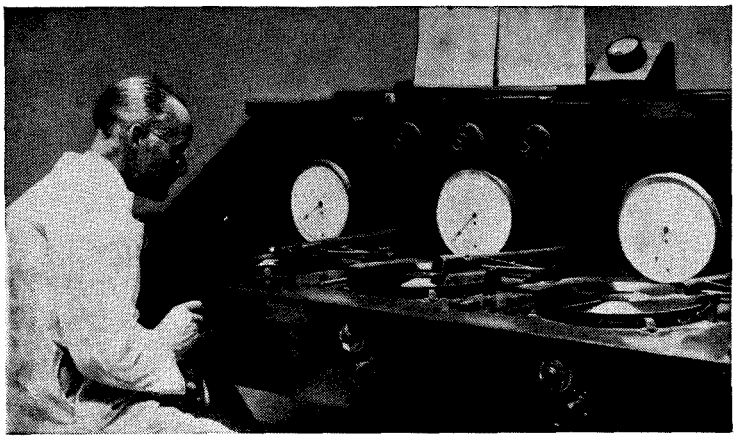
POWER SUPPLY: A.C. mains, 200-250 volts, 40-100 cycles.

MAKERS: Ferranti, Ltd., Bush House, Aldwych, London, W.C.2.

We regard the quality from this Ferranti Lancastria as very satisfactory. We got the impression that there seemed to be a little more top than usual for a superhet though, as our report indicates, there is no lack of selectivity.

This Ferranti receiver is a thoroughly good outfit and one which we can confidently recommend.

New Records for the Radiogram



This is the apparatus used at the H.M.V. recording studios for transferring sounds from one or more records for embodying in a new record. Excerpts from up to three records can be re-recorded at once, faders being used for control

THERE are two ways of looking at records. You might be the type of person who frequently buys a record because the tune happens to be topical; you play it continuously for a week, then throw it on one side. And so this process goes on until you have a pile of practically worn out records—you call them "old ones."

The other way is occasionally to get one or two good records, play them when you feel in the mood; after which they are carefully put back in their cases and stored away until the next time. The moral is that to get the best value out of records, it is wiser policy to buy what you enjoy rather than what you rave about. Dance records you bought twelve months or so ago: do you still regard them in the same light as a record you bought yesterday?

For instance, I bought Rimsky Korsakov's *Scheherazade* on *five* H.M.V. records about six years ago. I still treasure those records as if I had bought them yesterday. And, very strangely, I see that H.M.V. has issued the same work played by the same artists, Stokowski and the Philadelphia Symphony Orchestra on *six* records this month. (DB2522 to DB2527).

The natural question is why five in the first case and six today; I think the answer is that in modern recording the grooves are not quite so close together. But I still think you get value for money, especially when you compare the quality of recording, then and now.

The quality of some of this month's new records—not so many as usual—is as good as I have ever heard. My fancy is for the combined bands of the Coldstream and Welsh Guards under Major Andrew Harris playing Walford Davies' *Solemn Melody* and *Homage March* by Haydn Wood. This is undoubtedly worth getting for the record cabinet. (Columbia DX695. 4s.)

Gluck's *Alceste* overture on Decca K771 (2s. 6d.) is the first recording for this concern by William Mengelberg and the world-famous Concertgebouw Orchestra of Amsterdam. Gluck's overture needs little comment; it is very tuneful and is well worth having.

Very British are the tunes on two half-crown H.M.V. records, B8346 and 7. They are the three English Dances by Roger Quilter with the odd side for a Quilter arrangement of *Drink to Me Only With Thine Eyes*. The three Quilter dances are superbly played, but I can't say I even listened to the fourth side!

I pride myself on my collection of Peter Dawson records. Every song he sings possesses a vivacity and genuineness of artistry not often come across. There are two more, *Good Green Acres of Home* and *The Strong Go On* (H.M.V. B8353. 2s. 6d.). Even the titles express the spirit of them. Records of this kind always keep!

Decca has sent me two fine songs—arias if you so wish—sung by Heinrich Schlusnus, *Gazing Around* and *O Star of Eve*, both from Wagner's *Tannhäuser*, on CA8206 (4s.). Two well-known songs—hackneyed if you like—sung by a great artist.

Did you hear the four thousand in the theatre at Olympia cheer Pat O'Brien—known as the Irish Street Singer—during the broadcasts? Decca has sent me one of his records—F5642—I do admire his clear Irish accent. He has a wonderful voice for one who has never been trained.

Those fond of military band records should hear Columbia's recording of *Tattoo!*—a selection of four well-known marches played by the Massed Bands of the Northern Command Tattoo, recently held in Nottingham. They are marches you all know—*Entry of the Gladiators, Le Rêve Passe, Officer of the Day* and *Grenadiers du Caucase*—and played with the precision known only to the British Army. (Columbia DX703. 2s. 6d.)

Ketèlbey—a British composer of delightful light music whose works do not get the prominence they deserve in our radio programmes—has his *In a Monastery Garden* played by Quentin Maclean, at the organ of the Trocadero Cinema, on Columbia DB1571. If you are not too tired of hearing it I would recommend this. (2s. 6d.)

For the best of the light dance music I look to Parlophone, who sends me this month another *Waltz Medley* played by Harry Roy's Tiger-ragamuffins. The tunes are old, but good, and include *Charmaine, Ramona* and *What'll I Do*; these boys' medley records sell like hot cakes, so I'm told, and judging by the fine rhythmic precision of this one I am not surprised. (F208. 1s. 6d.)

The best of the Harry Roy records are *South American Joe* and *Campesina* (rumbas) on F207, and *According to the Moonlight* and *It's an Old Southern Custom* (foxtrots—both from the film, *George White's Scandals*, 1935) on F205. Harry does some of his foolishness in them and altogether they are full of pep!

Of the H.M.V. dance records I like *I Won't Dance* and *Lovely to Look At* played by Jack Hylton and the lads on BD200. Jack's dance music is good—speaking modern rhythmically perhaps not so hot, but as an ordinary listener I appreciate the emphasis he gives to melody without losing the kick in the tune. (1s. 6d.) *T.F.H.*

"W.M." Book Reviews

Popular Television, *by H. J. Barton Chapple, Wh.Sch., B.Sc. (Hons.), A.C.G.I., A.M.I.E.E. (Pitman, 2s. 6d.)*

THE sub-title of this little book describes it as providing " up-to-date principles and practice explained in simple language " and that seems to this reviewer a very fair rating. The book is certainly much more nearly up-to-date than the great majority of those appearing of late; we have indeed no fault to find with it on this score for it presents a very well-balanced picture of the technical television situation at this moment.

It gives a commendably clear account of all the major principles on which the modern high-definition systems operate, without assuming any great amount of technical knowledge on the part of the reader, and we can recommend it fully to those who wish to obtain a good groundwork for the practical knowledge we all hope to acquire in the near future.

Practical Radio Communication, *by Arthur R. Nilson, U.S.N.R. (retd.), M.I.R.E., and J. L. Hornung, M.I.R.E. (McGraw-Hill Publishing Co., Ltd., 30s.)*

TO do justice to a work of this magnitude within the usual " W.M." reviews limit is quite impossible : it contains about 750 large pages and represents one of the most comprehensive kinds of general treatises we have seen. It is definitely a book for the professional radio engineer or the serious experimenter who wishes to acquire a really substantial basis of knowledge and is not afraid of a certain amount of mathematics.

Probably a list of the chapter headings will convey an idea of the scope of the work and this we append.

Chapter 1—Direct current electricity and magnetism.

Chapter 2—Alternating current electricity.

Chapter 3—Introduction to vacuum tubes.

Chapter 4—Transmitting circuit principles

Chapter 5—Receiving circuit principles.

Chapter 6—Antennas and wave propagation.

Chapter 7—Studio acoustics and apparatus.

Chapter 8—Control room equipment and operation.

Chapter 9—Broadcast transmitters.

Chapter 10 — Communication transmitters.

Chapter 11—Radio receivers.

Chapter 12—Radio aids to navigation.

Chapter 13—Rectifier units.

Chapter 14—Dynamo-electric machinery and meters.

Chapter 15—Storage batteries.

The book ends with an appendix of some forty pages containing much useful information. We can thoroughly recommend this work.

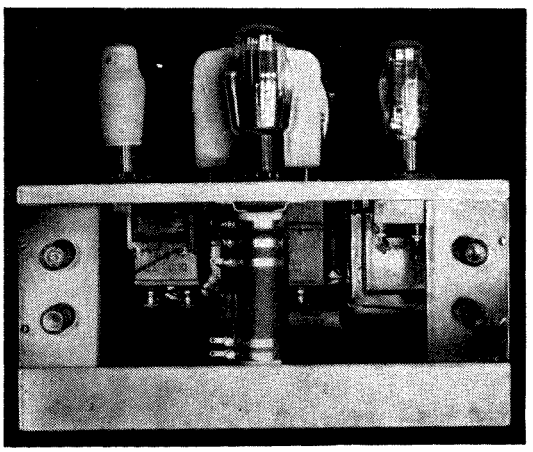
Photo-electric and Selenium Cells, *by T. J. Fielding. (Chapman and Hall, 6s.)*

A USEFUL and practical book for those who wish to acquire both practical and theoretical knowledge of one of the most versatile and useful of modern inventions. It makes little demand upon the readers existing technical knowledge, but nevertheless manages to cover a lot of ground. It should be of considerable value to all interested in television, talkies, and so forth.

HOW TO SUPPRESS HUM—*Continued from page 190*

Positions for these extra condensers, by the way, can be found round the inner surfaces of the *sides* of the chassis frame as well as on the underside of the baseboard proper.

In the other case of a rough-sounding hum, especially with variations from time to time, some form of high-frequency filter in the mains lead to the set is indicated. I have had a special diagram drawn to show in schematic form how this is connected up, along with various other useful auxiliaries such as a mains on-off switch, a fuse unit, and so on.



Any cabinet design used for the Unicon should be arranged to cover the loudspeaker terminals when the back is on, since these are among the "live" points of the circuit

The choke suggested is the Bulgin double type HF11, and the two .05-microfarad condensers *must* be of adequate voltage rating (e.g., the T.C.C. type 250 tubular). All these items can best be mounted upon the inner sides of the cabinet housing the receiver: this provides a convenient location for the control switch and is better electrically than the alternative placing on the set chassis.

A filter of this type will often do wonders on really bad mains, but in those really obstinate cases wherein something further is still needed it is worth while to try a fixed condenser of from .01 to .05-microfarad connected between the plate and cathode of the rectifying valve (the V2118). This is one of those things that look all wrong in theory but are quite useful in practice!

I should like to add an emphatic warning in connection with all these experimental modifications: never try to do anything inside the set without disconnecting completely from the mains. *It is not sufficient to turn off the switch.* Remember that the shock administered by a universal-type set may on occasion have the full power of the mains behind it. *Don't take risks!*

By the way, I remember that I did not mention last month the manner of using the series-aerial condenser, and this question of safety has reminded me: the knob of the series condenser is *not* a danger point, because there is a protective fixed condenser further back in the circuit in the usual manner, but I still suggest that the capacity should not be altered while the set is working, because one's fingers may stray.

COMPONENTS NEEDED FOR THE UNICON TWO

	s.	d.
CHASSIS		
1—Wooden chassis frame to specification	6	6
CHOKES		
1—Varley Junior high-frequency choke	3	6
1—Ferranti smoothing choke, type B10	11	6
COIL		
1—Goltone coil unit, type GIC2 ...	9	6
CONDENSERS, FIXED		
1—Dubilier .0001-microfarad, type 620	1	3
1—Dubilier .001-microfarad, type 620 (500-volt working)... ...	3	0
1—Dubilier .005-microfarad, type 620	2	3
1—Dubilier .05-microfarad, type 4503	1	4
1—Dubilier 2-microfarad, type LSB	4	6
2—Dubilier 4-microfarad, type LSB	16	0
1—Dubilier 20-microfarad, type 401	2	6
CONDENSERS, VARIABLE		
1—J.B. .0005-microfarad single Nugang with cover	10	6
1—Graham-Farish .0003-microfarad Litlos reaction	2	0
1—Formo .0003-microfarad compression	1	6

	£	s.	d.
RESISTANCES, FIXED			
1—Amplion 250-ohm		1	0
1—Amplion 25,000-ohm		1	0
1—Bulgin mains, type MR25 ...		3	6
1—Graham-Farish 2-megohm grid leak			10
SWITCH			
1—Bulgin, type S98		2	3
TRANSFORMER, LOW-FREQUENCY			
1—Varley Nicore No. 2		11	6
VALVE HOLDERS			
2—Clix 5-pin		2	0
1—Clix Continental 7-pin		1	1
SUNDRIES			
4—Belling-Lee terminals, marked A, E, LS(2)		2	0
2—Small Terminal plates			
Flex for mains connection.			
Mains plug			
Wire, sleeving, etc.			
LOUDSPEAKER			
1—W.B. Stentorian standard model	2	2	0
VALVES			
1—Tungsram R2018		10	6
1—Tungsram PP4118		14	9
1—Tungsram V2118		10	0

Screened Plugs to Improve Car Radio

THE growing popularity of car radio has led to advanced research by the manufacturers of ignition components.

As is appreciated by technically-minded motorists, the ignition system is acting as a miniature transmitting station the whole time the engine is running. This, of course, causes interference with reception, and to prevent it one has either to "screen" the whole electrical system or to damp down the spark by inserting resistances in the high-tension circuit. With the latter arrangement, which is the simpler and cheaper of the two, results are often fairly good on the long waves, but short-wave reception is still affected. To stop interference on very short waves the spark would have to be damped down so much that the ignition might give much trouble.

Screening Problems

In order to screen the ignition set, the first thing to do is to encase the magneto (or coil and distributor) in a metal box and to put metal braiding round the high-tension cables. When it comes to the sparking plugs, however, the metal enclosure is a problem, largely owing to the heat in the neighbourhood of the plugs, and, of course, to the restricted space.

Years of Experiment

The difficulty has now been overcome by the Lodge company, who have introduced a new screened plug suitable for all types of cars and passenger coaches. This has been produced after years of experiment on military aircraft, which, of course, have to keep in constant touch by wireless with the ground stations and other aircraft, and the design has now reached the stage where the plugs can be offered for cars and coaches at a reasonable price.

Screening the remainder of the set is relatively simple, so it appears that this latest invention should go a long way towards perfecting reception, with the consequent increased popularity of the car-radio set.

In Tune with the

by EXAMINER

UTILITY COMPONENTS

MANY pleasant moments have I spent glancing through Utility's (alias Wilkins & Wright, Ltd.) latest catalogue. From this I learn that they have been established some seventy years in the fine engineering business, so there is little excuse for them to turn out an indifferent product.

My own experience of Utility stuff is definitely one of reliability. The list I have before me is a great deal more than a plain catalogue of condensers, tuning units, dials, and switches with prices; it is packed with real useful technical information.

You know the principal Utility components. Here are some of them: ganged condensers, midget and ordinary, superhet or otherwise, bakelite condensers, short-wave condensers, dials and micro dials, and an extensive range of switches and knobs. The catalogue is yours for the asking. **482**

ARDENTE SOUND SYSTEMS

I MUST confess that my own knowledge of the activities of this firm was very limited until I received this latest broadsheet. The name Ardente to me conjured up deaf-aid equipment, for which this concern is universally known.

Now I learn that they make a most extensive range of public-address apparatus in every size and form. For instance, they make complete radiograms with undistorted outputs up to 20 watts in prices ranging from sixty to eighty-seven guineas.

On the other hand, they supply compact units containing pick-up and electric gramophone motor complete with a "fader" control for as little as seven guineas.

In addition there are literally dozens of other lines of special interest to the ordinary radio listener and P.A. engineer—loudspeakers, microphones, small and large amplifiers, mobile equipment and so on. **483**

A COPPER-BOUND BOOK

FROM the Copper Development Association comes one of a series of books; this one in effect a veritable dictionary about copper.

There are some sixty pages dealing with the properties of copper, treatment and working of the metal and its commercial grades and applications together with several useful tables. Readers interested can obtain copies free through this service. **484**

BATTERY-REPLACEMENT TIME

SETS must be on tip-top form for the coming listening season. And the best way to see that your set is in form—if it is a battery model—is to make certain that the high-tension and grid-bias batteries are containing their full amount of volts. If not, scrap them and get new! Old advice, admittedly, but very sound.

I would draw your attention to a comprehensive list received from the C.A.V. people. Besides details of the complete range of C.A.V. batteries and accumulators, there is a chart listing all kinds of battery sets, old and new, with appropriate C.A.V. re-fills.

Incidentally, on the last page there is a fine sectional drawing showing the construction of a C.A.V. accumulator. You will be surprised at the amount of thought that has to be put into an ordinary two-volt wet accumulator. **485**

W.B. STENTORIANS

W. B. send me an attractive list dealing with their much-

SEND TO US FOR THESE CATALOGUES!

Here we review the newest booklets and folders issued by seven manufacturers. If you want copies of any or all of them, just cut out this coupon and send it to us. We will see that you get all the literature you desire.

Please indicate the numbers (seen at the end of each paragraph) of the catalogues you want below:—

My name and address are :—

Send this coupon in an unsealed envelope, bearing ½d. stamp, to "Catalogue Service," WIRELESS MAGAZINE, 8-11 Southampton St., W.C.2.
Valid till October 31.

Trade

improved range of loudspeakers. This year, particularly, W.B. have paid a deal of attention to the appearance and design of the cabinet models. All cabinets have been designed with a thought to the acoustic side, with the result that W.B. claim that their new cabinet loudspeakers are free from any trace of box resonance.

If you are interested in fitting up an extension loudspeaker for your commercial receiver, I do suggest strongly that you earmark one of these latest W.B. lists. **486**

◇ ◇ ◇

WEARITE COILS

THERE is no need to say much about Wearite coils in "W.M."; we have used them on and off in constructional sets for years.

The latest catalogue—as full of technical hints and information as usual—consists of some thirty-two pages dealing primarily with coils—air-core, iron-core, superhet types—besides a large range of power transformers, smoothing chokes, high-frequency chokes and switches.

The section on mains interference is particularly commendable. The problems are simply explained, and the language used is such that non-technical readers should be able to set about curing any interference with which they may be troubled. **487**

◇ ◇ ◇

VARIDEP MIKE

OF special interest among the new books is a 16-pager from the Telephone Manufacturing Co., Ltd., describing a new type of carbon microphone. To quote from the book: "The microphone, which has been fully protected by patents, embodies certain features which permit its response for a certain sound pressure to be uniform and, on account of its variable depth properties, independent of frequency."

This new mike has an impedance of approximately 500 ohms, and will operate with an energising current of 2 to 30 milliamperes—20 milliamperes is the recommended figure for continuous use. The booklet contains *full* technical details, curves, and prices, and is worth having. **488**

Conducted by the "W.M." Technical Staff

Tests of New Apparatus

B.T.H. Pezolectric Pick-up : : T.M.C. VariDep Microphone : : Voigt Domestic Loudspeaker : : Erie ¼-watt Resistances

B.T.H. PEZOLECTRIC PICK-UP

Description

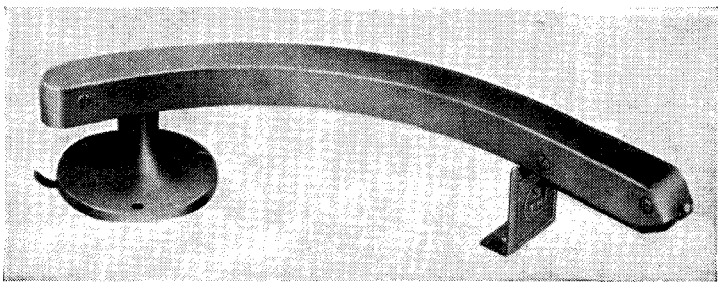
UNDER the name of Pezolectric, the Edison Swan Electric Co., Ltd., are marketing a crystal pick-up. The construction is very simple and comprises an arcuate channel-pressing pivoted on the usual type of pillar. The channel pressing retains a two-piece bakelite moulding used as a mounting for the crystal combination. The pick-up is provided with the usual type of needle holder, which is pear shaped, fixing being by the ordinary needle screw.

An oxidised finish is employed and the pick-up is provided with a very simple metal pressing acting as a rest when the arm is not in use. Connection is by means of a short twin-braided cable.

Observations

The general appearance is quite pleasing, the lines being simple and modern, and the construction appears to be highly satisfactory. Needle changing is quite easy, the needle clamp being accessible. The needle holder is free and accordingly the pick-up should not cause undue wear. The freedom also permits the development of appreciable amplitudes so necessary for good bass reproduction.

The frequency response is excellent. It takes the form of what is substantially a straight line between 70 and 5,000 cycles, the line being only slightly inclined representing quite a small decibel gain and loss. The compensation in the bass is of the order of 10 decibels. The response is free from marked resonances, and even above 5,000 cycles the output is very appreciable.



The new B.T.H. Pezolectric pick-up, which has given a more than satisfactory performance on test

TESTS OF NEW APPARATUS—
Continued

The actual output depends upon the type of needle used and the shunt resistance. In the lower registers it runs into several volts and it is quite possible with certain needles and record amplitudes to obtain voltages of 5 to 6 volts.

The practical performance is good, the reproduction being very crisp and clear with excellent attack.

Measurements

Swing Radius .. 9 inches
Offset Head
Angle .. .. 35 degrees

The pick-up is marketed by the Edison Swan Electric Co., Ltd., of 155 Charing Cross Road, London, W.C.1. : price £2 2s.

◇ ◇ ◇

T.M.C. VARIDEP MICROPHONE

Description

THE Telephone Manufacturing Co., Ltd. has recently introduced a transverse current microphone. The system utilizes an ordinary transverse current path through a layer of granules, held in a separate shaped bakelite moulding. They are retained by a mica diaphragm fitted with a grille and gauze protection.

It is well known that the response of a granule microphone depends upon the size of the granules and the thickness and general shape of the layer. In the VariDep a double " V " formation of varying depth is used in conjunction with suitably graded granules. The manufacturers claim that the physical properties are such that a very even frequency response is obtained.

The microphone is attractively finished and is arranged for suspension by means of hooks.

Observations

For a carbon microphone the background level is quite low and the sensitivity is about average. Provided the microphone is suitably matched to the input transformer, and it should be noted that a suitable transformer is supplied by the manufacturers, a very good frequency response can be obtained. The high-note response is very well maintained, the reproduction of the higher notes being a little above average.

At the same time the response extends well below 50 cycles. There are certain resonances, which are invariably obtained in a carbon granule microphone, but these are

Continued on page 236

not unduly marked and practical tests with a high-fidelity amplifier and reproducer show that the reproduction is very natural.

The attack is good and the general quality is not characteristic of what is generally known as a "carbon tone."

This microphone is undoubtedly one of the most satisfactory transverse types we have examined.

Finally it should be mentioned that no trace of packing was noticed during the tests and the sensitivity appeared to remain constant.

Measurements

Average resistance	500 ohms.
Operating current	7 milliamperes to 20 milliamperes.

The VariDep mike is distributed by T.M.C.-Harwell (Sales), Ltd., of 223 Shaftesbury Avenue, W.C.2.; price £7 7s. (transformer 19s. 6d.)

◇ ◇ ◇

VOIGT DOMESTIC LOUDSPEAKER

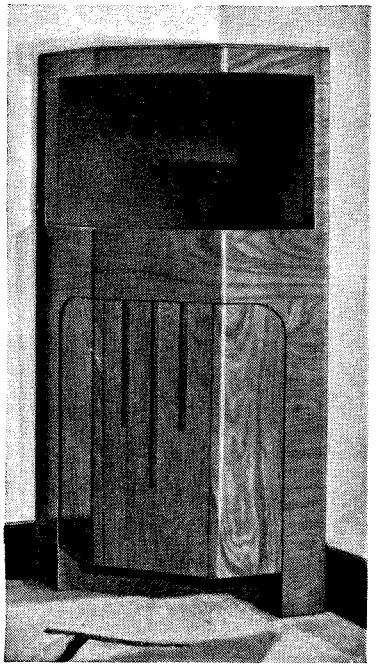
Description

WITH the Voigt Domestic loudspeaker, which is designed only for operation in the corner of a room, it is possible to obtain results equivalent to those given by a large horn. This is due entirely to the special construction.

The housing or cabinet is intended to make a tight fit into a corner of a large room. The driving unit is a specially constructed moving-coil assembly in which the diaphragm is designed to energize two air columns. The output from the front of the diaphragm is reflected from a concrete block on to a specially shaped distribution cone, which appears to be constructed from plaster built up on a suitable framework. This communicates with three openings in the housing, the openings occupying a space of about 4½ sq. ft.

The back of the diaphragm is used to energise what is referred to as a "bass chamber," the bass radiation being distributed from the bottom of the cabinet via the walls and floor. It will be seen, therefore, that the satisfactory operation of the loudspeaker is dependent upon it being suitably placed with respect to solid walls and floor.

The energizing system comprises a very large electro-magnet which develops a high flux density in the gap. The diaphragm is very freely mounted, being composed of a crisp bakelized material. The mounting



The cabinet model of the Voigt domestic loudspeaker. Expensive perhaps, but it delivers the goods

TESTS OF NEW APPARATUS—Continued

is such that appreciable amplitude is possible, which of course accounts for the good bass radiation.

The diaphragm is also fitted with a subsidiary free-edged cone concentrically mounted with the main cone and this tends to improve the high-note response. Finally, mention must be made of a special power pack for supplying the field energising current.

Observations

The performance of the speaker is exceptionally good. The total radiation is amazingly level and there is excellent reproduction well into the region of 7,000 or 8,000 cycles. The low-note radiation also extends well below 50 cycles provided, of course, that the loudspeaker is suitably exposed.

From a practical point of view the tone is extremely natural and the good high and low note radiation gives depth and crispness, the reproduction under transient conditions enhancing the naturalness of the general tone.

Measurements

Field Resistance : 980 ohms.

The loudspeaker is made by Voigt Patents, Ltd., of The Courts, Silverdale, London, S.E.26. The price of the unit is £15 for D.C.; for A.C. £3 to £7 extra. The corner cabinet in unfinished wood costs 14s.

◈ ◈ ◈

ERIE ¼-WATT RESISTANCES

Description

THERE are many parts of a receiver in which a 1- or 2-watt resistance is quite unnecessary. To supply the needs of a low-rated resistance the Radio Resistor Co., Ltd. has introduced a series of ¼-watt models. These have the advantage of being extremely small, light and compact.

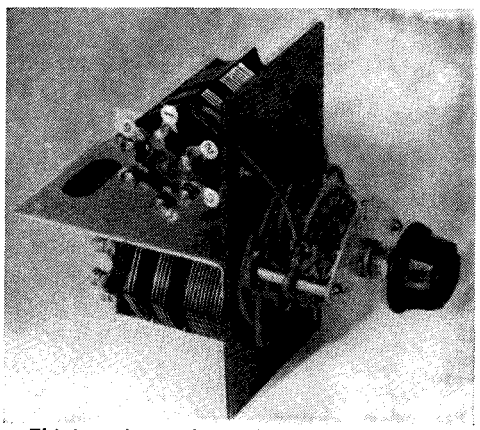
The resistance appears to be mounted inside a ceramic tube colour coded in the ordinary way. The tube is extremely small, being just under ½ in. long. The tubes are fitted with soft tinned-copper connecting wires, which are of adequate length.

Observations

The resistances appear to be quite well made and the connections are very soundly fixed. Out of the five samples tested not one departed materially from its nominal rating.

These resistors are marketed by the Radio Resistor Co., Ltd. of 1 Golden Square, London, W.1 : price 1s. 0d. each.

From Here and There



This is an interesting and new multiple-range short-wave coil unit introduced by B.T.S. which we hope to review in our test pages in the near future

THERE are still a few more days left for readers to explore the Shipping, Engineering and Machinery Exhibition at Olympia—the closing day is September 28. Of special interest is the display of the most up-to-date Marconi wireless telegraphy and telephony apparatus and direction-finding equipment.

The exhibits are arranged to give visitors a general idea of how the equipments are installed in wireless cabins on board ships, and are set out in such a way as to give the greatest facility for examination.

The gear on show includes wireless telegraphy and direction-finding equipment as used on large passenger vessels, similar gear for use on cargo vessels and small passenger craft, as well as installations for yachts and band repeater equipment for entertainment for use on all types of ships. It is certain that radio enthusiasts will find much to interest them on the Marconi International Marine Communication Co's stand.

◈ ◈ ◈

We expect many readers noticed the unfortunate error that occurred in our article "Automatic Grid Bias Without Dropping H.T. Volts," published in our last issue. Figs. 2 and 3 should be transposed, as obviously Fig. 3 illustrates the use of a metal rectifier.

Will readers please note that the W.B. Senior loudspeaker is priced at £2 2s., and not at £4 4s. as mentioned on page 152 of our last issue.

◈ ◈ ◈

To cope with increasing business Burne-Jones & Co., Ltd., has moved to much larger premises at 309-317 Borough High Street, London, S.E.1. Already this concern has manufactured upwards of 25,000 receivers for the use of blind persons in the United Kingdom.

◈ ◈ ◈

How wide is the scope covered by systems of sound reproduction is indicated very clearly in a folder just published by the General Electric Co., Ltd., of Magnet House, Kingsway, London, W.C.2. The G.E.C. has specialised in the development of all manner of sound equipments for more than a quarter of a century and has to its credit the fine systems at the Lyceum and Leicester Square Theatres in London, and at many leading hospitals all over the country.

Copies of the folder are free on request from the G.E.C.

◈ ◈ ◈

No doubt many readers heard the broadcasts on the new pipeless organ, made by the Compton Organ, in the Radiolympia relays this year. The organ makes use of a powerful amplifier which delivers a speech output of 90 watts to a number of specially designed Voigt power loudspeakers.

The lowest pedal note heard corresponds to a 16 ft. pipe (that is 32 cycles). The electrical reproduction of notes in this part of the frequency spectrum is effected by means of a special bass chamber. This was built at the Compton works at very short notice to a design of Mr. Voigt, of

Voigts Patents, Ltd., and utilises four Voigt units with double-power diaphragms.

Four more units of normal power are used for the middle and upper registers, while two double-power units with the corner reflector-type horns can be used for additional sound coverage.

◈ ◈ ◈

To improve the facilities for Italian vessels to keep in touch with their own country from all parts of the world the Italian Ministry of Communications has recently erected a new Marconi short-wave transmitter with a wavelength of from 13 to 100 metres at Coltano.

The output of the transmitter to the aerial feeders is 56 kilowatts maximum on continuous-wave telegraphy and 35 kilowatts on telephony at 80 per cent modulation. It is, therefore, one of the most powerful of its kind in the world.

The speech response of the new installation is of an exceptionally high order and is equivalent to that of a modern broadcasting station.

◈ ◈ ◈

Interesting news comes from W.B., the loudspeaker manufacturers, concerning their new 36J cabinet loudspeaker. The cabinet is very pleasing to look at; but what is more pleasing to the technical man is the fact that the cabinet has been lined very thickly with a non-resonant material.

In the chassis itself a noticeable feature is the strength of the new magnet, especially so when one considers the very moderate price. It is an interesting fact that a higher flux density has been obtained without resort to the method of using a smaller air gap; actually the gap here has been increased.

Another improvement is that the centring spider is now mounted on a separate framework and centring is carried out from the front by the use of a jig. This, of course, enables the task of centring—a delicate process at all times—to be carried out with minute accuracy. These improvements are noticeable throughout the entire W.B. range of loudspeakers.

BLUEPRINT COUPON

Valid only until Oct. 31 1935 (or until Nov. 29 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 one blueprint only at the price indicated:—

VARSITY FOUR (page 169), No. WM395 price 9d. post paid.

MINITUBE THREE (page 184), No. WM396, price 6d. post paid.

INFORMATION COUPON

Valid only until Oct. 31 1935 (or until Nov. 29 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 Street, Strand, London, W.C.2

THE SET BUYERS AT OLYMPIA

Continued from page 223

ten-valve all-wave A.C. superhet covering wave-ranges of from 13 to 33 metres, 30 to 82 metres, 198 to 560 metres, and 850 to 2,000 metre. It would take pages to describe the set fully, but here are its leading features: full-vision tuning scale marked in metres and kilocycles, variable selectivity, tuning indicator, A.V.C., tone control, 8-watt undistorted output with valves in push-pull; connection for pick-up; price 28 guineas.

Other fine all-wavers were shown by R.A.P.—whose prices are within the reach of all—and Philips.

Two unusual sets, for which we feel there will be a steady demand. The Dynamic Portable, made by All-Wave International Radio and Television, Ltd., a simple battery three-valver complete with all batteries, aerial, moving-coil loudspeaker in a wooden cabinet 17 in. long by 7 in. high and 7 in. wide with a leather carrying handle, priced at £5 15s.

The makers claim excellent reception of all the more powerful home and foreign stations, while an external aerial and earth fixed to the connections provided converts the set into a selective and powerful instrument for home use.

The other is a small three-valve A.C. table radiogram for A.C. mains operation selling at £11 11s. made by Burgoyne. This latter set is ideal for the man with limited means requiring a radiogram and who is content with fair selectivity.

INDEX TO ADVERTISERS

FREE ADVICE FOR 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., D.C., or A.C./D.C.

(6) Special requirements : Quality needs ; appearance, etc.

A stamped-addressed envelope for our reply is your only expense. Address your inquiry to Set Selection Bureau, "Wireless Magazine," 8-11 Southampton Street, Strand, W.C.2.

Printed in Great Britain by THE SUN ENGRAVING CO., LTD., London and Watford, for the proprietors, GEO. NEWNES, LTD., 8-11 Southampton Street, Strand, London, W.C.2. Sole Agents for Australia and New Zealand : Gordon & Gotch, Ltd. Sole Agents for South Africa : Central News Agency, Ltd. October, 1935.

"Wireless Magazine" Blueprint Service

These blueprints are full-size. Copies of appropriate issues of "Practical Wireless," "Amateur Wireless," and of "Wireless Magazine" containing descriptions of most of these sets can be obtained at 4d. and 1s. 3d. each, respectively, post paid. Index letters "P.W." refer to "Practical Wireless" sets, "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., Geo. Newnes, Ltd., 8-11 Southampton Street, Strand, W.C.2.

CRYSTAL SETS

Blueprints, 6d. each.

Four-station Crystal Set ...	31.3.34	AW427

STRAIGHT SETS (Battery Operated)

Two-valvers: Blueprints, 1s. each.

Iron-core Two (D, QPP) ...	12.8.33	AW396
Unicon AC/DC Two (D, Pen.)	Sept '35.	WM394

Three-valvers: Blueprints, 1s. each.

Transportable Three (SG, D, Pen)	Feb. '32	WM271
Multi-mag Three (D, 2 Trans)...	June '32	WM288
£6 6s. Radiogram (D, RC, Trans)	Apr. '33	WM318
Simple-tune Three (SG, D, Pen)	June '33	WM327
Tyers Iron-core Three (SG, D, Pen)	July '33	WM330
Economy-pentode Three (SG, D, Pen)	Oct. '33	WM337
All-wave Three (D, 2LF) ...	Jan. '34	WM348
"W.M." 1934 Standard Three (SG, D, Pen)	Feb. '34	WM351
£3 3s. Three (SG, D, Trans) ...	Mar. '34	WM354
Iron-core Band-pass Three (SG, D, QP21)	June '34	WM362
1935 £6 6s. Battery Three (SG, D, Pen)	Oct. '34	WM371
Graduating to a Low-frequency Stage (D, 2LF)	Jan. '35	WM378
P.T.P. Three (Pen. D, Pen.) ...	June '35	WM389
Carrier Short-wave (SG D, Trans)	July '35	WM390
Certainty Three (SG, D, Pen.)	Sept. 35	WM393
Class-B Three (D, Trans, Class B)	22.4.33	AW386
New Britain's Favourite Three (D, Trans, Class B)	15.7.33	AW394
Home-built Coil Three (SG, D, Trans)	14.10.33	AW404
Fan and Family Three (D, Trans, Class B)	25.11.33	AW410
£5 5s. S.G.3 (SG, D, Trans) ...	2.12.33	AW412
1934 Ether Searcher: Baseboard Model (SG, D, Pen)	20.1.34	AW417
1934 Ether Searcher: Chassis Model (SG, D, Pen)	3.2.34	AW419
P.W.H. Mascot with Lucerne Coils (Det, R.C., Trans) ...	17.3.34	AW337A
Pentaquester (HF, Pen, D, Pen)	14.4.34	AW431
£5 5s. Three: De-luxe Version (SG, D, Trans)	19.5.34	AW435
Lucerne Straight Three (D, RC, Trans)	9.6.34	AW437
"Wireless League" Three (HF Pen, D, Pen)	3.11.34	AW451

Four-valvers: Blueprints, 1s. 6d. each.

Quadradyne (2 SG, D, Pen) ...	Feb. '32	WM273
Calibrator (SG, D, RC, Trans)	Oct. '32	WM300
Table Quad (SG, D, RC, Trans)	Nov. '32	WM303
Calibrator de Luxe (SG, D, RC, Trans)	Apr. '33	WM316
Self-contained Four (SG, D, LF, Class-B)	Aug. '33	WM331
Lucerne Straight Four (SG, D, LF, Trans)	Feb. '34	WM350
£5 5s. Battery Four (HF, D, 2LF)	Feb. '35	WM381
The "HK" Four (2HF, D, LF)	Mar. '35	WM384
A.W." Ideal Four (2 SG, D, Pen)	16.9.33	AW402
Crusaders' A.V.C. 4 (2 HF, D, QP21)	18.8.34	AW445
(Pentode and Class-B outputs for above; blueprints 6d. each)	25.8.34	AW445A

Five-valvers: Blueprints, 1s. 6d. each.

Super-quality Five (2 HF, D, RC, Trans)	May '33	WM320
New Class-B Five (SG, D, LF, Class B)	Nov. '33	WM340
Class-B Quadradyne (2 SG, D, LF, Class B)	Dec. '33	WM344
1935 Super Five (Battery Superhet)	Jan. '35	WM379

Mains Operated

Two-valvers: Blueprints, 1s. each.

Economy A.C. Two (D, Trans) A.C.	June '32	WM286
Consolectric Two (D, Pen) A.C.	23.9.33	AW403

SPECIAL HALF-PRICE OFFER

Blueprints of the following "Wireless Magazine" sets described in this issue are obtainable at the special price, given below, if the coupon on facing page is used before Oct. 31.

Varsity Four WM395...	9d.
Minitube Three WM396	6d.

Three-valvers: Blueprints, 1s. each.

D.C. Calibrator (SG, D, Push-pull Pen) D.C.	July '33	WM328
Simplicity A.C. Radiogram (SG, D, Pen) A.C.	Oct. '33	WM338
Six-guinea AC/DC Three (HF Pen, D, Trans) A.C./D.C. ...	July '34	WM364
Mantovani A.C. Three (HF Pen, D, Pen) A.C.	Nov. '34	WM374
Home-lovers' New All-electric Three (SG, D, Trans) A.C. ...	25.3.33	AW383
S.G. Three (SG, D, Pen) A.C....	3.6.33	AW390
A.C. Triodyne (SG, D, Pen) A.C.	19.8.33	AW399
A.C. Pentaquester (HF Pen, D, Pen) A.C.	26.6.34	AW439

Four-valvers: Blueprints, 1s. 6d. each.

A.C. Quadradyne (2 SG, D, Trans) A.C.	Apr. '32	WM279
All Metal Four (2 SG, D, Pen) A.C.	July '33	WM329
"W.M." A.C./D.C. Super Four	Feb. '35	WM382
My 1935 Radiogram (SG., D., 2 L.F.)	May '35	WM386
AC/DC Straight A.V.C. 4 (2 HF, D, Pen) A.C./D.C. ...	8.9.34	AW446

SUPERHETS

Battery Sets: Blueprints, 1s. 6d. each.

Super Senior	Oct. '31	WM256
1932 Super 60	Jan. '32	WM269
Q.P.P. Super 60...	Apr. '33	WM319
"W.M." Stenode	Oct. '34	WM373
Modern Super Senior	Nov. '34	WM375
1934 Century Super	9.12.33	AW413

Mains Sets: Blueprints, 1s. 6d. each.

1932 A.C. Super 60, A.C. ...	Feb. '32	WM272
Seventy-seven Super, A.C. ...	Dec. '32	WM305
"W.M." D.C. Super, D.C. ...	May, '33	WM321
Merrymaker Super, A.C. ...	Dec. '33	WM345
Heptode Super Three, A.C. ...	May '34	WM359
"W.M." Radiogram Super, A.C.	July '34	WM366
"W.M." Stenode, A.C. ...	Sep. '34	WM370
1935 A.C. Stenode (A.C. Superhet)	Apl. '35	WM385
1934 A.C. Century Super, A.C.	10.3.34	AW425

SHORT-WAVERS (Battery Operated)

One-valvers: Blueprints, 1s. each.

New Style Short-wave Adapter	June '35	WM388
Roma Short-waver	10.11.34	AW452

Two-valvers: Blueprints, 1s. each.

Home-made Coil Two (D, Pen)	14.7.34	AW440

Three-valvers: Blueprints, 1s. each

Experimenter's 5-metre Set (D, Trans. Super-regen)	30.6.34	AW438
Experimenter's Short-waver ...	19.1.35	AW463

Four-valvers: Blueprints, 1s. 6d. each.

"A.W." Short-wave World Beater (HF Pen, D, RC, Trans)	2.6.34	AW436
Standard Four-valve Short-waver (SG, D, 2LF)	Mar. '35	WM383

Mains Operated

Two-valvers: Blueprints, 1s. each.

Two-valve Mains Short-waver (D, Pen) A.C.	10.10.34	AW453
"W.M." Band-spread Short-waver (D, Pen) A.C./D.C. ...	Aug. '34	WM368

Three-valvers: Blueprints, 1s. each.

Emigrator (SG, D, Pen), A.C. ...	Feb. '34	WM352

Four-valvers: Blueprints, 1s. 6d. each.

Gold Coaster (SG, D, RC, Trans), A.C.	Aug. '32	WM292
Standard A.C. Four-valve Short-waver (SG, D, RC, Trans) ...	Aug. '35	WM391
Trickle Charger ...	5.1.35	AW462

Amplifiers: Blueprints, 1s. 6d. each.

Enthusiast's Power Amplifier	May & June '35	WM387
Listener's 5-watt A.C. Amplifier	Sept. '35	WM392

"PRACTICAL WIRELESS"

Sixty-shilling Three	2.12.33	PW34A
Nucleon Class-B Four	6.1.34	PW34B
Fury Four Super	27.1.34	PW34C
A.C. Fury Four Super	10.2.34	PW34D
Leader Three	10.3.34	PW35
D.C. Premier	31.3.34	PW35B
A.C. Leader	7.4.34	PW35C
Atom Lightweight Portable ...	2.6.34	PW36
Ubique	28.7.34	PW36A
Four-range Super-mag. Two ...	11.8.34	PW36B
Summit Three	18.8.34	PW37
Armada Mains Three	18.8.34	PW38
Midget Short-wave Two ...	15.9.34	PW38A
All-pentode Three	22.9.34	PW39
£5 Superhet Three	27.10.34	PW40
A.C. £5 Superhet Three ...	24.11.34	PW43
D.C. £5 Superhet Three ...	1.12.34	PW42
Hall-mark Three	8.12.34	PW41
Universal £5 Superhet ...	15.12.34	PW44
A.C. Hall-mark	26.1.35	PW45
Battery Hall-mark 4	2.2.35	PW46
Universal Hall Mark	9.2.35	PW47
Hall-mark Cadet	23.3.35	PW48
Short-wave Converter-Adapter	23.2.35	PW48A
F. J. Camm's Silver Souvenir (All-Wave Three)	13.4.35	PW49
F.J. Camm's A.C. All-Wave Silver Souvenir Three	–	PW50
Cameo Midget Three	8.6.35	PW51
F. J. Camm's Two-valve Superhet	13.7.35	PW52