NEW B.B.C. TELEVISION FULLY EXPLAINED

Wireless Magazine

AND MODERN TELEVISION

NOVEMBER

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

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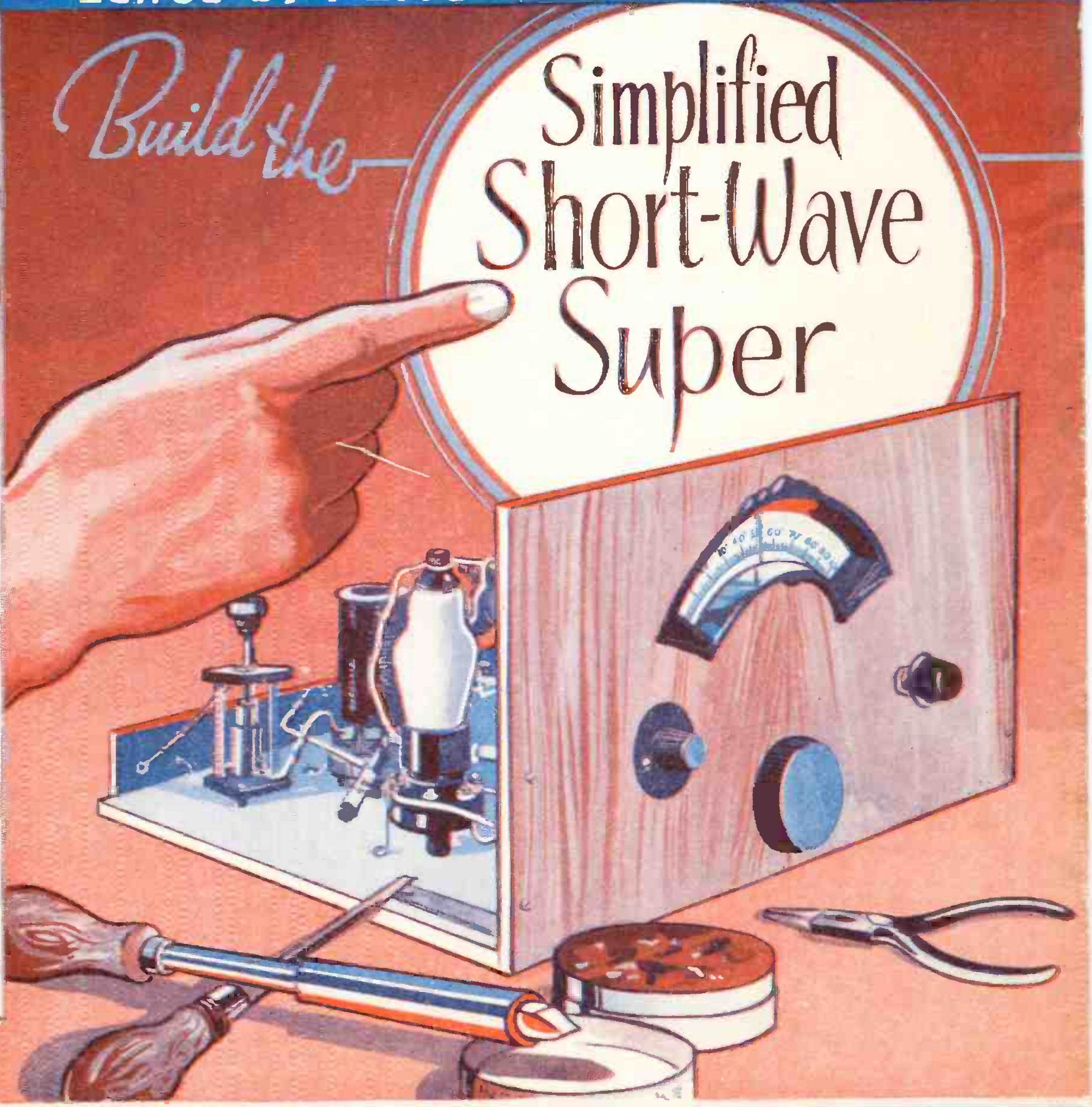

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Wireless Magazine
AND MODERN TELEVISION

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

Vol. XXII : NOVEMBER, 1935 : No. 130

Assistant Editor :
T. F. HENN.

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

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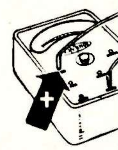

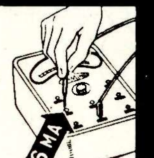

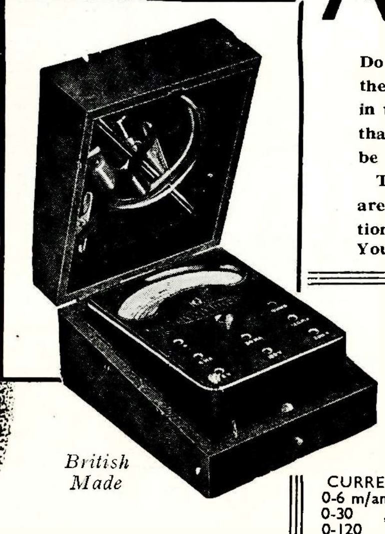

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Wireless Magazine
and Modern Television

The Editor's Page

November, 1935

Television—A Move at Last

IN this issue will be found not only the official statement issued by the Baird and Marconi-E.M.I. companies regarding the transmissions from the Alexandra Palace, but also an attempt on our part to explain in simple language practical details of the transmission. With this information both amateurs and the industry can now start their plans for building television receivers.

And then what? At first, of course, these receivers will be in the high-price class, for they are more complicated, more difficult to design, and require more valves than any of the existing popular wireless receivers. You will pay more money, but do not forget that not only will a television receiver reproduce the performances in the studio and outdoors in sound—we are at present prepared to pay well to get that alone—but it will also give vision with a clarity and sharpness of definition that will surprise the general public. In a sentence, you will pay more than for an ordinary wireless receiver and you will get more.

In the past year, with some reason, the wireless trade has been worried about the coming of television. A certain exuberance on the part of a few (not many) newspapers when the first high-definition television demonstrations were given led to a temporary impression being given to the public that the purchase of an ordinary wireless receiver might well be delayed as television was so near.

In this way, some thought they would get the very latest when their money was next spent. Soon after, however, this impression was corrected in all journals, but it led to a certain amount of panic in some trade quarters and what may be termed an anti-television propaganda designed to impress upon the public that practical television was so far off that they need not worry about it.

Now, "Wireless Magazine" has always tried to steer a middle course. We are fully aware that good, practical, high-definition television of splendid entertainment value will come to us soon, without in any way making obsolete sound broadcasting on normal wavebands. Television is, and will be, an adjunct to sound broadcasting, for there are many forms of wireless entertainment which require no vision at all.

In fact the necessity of watching as well as listening to some entertainments would be irritating. We are, however, afraid that this anti-television propaganda will have a boomerang effect when the first receivers are put on the market, for it is not unlikely that when demonstrations are given with the first television receivers the public will feel that good television has come much quicker than they were told would be the case. This sudden realisation in turn will lessen their faith in any further advice given them.

In our opinion the preparation of the public for the coming television programmes should start *now* and should be accompanied by a clear explanation that normal broadcasting and vision broadcasting will occur side by side for some time to come. In view of the high technical perfection already reached in television, any belittling of its entertainment value is futile.

Considerable dissatisfaction has been expressed by experimenters in all parts of the country regarding the closing down of low-definition broadcasting before the high-definition service has started. While the number using these transmissions has not been large, it has been an enthusiastic minority and their interests were fully recognised by the Television Commission, which in its report stated:

"We feel that it would be undesirable to deprive these 'pioneer lookers' of their present facilities until at least a proportion of them have the opportunity of receiving a high-definition service. On the other hand, the maintenance of these low-definition broadcasts involves not only some expense, but also possibly considerable practical difficulties. We can only, therefore, recommend:

(1) that the existing low-definition broadcasts be maintained, if practicable, for the present; and
(2) that the selection of the moment for their discontinuance be left for consideration by the Advisory Committee."

In view of this the feeling of grievance is understandable.

Percy W. Harris.

Dr. McLachlan on Amplitude Distortion in Loudspeakers - page 256

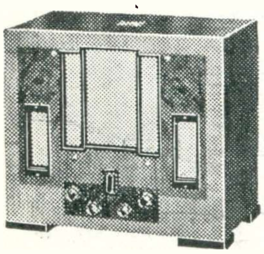
By Appointment
Radio Manufacturers
to H.M. The King.

By Appointment
Radio Manufacturers
to H.R.H. the Prince
of Wales.

Every radio expert should know these facts about

1936 PEDIGREE RADIO

There is 37 years' experience in the design of sound reproducing instruments behind every radio receiver or radiogram which bears the "His Master's Voice" symbol. Be guided by this experience. When your non-technical friends ask you which is the best radio they can buy, recommend "His Master's Voice." There are fourteen radio instruments to choose from in the 1936 Pedigree range—and whichever they choose you can safely tell them they will get, *at no extra cost*, "His Master's Voice" tone at all volumes of sound, a cabinet which is a fine piece of furniture, noiseless tuning with easy station location, complete station s-e-p-a-r-a-t-i-o-n, devices which automatically counter fading and unwanted noise, and everything for full and untroubled enjoyment.



Here are two typical examples of the kind of value which "His Master's Voice" 1936 Pedigree Radio offers.

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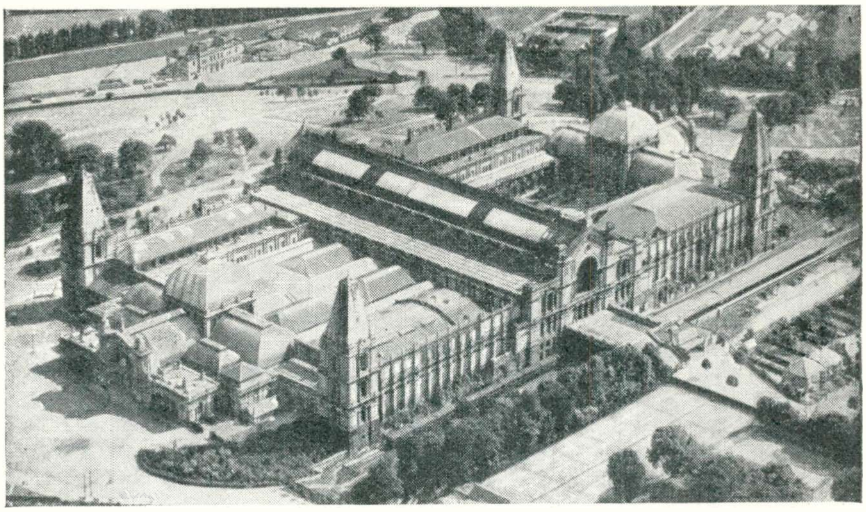
Mention of the "Wireless Magazine" will ensure prompt attention

By the
EDITOR

Television is beginning to move at last and complete technical details of the future transmissions have been announced. On these pages we present a clear and full explanation of the electrical characteristics of the transmissions and show exactly what it all means in terms of actual practice


The future home of British television : an unusual aerial view of the Alexandra Palace

B.B.C. High-definition Television

A Simple Explanation of the Technical Details

FOR some time past the trade has been anxiously awaiting the publication of technical details of the radiations to be used for the high-definition television transmissions from the Alexandra Palace early in the new year. Without precise information of this kind and, with the best will in the world, they could not possibly get down to the practical designs of commercial receivers for the public.

The necessary information has now been issued at the request of the B.B.C. by both the Baird and the Marconi-E.M.I. Television Companies, and the two respective statements, together with the necessary diagrams, are reproduced in full on other pages. They are precise, accurate and detailed, as one would expect from such organisations, but to the man in the street—and even to the average experimenter—they are so much Greek.

Similarities Between the Two Systems

" Wireless Magazine " has been requested by both companies to publish the information in full without modification, and this, of course, we have done, but in order that our readers may appreciate more clearly the significance of the information, I propose to try and put the gist of the matter in a simpler form.

First of all let us deal with the similarities and the differences between the two systems, for both will be radiated alternately. The similarities may be treated first. Although it is not indicated in either statement, both transmissions will apparently be on the same wavelength. Both radiations will occur on the ultra-short wave band round about six or seven metres, and both will occupy considerable ether space, 2,000,000 cycles at a maximum for Baird and 4,000,000 for Marconi-E.M.I. There will also be simultaneous sound transmissions on an adjacent waveband, but these, of course, will not occupy so much space in the ether spectrum, for the maximum sideband radiation of the average telephony transmission does not exceed 20,000 (10,000 on either side of the carrier wave).

Both will transmit 25-frames per second and both will have two sets of synchronising impulses in addition to the complex modulations which produce the actual picture, as explained in the series of articles at present appearing under the heading of " Television For The Busy Man." These synchronising signals take two forms : one serves to synchronise the picture *frames* and the other the picture *lines*. The synchronising signals naturally are not transmitted at the same time as the picture signals, but occur between frames for the frame signals and between lines for the line signals.

Both transmissions will scan the picture *horizontally* as distinct from the vertical scanning which has been used in the past for the low-definition television transmission : it will be understood in this connection that in the new service the longer dimension of the picture will be placed horizontally instead of vertically as in the old system.

Modulation Details

Another point of similarity between the two transmissions relates to the proportionate intensity of the signal for the synchronising and for the picture itself. Taking the maximum intensity of the carrier wave to represent the highest light, or white, in the picture, then if the signal only reaches an intensity of about forty per cent. it will not have reached beyond what may be called the " maximum black."

Put in another way, you will not see any light at all upon the screen unless the intensity reaches somewhere between a third and a half of the maximum intensity. The actual proportion of the two systems will be found in the statements and diagrams accompanying them on other pages.

All variations of light between maximum black and the fullest white therefore occur between about 40 and

100 per cent. of the maximum strength. This all means, of course, that in television to get synchronisation and a good picture, you must have a good signal, for first of all the signal has to be strong enough to operate the synchroniser and *after* that you will get your picture.

Scanning Differences

And now let us consider a few of the important differences. The chief of these relates to the *method* of scanning. In the Baird system the scanning spot starts at the top left of the picture, goes across to the right, skips rapidly back to the left to a spot immediately below the starting point of the first line, away to the right, back again to the left, and so on, working gradually from top to bottom of the picture, in such a way as to scan the whole area from top to bottom *without leaving any spaces between lines.* The total number of lines in the complete picture is 240 and as there are 25 completed frames per second, the *line* frequency is thus 6,000 per second. The dimensions of the observed picture have a ratio of 4 horizontally and 3 vertically.

In the Marconi-E.M.I. system what is known as *interlaced* scanning is used. In this the scanning spot starts as before at the top left, passes across to the right, skips back to the left, across to the right again and so on, *but*—and this is very important—instead of the spot returning to a point *immediately* below that at which it started before, it skips a space equal to the width of one line and then goes across. When it reaches the bottom of the frame, it jumps back again to the top but instead of re-tracing the same path as before, it runs over a slightly " staggered " path and fills in the spaces.

Picture Repetition Rates

Thus in the Marconi-E.M.I. interlaced scanning system, instead of the picture being completely scanned from top to bottom in one " go," the spot has to run over each frame twice before it is completely scanned. Two frames, each of 202.5 lines are thus interlaced, to give a total of 405 lines, with a completed picture speed of 25 per second. The odd number of lines is necessary in order that the interlacing may occur in the manner just described.

Another difference between the Baird and the Marconi-E.M.I. transmissions concerns the proportionate width and height of the frame. As mentioned previously, the ratio is 4 to 3 in the Baird, whereas in the Marconi system it is 5 to 4. These proportions are very similar to those with which we are familiar in the talking picture in its present form.

Fairly Simple Change-over

At first thought it might seem that two separate receivers would have to be designed, one for the Baird and the other for the Marconi-E.M.I. transmission, but when you think the matter over you will see that the receiving gear for the two forms of transmission is identical in so far as the picking up and tuning of the television signal is concerned, its amplification and its use to modulate the strength of the beam from a cathode-ray tube.

Assuming that a cathode-ray tube is used to produce the picture, only a modification of the synchronising and beam controlling apparatus is needed to change from one form of scanning to the other, and receivers have already been built which reproduce either form of scanning by a simple change-over.

An Open Question

It is claimed for the interlaced scanning that it produces a better picture, with less flicker, than the sequential scanning used by Baird, while it is also claimed for the other side that the disadvantages of interlaced scanning outbalance the advantages. We hold no opinion on the subject at the moment and await practical demonstrations in commercial conditions before coming to any conclusion on the matter.

And now you have read all this, and have delved into the highly technical particulars issued by the two companies, perhaps you will appreciate the slight difficulty we have in our Query Department when somebody writes and asks how can they convert a 1931 3-valve kit set into a high-definition television receiver, and will any more valves be required, please ?

Apparently doomed to be abandoned : the Crystal Palace deserves to be remembered as the scene of the first demonstrations of a high-definition service in actual practical existence

B.B.C. High-definition Television Service

Details of the Baird Transmissions

Full Text of the Official Statement issued by Baird Television, Ltd.

Waveform

THE attached drawing gives complete details of the waveform for picture modulation and synchronising impulses. From this it will be seen that, using the arbitrary aerial current units of zero to 100, the total modulation for synchronising (black) extends between the tolerance limits of zero to 5 and 37.5 to 42.5, while the picture modulation (black to white) extends between the tolerance limits of 37.5 to 42.5 and 100.

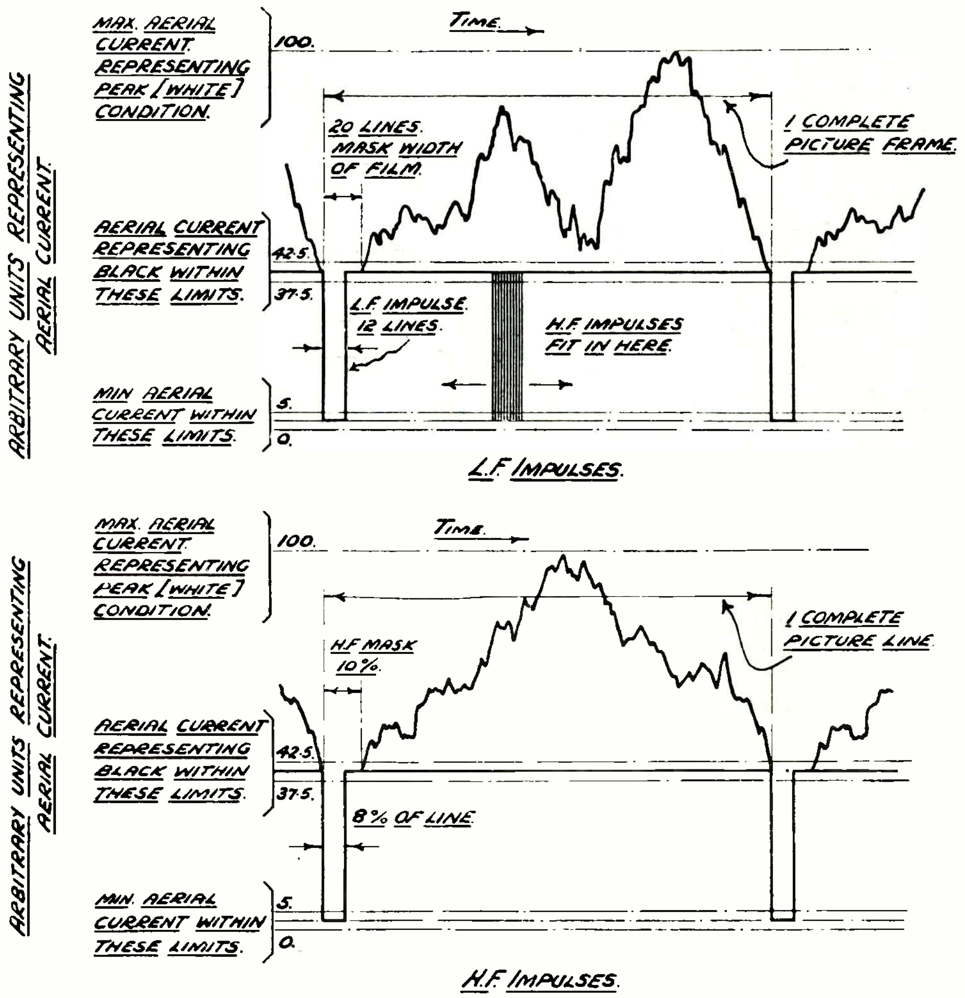
It will be noted that the high-frequency synchronising impulse is rectangular in shape and is maintained for 8 per cent of the total time taken in tracing the line, and occurs between the *line* traversals. The low-frequency synchronising impulse, which is also rectangular in shape, is maintained during the time that 12 lines are traced, and occurs between the *frame* traversals. These traversals, as seen by an observer looking at the received image from the front, scan from left to right (line) and from top to bottom (frame).

The diagram also shows that, in addition to the above 8 per cent of the line traversal time occupied by the high-frequency synchronising impulse, a further 2 per cent is masked off to form a black edging. Similarly, an additional 8 lines are masked off in the case of the low-frequency synchronising impulse for the same purpose.

Additional Details

The total number of lines in the complete picture is 240, scanned sequentially and horizontally at 25 picture traversals per second and 25 complete frames per second. The line frequency is thus 6,000 impulses per second and the frame frequency 25 impulses per second. The dimensions of the observed picture have the ratio of 4 horizontal to 3 vertical.

Amplitude modulation is employed which results in light intensity modulation in the observed picture, the transmitter carrier increasing towards the white. The line synchronising signals and the frame synchronising signals are in the sense opposite to increasing picture modulation. The maximum frequency band involved in the transmission is 2 megacycles and the average component of light in the picture is transmitted, a black in the picture being transmitted as black, and a white transmitted as white, in accordance with the modulation percentages referred to above.



This diagram is a complete pictorial representation of the picture modulation and synchronising impulses of the Baird transmission, produced from the records of the monitoring oscillograph of the transmitter

Wireless Magazine, November 1935

B.B.C. High-definition Television Service

Details of the Marconi-E.M.I. Transmissions

Full Text of the Official Statement Issued by the Marconi-E.M.I. Television, Co., Ltd.

THE Marconi-E.M.I. television system transmits 25 complete pictures per second each of 405 total lines. These lines are interlaced so that the frame and flicker frequency is 50 per second. The transmitter will radiate signals with sidebands extending to about 2 megacycles either side of the carrier frequency. Good pictures can be received utilising only a fraction of the radiated band, but naturally, the quality of the received picture will depend upon the degree to which the receiver makes use of the transmitted band width. The transmitted waveform is shown in Fig. 1.

(1) Line Frequency

10,125 lines per second, scanned from left to right when looking at the received picture.

(2) Frame Frequency

50 frames per second, scanned from top to bottom of the received picture.

(3) Type of Scanning

The scanning is interlaced. Two frames, each of 202.5 lines, are interlaced to give a total of 405 lines with a complete picture speed of 25 per second. The line component and the frame component of scanning are regularly recurrent, the interlace being derived from the fractional relationship between line and frame frequencies. An explanation of the method of interlacing is given at the end of this specification.

(4) Interval Between Lines

There will be intervals between the vision signals of successive lines, which intervals provide time for the transmission of a line synchronising signal and also provide time for the return of the cathode-ray beam to the beginning of the next line. The minimum interval between the vision signal of successive lines will be 15 per cent of the total line period (1/10,125 sec.), the first 10 per cent of this interval between lines being occupied by the line synchronising signal and the remaining 5 per cent. by a signal corresponding to "black" in intensity. The remaining 85 per cent of the total line period is available for transmitting vision signals.

(5) Interval Between Frames

There will be intervals between the vision signals of successive frames. The minimum interval between frames will be 10 lines, leaving a maximum of 192.5 active lines per frame, or 385 active lines per complete picture.

(6) Picture Ratio

The picture ratio will be 5 : 4, that is to say, the distance scanned during the active 85 per cent of the total line period will be 5/4 times the distance scanned during the 192.5 active lines of the frame.

(7) D.C. Modulation

The picture brightness component (or the D.C. modulation component) is transmitted as an amplitude modulation so that a definite carrier value is associated with a definite brightness. This has been called "D.C. working," and results in there being no fixed value of average carrier, since the average carrier varies with picture

(Continued on page 318)

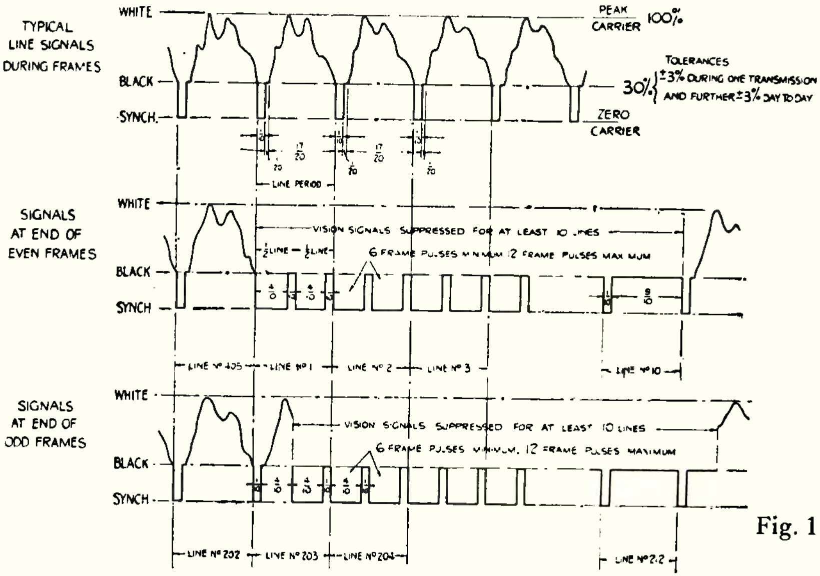
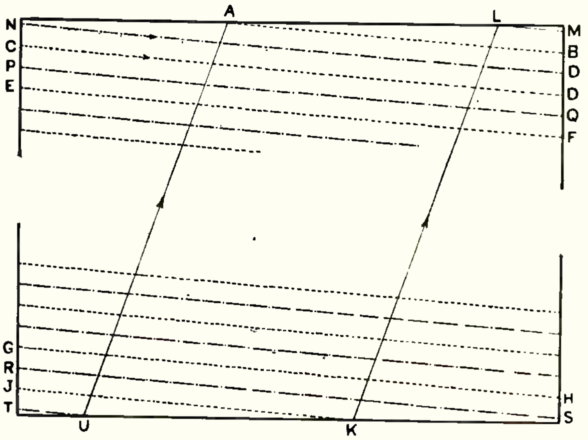


Fig. 1

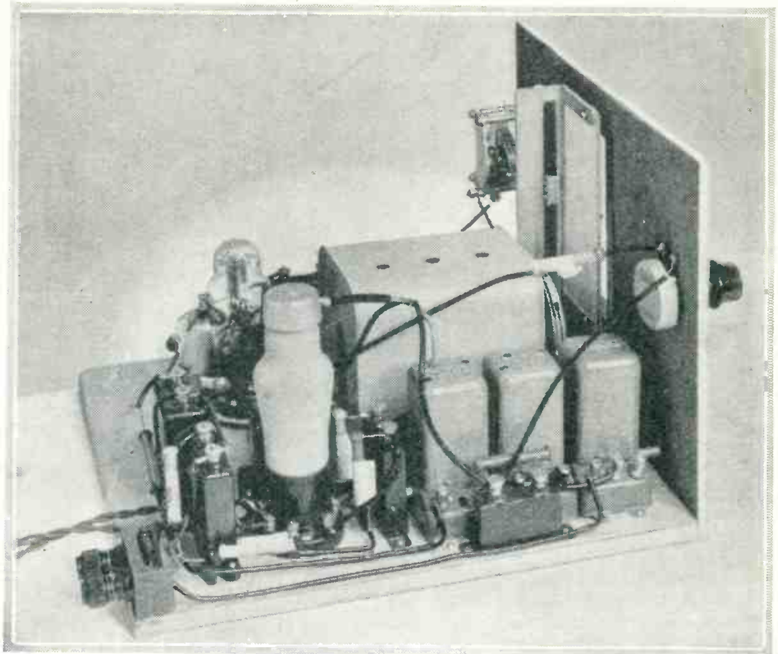


These two diagrams give complete details in graphic form of the Marconi-E.M.I. transmissions, and show how the picture modulations and special synchronising signals will be transmitted, also the method of "interlacing" the scanning

Fig. 2

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

In our September issue our contributors described the construction of a 5-watt A.C. amplifier which could be built for about £14. Reports indicate that this amplifier has given complete satisfaction, and with the radio unit described in these pages will form the nucleus of a really high-quality radiogram that cannot be bought commercially at the price it costs to build.



A Radio Unit for the Listener's Amplifier

SINCE we announced our intention of designing a radio unit for the Listener's Amplifier, we have received many suggestions regarding its design. Some have asked for a unit which will enable only the local stations to be received with super quality, others have suggested a superhet unit so that the whole of Europe could be tuned in with each station as loud as the local.

We have carefully weighed up all the requests received and the result will be found in these pages: a compromise between selectivity and sensitivity, with the all-important question of quality as the first consideration.

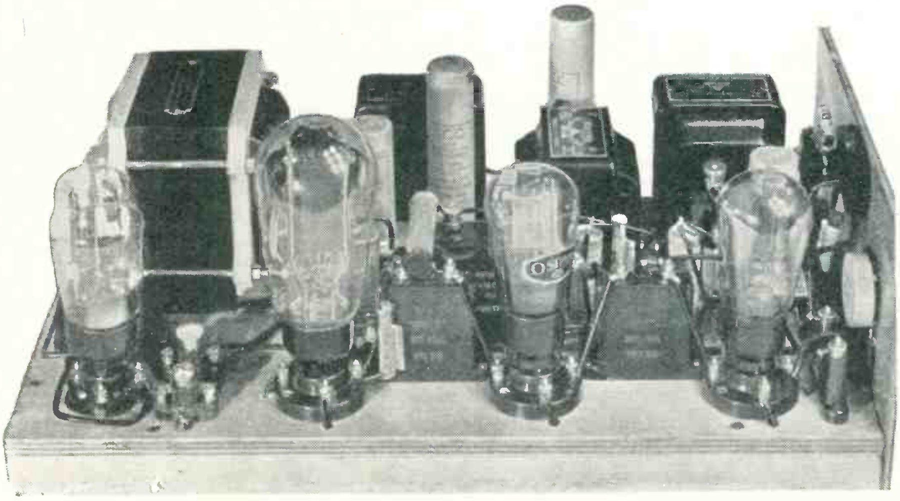
It is quite an easy matter to design the ideal quality-first unit if we could assume that the outfit would be used at, say, ten miles from the B.B.C. regional centre, but when, as we know for a fact, readers living fifty miles away from a centre are building the amplifier and unit, the problem has to be tackled on a broader basis.

Sufficient Entertainment—Good Quality

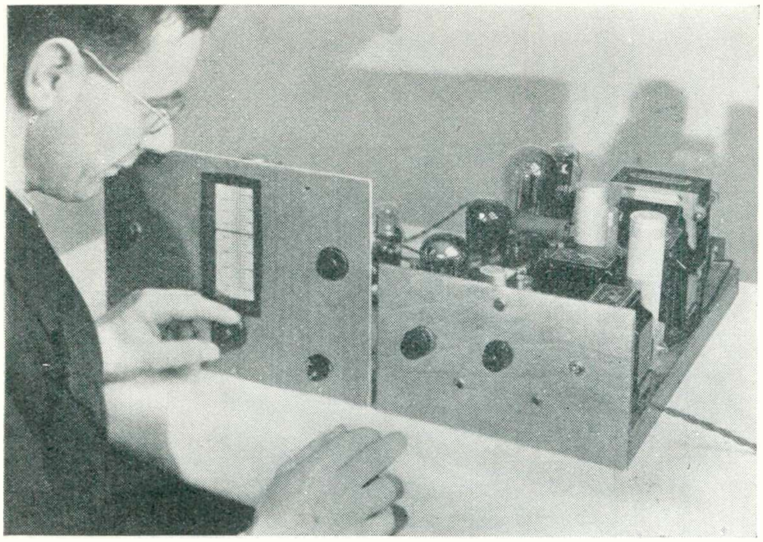
We claim that this unit can be used anywhere in England with the assurance that it will give sufficient entertainment at decidedly good quality. The unit and amplifier were built in South London, and during our tests we could pick up North and Scottish Regionals during daylight at very comfortable listening strength; so we think our claim is justifiable.

The circuit we have used is quite a straightforward one. It consists of two valves only, an Osram VMP4G (variable-mu high-frequency pentode) as an H.F. amplifier, and an ordinary triode (an Osram MH4) as a detector.

To obtain the necessary degree of selectivity we have made use of an aerial input band-pass circuit, the actual coils used being of the latest high-efficiency iron-core



The completed Listener's A.C. amplifier for which the radio unit described in these pages has been specially designed



The operation of the radio unit amplifier is simplicity itself. Accurately matched coils and condensers are used, and the tuning scale is calibrated directly in metres

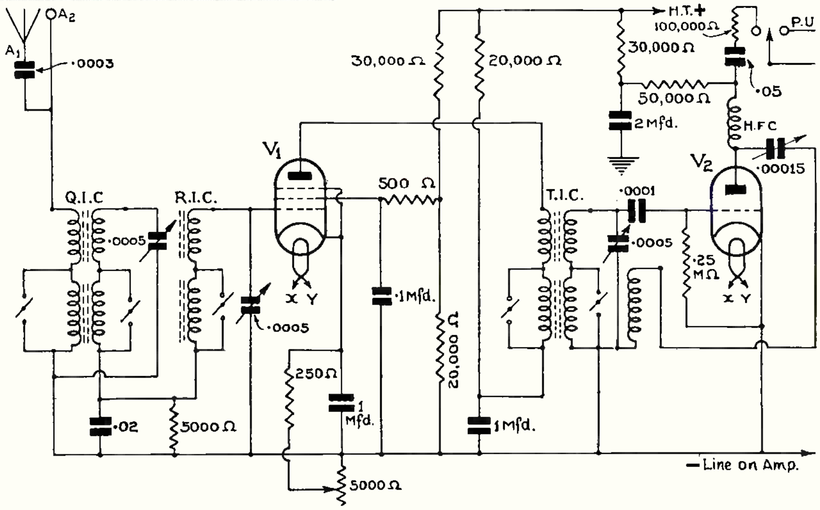
type. This circuit feeds the control grid of the variable-mu H.F. pentode in the normal manner, the necessary bias control being obtained by means of a fixed resistance of 250 ohms to provide adequate minimum bias—in series with a variable resistance of 5,000 ohms between cathode and earth.

Potentiometer Network

A potentiometer network is employed to maintain the screen voltage at a constant potential, extra de-coupling being provided by means of a 500-ohm resistance and a .1-microfarad fixed condenser. The anode circuit of this valve feeds into an iron-core high-frequency transformer having a ratio of 1 to 2 on medium waves and 1 to 1.6 on the long waves.

Detector Stage

The grid circuit of the detector valve follows more or less the accepted practice with a .0001-microfarad grid condenser and a .25-megohm leak. This form of rectification will no doubt raise some doubts in the minds of those who consider diodes essential for high-quality rectification. While we fully appreciate these people's views, and agree with them in the main, we have had to bear in mind the case of the listener whose conditions demand the more sensitive form of grid rectification



The circuit of the Radio Unit. It consists of a band-pass aerial input, coupled to a variable-mu high-frequency pentode H.F. amplifier, which is tuned-transformer coupled to an ordinary triode detector. All power is derived from the mains section of the amplifier.

With the valves we have used one gets a quality of reproduction that even the most critical will have to admit is extremely satisfactory. To put it very bluntly, we know the amplifier is good, and we know that the radio unit is in every way worthy to be used with it.

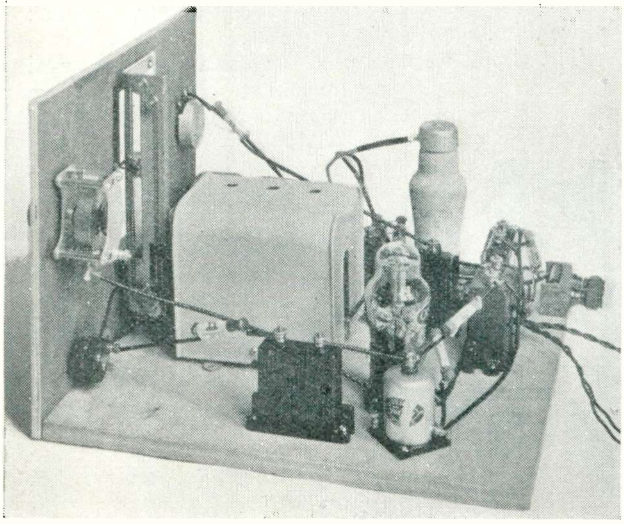
It will be noted from the circuit diagram that reaction is employed, and here again is a likely cause of comment. To those who are in the happy position of being well within the service area, this reaction control is quite unnecessary and can be omitted, if the anode of the detector is by-passed to earth by a. 0001-mfd. condenser.

Anode Circuit of the Detector

Resistance-capacity coupling is used in the anode circuit of the detector valve, consisting of a 50,000-ohm resistance and a .05-microfarad mica coupling condenser, the volume control already incorporated on the amplifier acting as the grid leak.

The output of this circuit is taken to one side of the single-pole double-throw switch—mounted on the panel which allows the radio unit or pick-up to be used.

Adequate de-coupling is provided throughout the



The Radio Unit is connected to the amplifier by means of six leads. Two for high tension, two for the heater currents, and two from the switch seen on the left of the unit radio unit and an H.F. stopper in the form of a 100,000-ohm fixed resistance is arranged in the lead between the coupling condenser and the gramo-radio switch.

Layout of the Panel

The question of the layout of the panel of the radio unit has been tackled with some care. You will notice that this panel is a little larger than the control panel of the amplifier ; the idea in the back of our minds being that the panel of the radio unit should form the major attraction when the whole outfit is fitted into the cabinet, the amplifier controls being subsidiary to those of the radio unit.

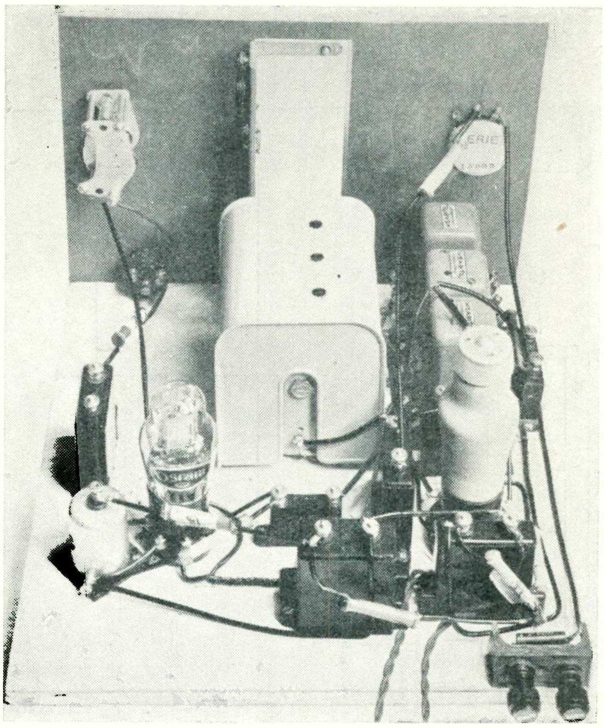
Next month we shall give a couple of suggested cabinet designs of a simple nature that any local cabinet-maker would make up for quite a moderate sum. We appreciate the fact that present-day constructors want their radio furniture to match with the rest of the home furnishing, and we are thus prepared to suggest a design rather than fix on one particular cabinet in one particular finish.

Wavelength-calibrated Scale

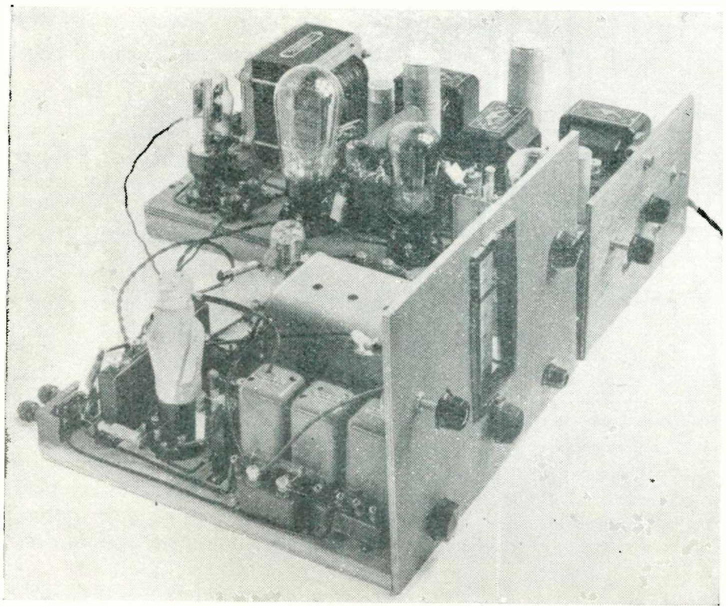
In the centre of the radio-unit panel is a somewhat unusual-shaped full-vision tuning scale ; it is marked in wavelengths only—present-day coils are made to standard inductance values so ensuring efficient matching with the three-gang condenser used—and we can assure readers that simple ganging will bring the readings quite well into line.

Beneath the scale is the single tuning control, which actuates the three sections of the gang condenser. On the left is the volume control above the wave-change switch, and on the other side the reaction control above the gramo-radio switch.

There are no real snags about the construction of the unit ; everything is perfectly straightforward. Bear in mind, however, that the three Wearite coils are not mounted on a base-plate, and it is essential that they should be firmly screwed to the wooden baseboard. Also make certain that these coils are dead in line before they are screwed down to avoid any undue strain on the D-section connecting spindle and the switches.



This view of the Radio Unit shows how simple is the layout and how easy it would be to build. The detector valve is on the left and the high-frequency amplifier on the right



The control panel of the Radio Unit consists of a wavelength-calibrated tuning scale with tuning control in the centre ; volume control above the wave-change switch on the left ; and reaction control above the gramo-radio switch on the right

Once again we emphasise the importance of twisting the two heater wires closely together ; this avoids the possibility of any stray fields causing objectionable hum which we can assure you does not exist if the layout we have adopted is carefully followed.

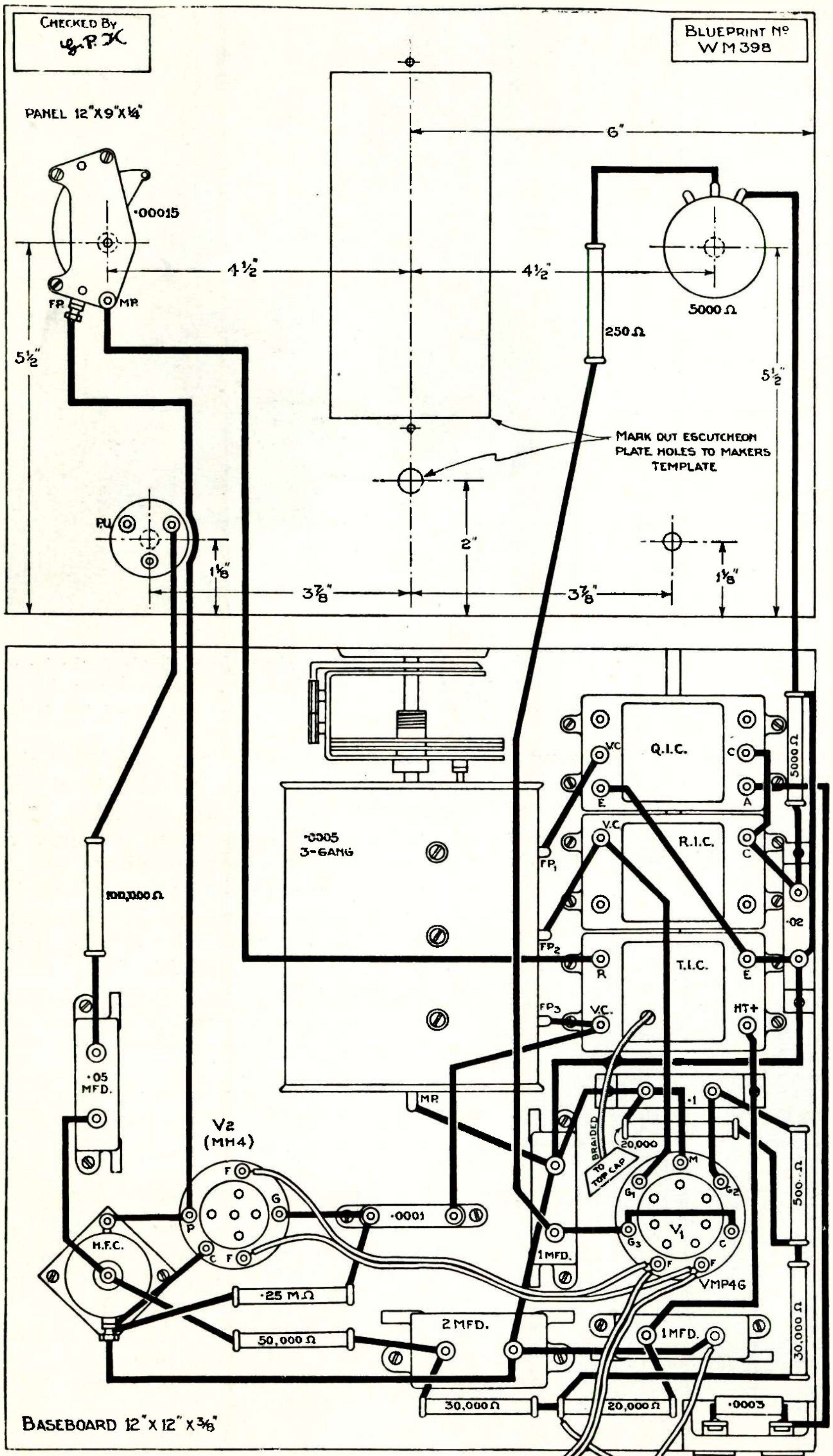
In this respect we would remind you of the value of using a full-size blueprint. Every component is drawn to its proper size and every wire is shown in the position it should take in the design of the unit.

Connections to Amplifier

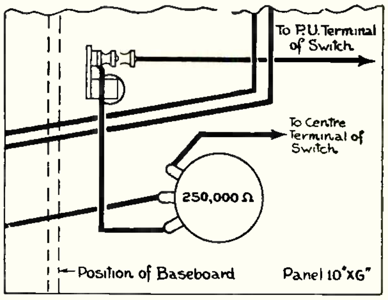
Connection of the radio unit to the amplifier is by means of six flexible wires ; two heater leads, two for H.T.+ and H.T.—, and two wires from the gramo-radio switch, which must be covered with metal-braided and earthed sleeving.

The two heater leads are taken to the heater terminals of either the first or second stage of the amplifier ; the H.T.+ lead is taken to the centre-tap of the dual low-frequency choke, this position is plainly marked on the amplifier blueprint ; the H.T.– lead goes to any negative point on the amplifier—for example, the screen terminal on the mains transformer or the negative side of any of the smoothing condensers.

Layout and Wiring Plan



If desired, a full-sized blueprint of the Radio Unit can be obtained for half-price, that is 6d., post paid, if the coupon to be found on the last page is used before November 30. Address your application to the " Wireless Magazine " Blueprint Dept., George Newnes, Ltd., 8-11 Southampton Street, London, W.C.2. Ask for No. W.M.398.



Showing the slight alteration necessary to wiring on the amplifier panel, and the two leads to the switch on the radio unit. Note that only one wire is removed.

The lead from the centre terminal of the gramo-radio switch is taken to one side of the 250,000-ohm volume control on the amplifier, the lead from this point to the input jack having been removed. The other wire from the gramo-radio switch is taken to the free side of the input jack. This arrangement is shown clearly in the small diagram on this page.

Additional Precaution

As an additional precaution against H.F. getting through to the output circuit of the amplifier, we advise the fitting of a 50,000-ohm resistance between the .05-microfarad coupling condenser and the grid of the ML4 valve in the amplifier itself.

We have had the unit and amplifier working together for quite a while and we feel sure that it will satisfy " W.M." readers as much as it has pleased us.

Actual operation of the radio unit is so simple that it calls for little comment. Volume and sensitivity is adjusted by means

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 NEEDED FOR THE RADIO UNIT FOR THE LISTENER'S AMPLIFIER

	s.	d.
CHOKE, HIGH-FREQUENCY		
1—Varley Nichoke type	4	6
COILS		
1—Wearite three-coil unit with 1 T.I.C. R I.C. and Q.I.C. coils, complete with D-section spindle £1	2	6
CONDENSERS, FIXED		
1—T.C.C. .0001-microfarad, type 34	1	3
1—T.C.C. .0003-microfarad, type 300	1	0
1—T.C.C. .02-microfarad, type 50 ...	1	9
1—T.C.C. .05-microfarad, type 34 ...	5	6
1—T.C.C. .1-microfarad, type 50 ...	1	10
2—T.C.C. 1-microfarad, type 50 ...	5	0
1—T.C.C. 2-microfarad, type 50 ...	3	6
CONDENSERS, VARIABLE		
1—Polar 3-gang Minor	18	9
1—Polar .00015-microfarad reaction No. 4 with knob	3	9
DIAL		
1—Polar vertical C.K. drive and dial	6	6
RESISTANCES, FIXED		
1—Erie 250-ohm, 1-watt type ...	1	0
1—Erie 500-ohm, 1-watt type ...	1	0
1—Erie 5,000-ohm, 1-watt type ...	1	0
2—Erie 20,000-ohm, 1-watt type ...	2	0
2—Erie 30,000-ohm, 1-watt type ...	2	0
2—Erie 50,000-ohm, 1-watt type ...	2	0
1—Erie 100,000-ohm, 1-watt type ...	1	0
1—Erie 250,000-ohm, 1-watt type ...	1	0
RESISTANCES, VARIABLE		
1—Erie 5,000-ohm potentiometer ...	3	6
SUNDRIES		
1—Bulgin anode connector for valve top.		
1—Belling-Lee terminal block for terminals marked A —		
2—Bulgin fuse bulbs.		
1—yard Bulgin screened cable.		
1—Bulgin S.P.D.T. switch, type S86	1	9
VALVE HOLDERS		
1—W.B. 7-pin baseboard mounting	1	6
1—W.B. 5-pin baseboard mounting	1	3
VALVES		
1—Osram MH4	13	6
1—Osram VMP4G	17	6

of the 5,000-ohm volume control to the left of the tuning scale with the reaction condenser set at minimum. Only in extreme cases will the reaction condenser be needed; this control need only be used when volume from the weaker foreign stations is insufficient.

One point: the sensitivity on the long waves is of a very high order, and it is advisable to reduce the volume control setting before switching over from medium to long waves, but this depends a deal on the length of aerial used and general reception conditions.

Method of Ganging

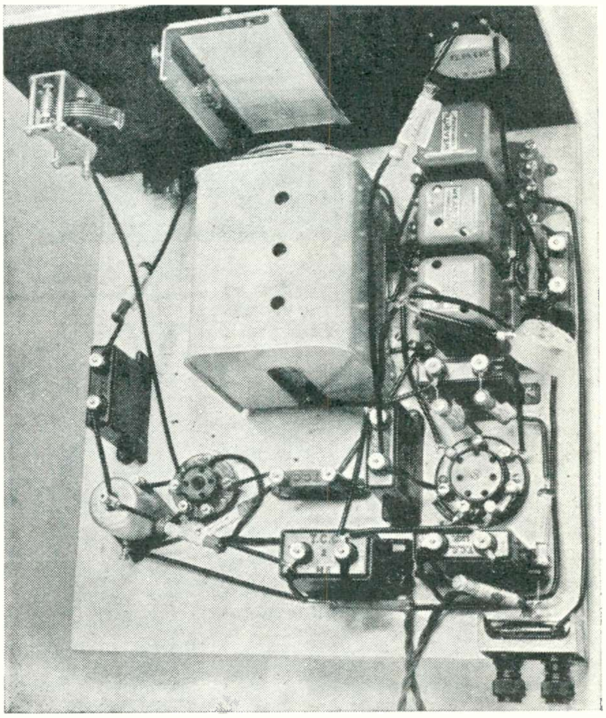
Ganging should present no difficulties. It is advisable to gang-up on a known weak signal near the middle of the medium waveband. The three trimmers should be adjusted in order from the front panel to the back.

In daylight the outfit gives good reproduction from the locals, the more powerful British stations and a few foreigners, for example: Hilversum, Fécamp, Brussels, Poste Parisien on the medium waves, and the usual crowd—Huizen, Radio Paris, Luxembourg, and so on—on the long waves.

At night-time we could listen to excellent entertainment from our two local stations and about a dozen foreigners. The iron-core coils give a really satisfactory degree of selectivity though not to the extent of cutting off even the quite high frequencies.

About quality. One thing we are certain; you cannot buy a ready-made set at the price this costs to build to give such brilliant quality of reproduction.

We shall be pleased to hear from readers who have built the amplifier and or radio unit, and also to receive photographs of their handywork for publication in these pages (10/6 will be paid for every picture published).



This photograph shows clearly the arrangement of the components on the baseboard. All components and wiring are on one side of the baseboard only.

If there is any point about which you are not quite clear or would like further information, please drop us a line, and, in the meanwhile, the very best of luck!

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

	£	s.	d.
CHOKES, LOW FREQUENCY			
1—Varley type DP11...		15	0
1—Varley standard, type DP10 ...		15	0
1—Varley constant-inductance, type DP12		17	6
CONDENSERS, FIXED			
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			
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			
1—Epoch A.C. energised moving-coil loudspeaker, type 667 ...	7	2	6
MAINS TRANSFORMER			
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			
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			
1—Erie .25-megohm potentiometer, without switch		3	6
1—Erie 15,000-ohm potentiometer, without switch		3	6
SWITCH			
1—Bulgin double-pole on-off toggle switch, type S104		2	0
SUNDRIES			
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			
2—W.B. five-pin baseboard mounting		1	4
2—W.B. four-pin baseboard mounting		1	0
VALVES			
1—Osram MHL4		13	6
1—Osram ML4		14	0
1—Osram PX25	1	5	0
1—Osram MU14 rectifier ...	1	0	0

Leslie Sarony (left) and Leslie Holmes before the mike. Really an outstanding vaudeville turn who brought the house down at this year's Radiolympia Theatre.

What the B.B.C. is Doing

Variety Director to Control Dance-music Broadcasts

By T. F. HENN

AT LAST dance-music programmes are to come under *very* strict control. In the past dance-music has been the "baby" of the outside-broadcasts director, but now, under the recent changes it comes into its proper category, that is in the light-entertainment department.

Eric Maschwitz, the Variety Director, is putting a big foot down; he intends to make dance music programmes worth listening to by all and sundry. No longer is it to be a wearisome hour and a half stuck on to the end of the day's programmes!

You remember I mentioned last month that the 90-minute sessions were to be split into two; no band being allowed to broadcast more than 45 minutes, or an hour at the most. This has meant another change. It is evident that two bands broadcasting for two consecutive periods would, without the slightest doubt, duplicate some tunes at least. That will not happen, for each band leader will *have to submit his programme three days before the broadcast for the Variety Director's approval.*

To my knowledge, this is the first time that programmes of this sort have come under a direct control. Further than this, as you no doubt know, cabaret turns are to be introduced to liven up the proceedings, and once a fortnight there is to be a broadcast of a real West-End cabaret show—the artists taking part being the pick of the cabaret artists then in Town.

There is no doubt, as I have pointed out many times, our British dance-music broadcasts are, to put it quite kindly, very weak. Such changes should do much to raise it to the standard necessary for the entertainment of seven-million licence holders.

◆ ◆

You remember the Budapest broadcasts—excellent except for landline troubles. These were arranged in Budapest by Val Gielgud and Maschwitz. They told me that they were received with great pomp on their arrival in Budapest; a whole crowd of journalists and photographers turned out to meet them at the railway station.

They attributed their remarkable welcome to the fact that the Prince of Wales had created such a tremendous impression in favour of British visitors and everything British. "Everybody," said Eric Maschwitz, "is mad about the Prince in Budapest."

◆ ◆ ◆

I was very sorry, and no doubt you were, to learn that Len Burman, the drummer and "comic" singer of the B.B.C. band had told Henry Hall he was leaving him on October 26. Like many other people who made a name for themselves at the B.B.C.—there was Les Allen, Phyllis Robbins, Kitty Masters, Val Rosing—he received a tempting offer from the music-hall kings, succumbed, and on November 4 he is starting his new career at Portsmouth. His "turn" will consist of "two pianos and himself,

In between times you will find many of the B.B.C. announcers "sampling" in the restaurant at Broadcasting House. Here is Stuart Hibberd, the chief announcer.

with some funny business." It is a pity, for he was a lively turn in the B.B.C. band broadcasts, and I am afraid that we shall all miss him. The best of luck, Len !

◆ ◆ ◆

The star item in November will be the broadcast of the wedding of the Duke of Gloucester and the Lady Alice Montagu-Douglas-Scott, at Westminster Abbey, on November 6. The service will be relayed in its entirety to all B.B.C. transmitters, including the Empire station at Daventry.

The scenes outside the Abbey will be described by Howard Marshall before and after the ceremony. The relay will involve a tremendous amount of work for the B.B.C. engineers; they will wire the Abbey for the eleven microphones which will be used to pick up the procession down the aisle and the actual ceremony, besides mikes outside for Howard Marshall and for "crowd effects." The control point will be hidden away in the crypt of the Abbey.

◆ ◆ ◆

I was very interested to see the name of a newcomer in the cinema-organ broadcasters. He is Frederic Bayco and he is giving his first four broadcasts from the Dominion Theatre, Tottenham Court Road, London, in the latter part of October and the beginning of November. He is quite a young man and I remember hearing him for the first time at the opening of a big cinema two years ago.

What struck me about his playing was his complete disregard for recognised uses of the cinema-organ. He manages, by some very clever means, to produce some marvellous effects. I think that we shall be hearing more of him later. I can promise you four very interesting half-hours if you listen to his broadcasts.

Two of our popular broadcast dance-band leaders, Lew Stone (above) and Joe Loss (left).

On his return from America, Henry Hall was met at Waterloo Station by a battery of cameramen and a news-reel unit. Here you see him, in the best of spirits, telling the mike what he thinks of America and its radio programmes !

Ignace Paderewski, statesman and pianist, celebrates his seventy-fifth birthday on November 6. To mark the occasion the B.B.C. has arranged for a special piano recital by Satompka to be broadcast at 7.30 p.m. As a contrast, this is to be followed by another recital—fifteen minutes of Gillie Potter.

◆ ◆

We are to hear on Wednesday evenings during the winter the usual Queen's Hall Symphony Concerts. This year there are only twelve and they finish much earlier—March 25. The reason for this early finish is that following the success of the Orchestra's visit to Brussels at the end of last season, an extensive European tour has been planned.

At the time of writing arrangements are going ahead for the orchestra to visit Zurich, Vienna, Budapest, and Paris.

On glancing through the programmes for our own Wednesday-evening concerts, I noticed that great attention is to be paid to first performances of modern works. We were to have heard a first English concert performance of a new Hindemith symphony, *Mathis der Maler*, but another British concert organisation has arranged for its first performance on the same date, with the result that the B.B.C. decided to amend its programme.

The four first performances with which we are to be "delighted" are: Three Pieces from the *Lyric Suite* by Alban Berg, arranged for string orchestra, on October 23; William Walton's *Symphony No.* 1, on November 6; *Summer's Last Will and Testament*, a masque for orchestra, chorus and baritone, on January 29, 1936; and Bela Bartok's *Cantata Profana*, on March 25.

I have mentioned these works and dates primarily for the benefit of overseas readers.

Amplitude Distortion In Loudspeakers

By DR. N. W. McLACHLAN, D.Sc., M.I.E.E.

Barratt Photo

A good-sized baffle is essential if the best bass response is to be obtained from a moving-coil loudspeaker. Our illustration shows one of suitable size and position in use at the London School of Broadcasting

In this instalment of his valuable series on the functioning of loudspeakers Dr. McLachlan deals with an interesting but very little-known aspect, namely the fact that curvature of the characteristic can introduce noteworthy distortion in the sound output

THERE are many causes of distortion in a loudspeaker, but in this article our attention will be confined to what is known as amplitude distortion. It is quite prevalent in many makes of moving-coil loudspeaker.

Tolerable Distortion

We are all aware that for absence of distortion at the power valve, the pointer of the milliammeter, which reads the steady anode-feed current, should always be stationary. In practice this is rather too rigorous a condition if the maximum output of the valve is to be obtained. But so long as distortion cannot be detected by ear, slight motion of the milliammeter needle during fortissimo passages is permissible.

Now suppose we violate this canon, which is laid down for undetectable distortion, and overload the power valve by increasing the voltage swing on the grid. The milliammeter needle then jumps about spasmodically and the resulting output from the loudspeaker is too distorted to be described in parliamentary language.

This takes me back to the good old days of 1922 when broadcasting first started. The type of microphone then in use at the transmitter was similar to that in a household telephone, and it was transformer coupled to a sub-modulating valve which stepped up the voltage to the main modulator.

Nobody was happy unless the feed-meter of the sub-modulator valve jumped about like a caged hyena, and no amount of argument would persuade certain people that serious distortion was occurring, since during modulation of the carrier wave the needle should " stay put."

Actually the chief drawback was that, although theoretically better quality would be expected, the range of the station was reduced materially. As crystal receivers were then almost universal, the reduced range and better quality would have been unpopular. The form of distortion to which we refer is known as " amplitude-distortion," and it arises when the voltage amplitude on the grid of any valve, but usually the power valve, causes the valve to operate on those parts of its characteristics which are curved.

Non-linear Distortion

Sometimes it is termed non-linear distortion, since the valve is not worked solely on those parts of its characteristic curve which are straight-lines.

We are so familiar with valve-characteristics that there is no difficulty in appreciating exactly what happens when a valve is overloaded. If the grid swings violently to the negative end of the scale, the anode current of the valve does not decrease in proportion, owing to curvature of the bottom end of the

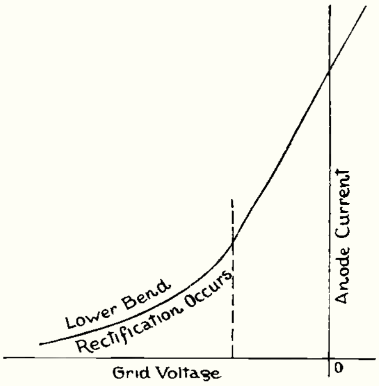


Fig. 1.—A typical sort of valve characteristic curve for comparison with its loudspeaker equivalent in Fig. 2

characteristic as shown in Fig. 1. We know that rectification occurs, and that the mean value of the feed current alters in consequence. Hence the milliammeter needle is affected by the change in steady feed current due to rectification, and the result is shown visually.

Strange as it may seem, an overloaded loudspeaker behaves in a somewhat similar manner, but as a general rule the results are not so distressing usually as when distortion of the same type is due to a valve, especially a pentode valve.

The Characteristic Curve

Before we can discuss amplitude or non-linear distortion in a loudspeaker it is necessary to have its characteristic curve. This curve shows the relationship between the driving current and the displacement of the diaphragm from its normal position when at rest, that is, in the absence of current. As the moving-coil speaker is used almost universally nowadays, we shall confine our attention to this type only, although our remarks apply even more acutely to inductor and other moving-iron speakers.

To avoid distortion, the relationship between the steady unidirectional current (D.C.) and the displacement of the diaphragm should be a straight line as shown in Fig. 2. The portion to the right of the origin O refers to displacements out of the magnet, the current then being in a certain direction. To get the portion of the line to the left of O the current is reversed.

The line of Fig. 2 is obtained by passing certain known values of D.C. through the coil and measuring the corresponding displacements. The apparatus for doing this need not concern us here, as it is irrelevant to our present purpose. In practice the characteristic curve of the loudspeaker is not linear (i.e. a straight line) over its complete length, and it resembles a valve characteristic as will be seen on examination of Fig. 2.

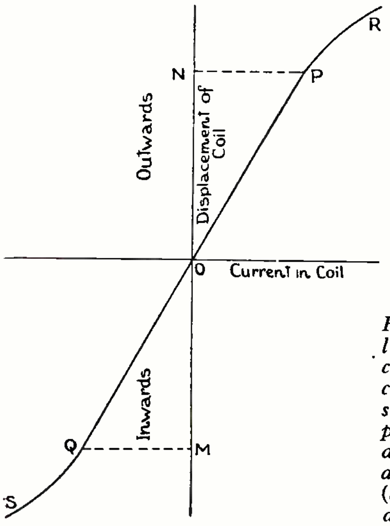


Fig. 2.—This loudspeaker characteristic curve is constructed by plotting coil displacement against (direct) actuating current

The line curves over at each end after the displacement exceeds ON on one side of the central position and OM on the other.

From this we infer that so long as the coil does not move outside the region MN, amplitude distortion will not occur. The question which now arises is this: what length is MN? The answer is that it depends upon the design of the loudspeaker. In some cases it may be $\frac{1}{8}$ in. or even more, but usually it is less than this.

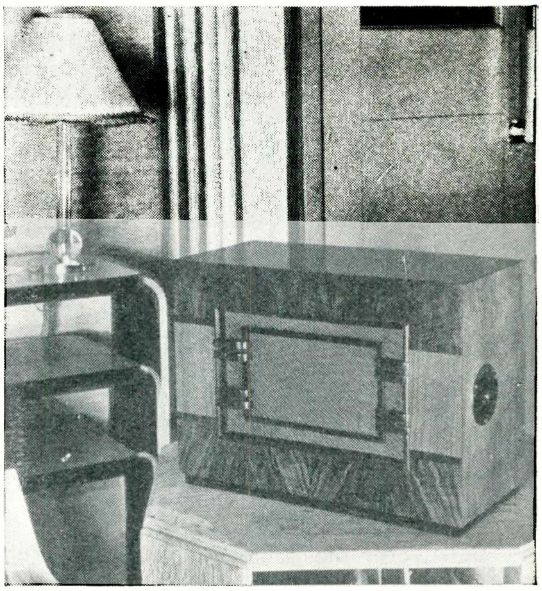
Further it does not follow that the portion OP will always have the same slope as OQ, owing to, (1) asymmetry of the mechanical constraint imposed by the centering device and annular surround (if any) at the edge of the cone, and (2) asymmetry of the magnetic field at each end of the air gap.

We shall now consider the effect of non-linearity in the centring device and the annular surround. To get the characteristic of the centring device alone—it is clamped to a framework—known forces are applied to it by means of weights and the corresponding displacements measured. Two specimen curves are given in Figs. 3a and 3b.

In Fig. 3a the displacement on each side of the central position is proportional to the force up to a distance of 0.06 in. or about $\frac{1}{16}$ in., which is really quite small. Over the straight part of the curve there would be no amplitude distortion during reproduction. When, however, the excursion of the coil at say 50 cycles per second, where the amplitude is large, exceeded $\frac{1}{16}$ in., then amplitude distortion would occur.

Really Bad Curve

The curve of Fig. 3b is an example of a very bad case, and it is defective in two respects, (a) it is not straight excepting for a small displacement on the right, and (b) for a given force the displacement on the left exceeds that on the right appreciably. Thus a centering device of this type would cause amplitude distortion whatever the excursion of the diaphragm backwards and forwards.



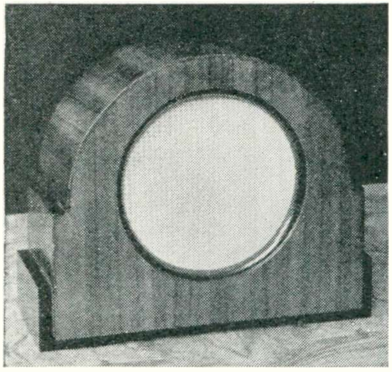
Marconiphone's latest extension loudspeaker—housed in a fine-looking cabinet—is provided with a universal matching transformer and volume control (model 143, £4 15s.)

Effect of Outer Surround

Next we come to the outer surround which supports the cone at its periphery. In some speakers the surround is made of kid leather, whilst in others it is made of paper being, in fact, moulded with the cone. To give flexibility in the case of a moulded cone with a surround, there is a corrugation near the edge as shown in Fig. 4a.

Tests made on the outer surround and corrugation, to determine its characteristic, show that the relationship between force and the corresponding displacement from the central position is not linear for appreciable excursions of the diaphragm. This is illustrated in Fig. 4b, which shows a gentle curvature almost the whole way along the characteristic.

Another peculiar feature is observed during tests of this nature. If the cone is gradually loaded up and the corresponding displacements measured, the curve of Fig. 4b is obtained. But when the load is gradually removed, the displacement curve obtained lies above the first curve, as shown in Fig. 5—if the loading is continued in the opposite direction, so that the cone is displaced in that direction, the curve travels down to Q, then removal of the load and its application in the other direction brings the curve back as shown. Thus if the cone is pushed and pulled over the same distance on each side of its central position, instead of working up and down *one* curve it works over a loop.



A good frequency range is covered by the Ferranti M1 extension loudspeaker. In its neat oval-shaped cabinet it is well suited to the mantel shelf

Hysteresis

The effect is known as *hysteresis*, from the Greek word meaning to lag behind, because the deflection lags behind the force producing it. For example, the deflection is O N when the force is zero, so it lags behind, since it would be zero if there were no hysteresis. The area of the loop represents, to a certain scale, the work done in moving the diaphragm to and fro, due to hysteresis loss. This loop means that there is distortion, so that if a pure tone of, say, 50 cycles per second passed through the speech coil, the acoustical output would sound impure.

In practice there are two cases of centring devices and surrounds which have to be considered. (1) When the centring device is stiffer than the outer surround, this being of kid leather or the like. (2) When the surround (usually the moulded type) is much stiffer than the centring device. In the first case, if a centring device with a characteristic akin to that of Fig. 3b were used, the results would be very unpleasant.

In the second case, however, the stiffness of the centring device is swamped by that of the outer surround, and if this had a characteristic as shown in Fig. 5, the distortion would be much less than that in case 1. At the same time the distortion might be noticeable by ear.

If the reader moves his cone backwards and forwards by hand, he may be able to detect (in a bad case) whether the force to push it inwards differs from that to pull it outwards. In the case of a speaker with a tight leather surround it will be found that after pulling the cone out a short distance it moves no farther.

Thus a saturation point is reached, so to speak, and the leather refuses to stretch any more. In cases of this nature there is bound to be amplitude distortion when the output from the speaker is appreciable, especially in reproducing an organ or an orchestra where there are powerful low tones, which necessitate large displacements of the diaphragm.

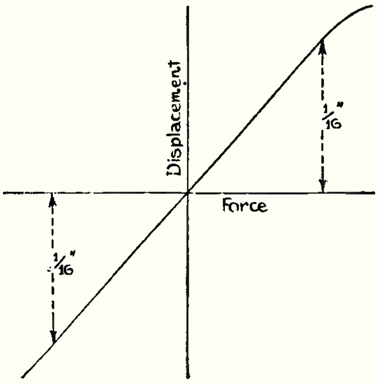


Fig. 3a.—The centring device possesses characteristics of its own

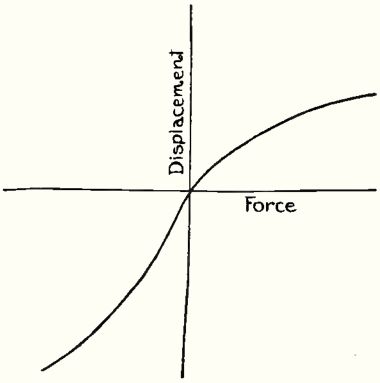


Fig. 3b.—A really bad centring device may even do things like this

(We may remark that for constant power output as sound, the lower the frequency the greater is the excursion of the diaphragm to and fro.)

Effect on Wave-form

We now proceed to show the effect of a non-linear characteristic upon the wave-form of the current fed to the loudspeaker. Consider a speaker whose force/displacement* curve is given by Fig. 2, this being symmetrical about the central position represented by O. When a sine-wave current of 50 cycles per second is supplied to the coil from, say, a heterodyne oscillator, there is no amplitude distortion provided the swing of the coil does not go beyond M inwards and N outwards.

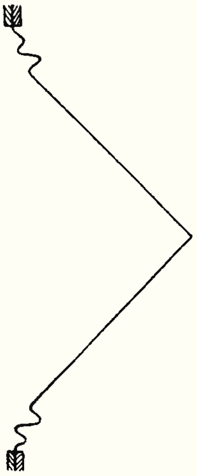


Fig. 4a (left).—Cone with corrugated edge to the surround to give flexibility

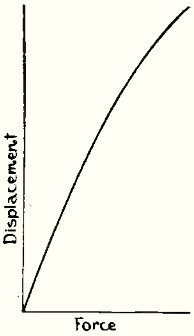


Fig. 4b (right).—The "static" characteristic curve of a cone surround

If it goes as far as R, then owing to the characteristic bending over, the acoustical wave-form is flattened as shown in Fig. 6. The flattened wave can be resolved into a fundamental frequency of 50 cycles per second and harmonics of 100, 150, 200 cycles per second, etc.

In the reproduction of speech and music, conditions differ from this simple case of a single frequency, since a myriad of tones, ranging from 40 to 10,000 cycles per second, is present. Consider two frequencies of 50 and 120 cycles per second to be present, and that the amplitude of motion is so large that the diaphragm swings right off the linear

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* The reader will observe that we started the article by referring to a current/displacement curve. If the mechanical force on the coil is proportional to the current, the two curves have the same shape, so it is immaterial which is used here.

portion of its characteristic. Then in the acoustic output there will be tones of 50, 100, 150, etc., 120, 240, 360, etc., $50+120=170$, etc., $(50-120)=70$, etc. The last two are sum and difference tones.

The effect of all these alien tones is to create dissonance and unpleasant reproduction.

Another Effect

There is, however, another effect. Imagine that there are two frequencies of 40 and 1,600 cycles per second fed to the speaker. If the lower frequency current is large enough, it will cause the coil to make a large excursion and the speaker will operate on P R and Q S of Fig. 2. Under this condition, since these are 40 oscillations of the 1,600 cycles-per-second tone to one of the 40 cycles-per-second tone, a number of oscillations of the higher tone occur whilst the diaphragm is operating over the curved parts of its characteristic.

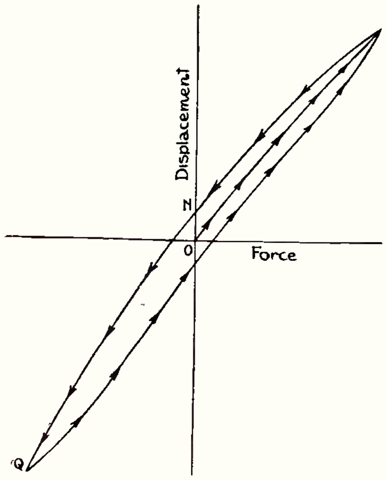


Fig. 5.—Graphic representation of the hysteresis loop introduced by a surround

The net result is that a number of new frequencies above and below 1,600 cycles per second are created. When many tones are present, as in the reproduction of speech and music, the number of alien frequencies is very large.

In Technical Phraseology

The effect is described in technical phraseology by saying that the 1,600 cycles-per-second tone is *modulated* by the 50 cycles-per-second tone, just as speech frequencies modulate the carrier wave of radio frequencies at the transmitting station.

The acoustic output is, therefore, seriously distorted if the amplitude of the diaphragm is sufficient to take it to the extreme points S and R. Needless to say the reproduction is very unpleasant, and it is truly amazing how the public stands it !

The centering device and the surround are not the only sources of amplitude distortion. If the characteristics of these two items are linear, it by no means follows that when a powerful sine wave current is supplied to the loudspeaker coil, that it will be transformed into a pure sine wave of sound.

Other sources of non-linear distortion and various means of testing a speaker for purity of reproduction will be considered in the next article. We may remark, that any mechanically minded person who considers carefully the design of centering devices and surrounds (or would it not be more accurate to say the lack of design ?), will see at once that in many cases the axial motion is due mainly to slackness of the parts.

In some cases the diaphragm seems to take a slight permanent set on one side of the central position. If the characteristic happens to be asymmetrical like that of Fig. 3b, there is an effect akin to that of an anode-bend rectifier. When the carrier wave is switched on, the steady anode-feed current rises, whereas in the case of the speaker there is a corresponding unidirectional displacement of the diaphragm from its central position.

During operation the to and fro excursions take place about this new position. If the displacement is appreciable, the coil will come out of the uniform part of the magnetic field of the magnet, and as we shall see in the next article this introduces yet another form of distortion which includes rectification.

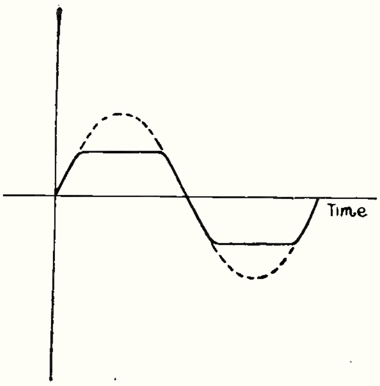
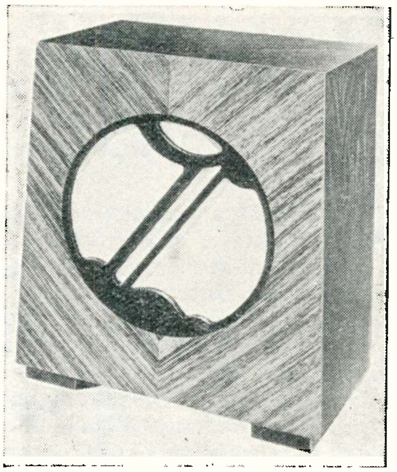


Fig. 6.—Flattening effect caused by the curvature of the Fig. 2 characteristic at PR and SQ



A moderately priced moving-coil cabinet loudspeaker for extension use is the model PMS2 made by W.B. and priced at £2 4s. 6d.

A New Constant Frequency Record

DECCA has produced an extremely useful constant-frequency record for the testing of pick-ups, loudspeakers, amplifiers and, in conjunction with a simple signal generator, for testing of overall response curves of radio receivers.

The makers claim a straight-line calibration from 6,000 down to 250 cycles a second, correct to within plus or minus $\frac{1}{4}$ db. Below 250 cycles the calibration cannot be stated with such accuracy, but the makers still claim plus or minus $\frac{1}{2}$ db. of the levels stated in the record.

Useful Scheme

On the label is a table which enables the user to keep a record of the number of playings up to 20. It must not be supposed that the record is limited to forty playings for the two sides, but accuracy cannot be guaranteed after this number.

The harmonic content of the waveform varies somewhat over the frequency range. It is at its maximum in the extreme bass, but nowhere does it exceed 5 per cent total.

When the record is run at the correct speed as shown by stroboscope on the label, the frequencies are correct to within approximately 1 per cent.

The price of the record is well within the reach of all experimenters, being only 2s. 6d. Fuller details can be had from the makers, the Decca Record Co., Ltd., at 1-3 Brixton Road, London, S.W.9.

The "W.M." Simplified Short-

A Simple Four-valve Battery-operated Superhet that Any Listener

SINCE the appearance of the Standard Four-valve Short-waver earlier this year, readers have been insistent in their demands for a good, but simple superhet for short-wave work.

Strange though it may seem, the design of a simple superhet, if it is also to be good, is not too easy. One never knows quite how far the simplification process may be carried without leading one into various kinds of trouble. One might even sink so low, for instance, as to use an autodyne circuit for the frequency-changer, which would be delightfully simple, but would end its list of virtues with that.

The small piece of paper on which the set was born, so to speak, is before me as I write, and it will give you the facts that you want to know in concise fashion :—Power-supply : batteries. Signal-frequency H.F. : No. Frequency-changer : Heptode. Tuning : ganged—no trimming. I.F.'s : one, with air-tune transformers. Output : Pentode. Valves : Four.

Comforting Set to Handle

There, in "Mr. Jingle" style, is the specification of the set. I feel tempted to add "Results : Good, very," but that might savour of self-praise. The fact remains that it seems to be a very comforting sort of set to handle; the controls are not numerous, single-knob tuning being provided, and although it is not equipped with large audio side (one pentode doing all the work) it will operate a loudspeaker quite comfortably on a large number of the stronger short-wave stations.

It is not, however, intended as an out-and-out loudspeaker set. Phones can be used in comfort when searching for really weak or distant stations, and a volume control, naturally, is provided and is really meant to be *used* for this purpose.

Looking at the specification of the set you will agree that there simply isn't enough of it to put it into the really lusty loudspeaker class. Those who want to make a noise, however, can easily leave out the output stage and feed the second detector into a big low-frequency amplifier. There is plenty of gain in the single intermediate-frequency stage—so much so that it may even be a little bit ticklish to "tie down" right at the outset, when the set is first being lined up.

Points about the Circuit

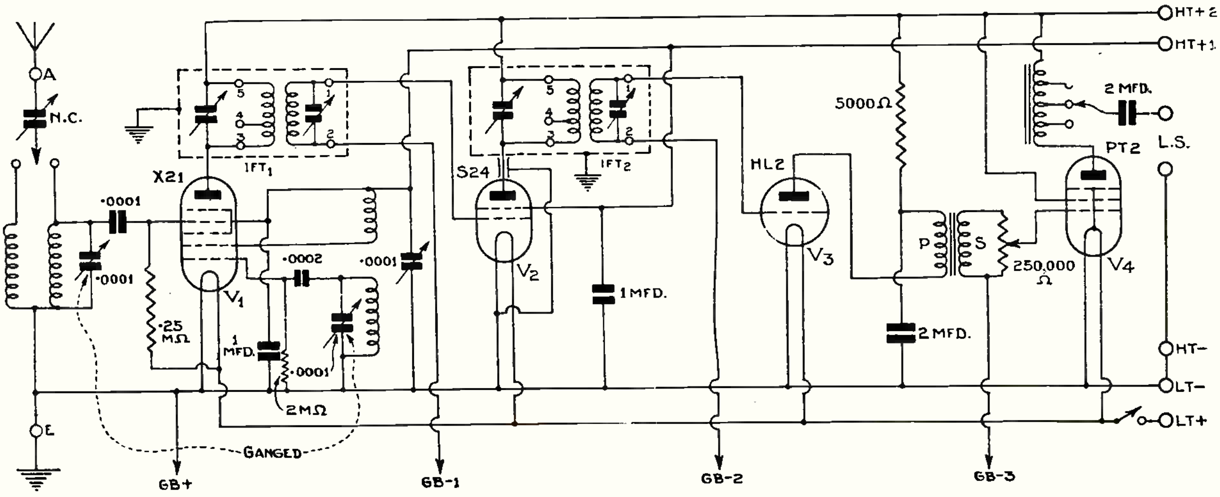
Let us scrutinise the circuit diagram and discuss any small points that crop up. First of all comes the question of the alternative methods of aerial coupling. An ordinary four-pin, two winding coil is used for the aerial circuit, and the aerial itself may be hitched on to the top of the grid coil through the neutralising condenser, or it may be coupled to the other winding, intended for reaction.

It is a little unconventional to use leaky-grid detection with a heptode, but it saves a second grid-bias battery and works admirably. The value of the grid-leak, however, is fairly low—250,000 ohms.

The first and second grids of the heptode serve as the grid and anode of the oscillator section, which uses the two windings of a similar coil. Here, strangely enough, a higher value of grid-leak was found to be beneficial, although we are often told that it is necessary to use quite a low value to give smooth oscillation through the range.

Control of Regeneration

A variable condenser has been provided in the position that would normally be occupied by the reaction control. This is in no way a control that has to be used when the set is operated; it is merely there for convenience in case the oscillator should become too violent or too



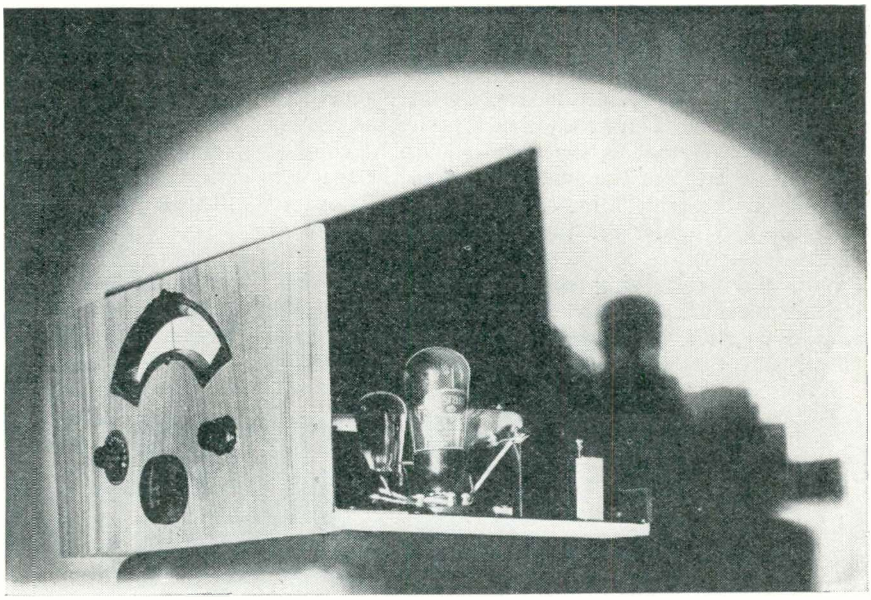
The circuit of the "W.M." Simplified Short-wave Super. The combination consists of a heptode frequency-changer, screened-grid intermediate-frequency amplifier, triode detector and pentode output valve. A comparatively high intermediate frequency is used with air-core transformers

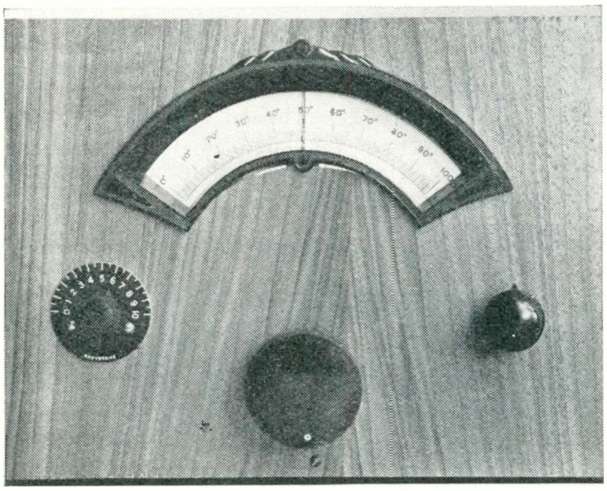
wave Super

Designed by G. HOWARD BARRY

Can Build and Use

Don't be misled by the word " simple " : this receiver is certainly easy to make and to operate, but performance is not sacrificed to achieve these ends. In the course of prolonged tests the receiver has put up a splendid show and we strongly recommend it to everyone seeking a really hot-stuff all-the-world receiver





Exceptional simplicity of control is the keynote of this receiver ; the knob on the left is rarely used, the one in the centre is for tuning, and the volume control is on the right

weak. Its normal setting—about half-way in — will probably never require alteration, but it is reassuring to have it instantly variable.

The two tuning condensers are ganged and coupled to a large " full-vision " dial, which is a luxury that one would like to meet more often in short-wave receivers. The reduction gear is just about comfortable for normal operation, although tuning is fairly sharp. There is, naturally, not the slightest suspicion of hand-capacity or any form of instability when the set is operating properly, and therefore tuning is merely a matter of common sense and the ability to turn a knob *slowly* !

The only other control on the front panel is the potentiometer across the low-frequency transformer secondary, serving as volume control. Normally, neither that nor the " reaction " control will need adjustment, so that you have truly single-knob tuning.

The " mixed " output is fed from the anode of the heptode to the primary of the first I.F. transformer. These transformers incorporate two air-dielectric trimmers and variable coupling between the coils, and with optimum coupling give a curve not more than about 16 kilocycles in width. (That, of course, applies to a single transformer.)

Ultra-sharpness on Demand

In practice, with the two transformers correctly " lined up " and with suitable adjustment of the screen voltage, the I.F. stage may be brought to a point at which regeneration is quite considerable, and the set handles almost as if a quartz-crystal filter were incorporated—but that is another story !

Anode-bend rectification is used for the second detector, which is transformer-coupled to the output pentode. The latter is provided with a tapped output choke, from which the loudspeaker is fed through a 2-microfarad condenser.

About the Heptode Frequency-changer

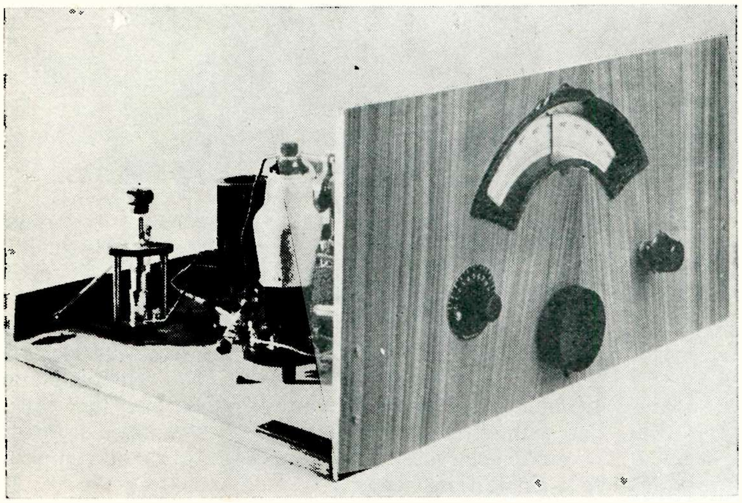
There is hardly anything else to be said about the theoretical arrangement of the set, except to cover a few small points concerning the frequency-changer. No battery version of the triode-hexode yet being available, an ordinary heptode has been used. We have been told that this suffers from considerable disadvantages on the shorter waves, chief of them being the " pulling " effect between the two tuned circuits—oscillator and detector.

If two separate tuning controls are used, this " pull " certainly appears to be a little troublesome, accurate tuning-in of a signal necessitating a kind of see-saw motion over the last few hairsbreadths, so to speak. Gang the two, however, and you remain in blissful ignorance of this little struggle. In any case, the tuning of the detector circuit is moderately flat, and I did not find it necessary even to install a trimming condenser in this set.

Alternative Methods of Aerial Coupling

Although I have provided for two alternative methods of aerial coupling, I must say that I prefer the tighter of them myself—that is, the aerial should be coupled directly to the top of the grid coil, not to the reaction winding on the same former. (Take the flex lead to P on the coil holder for the latter method or to G for the former.)

With the neutralising condenser nearly "all-in," a fair degree of off-setting of the aerial tuning condenser is necessary, but, fortunately, this appears to be non-critical and the adjustment does not need altering when one changes the waveband.



The author does not favour a metal panel; a very pleasing appearance has been obtained with one of polished hardwood-faced ply-board

If the set does give the impression of being "out of trim," one can always make a small adjustment by altering the value of the aerial coupling, thereby increasing or lessening the damping on the tuned input circuit. This may be crude, but it works.

Aerial Recommendations

Much will naturally depend upon the size and shape of your aerial. I am in favour of the use of a good outdoor aerial for short-wave reception, simply because the average indoor wire will pick up far more interference and far less signal, giving, in short, the worst possible signal-noise ratio.

One often hears misguided people saying: "Ah, but a big aerial shouldn't be necessary if the set is as good as you claim it to be!" I can't imagine a worse bloomer. The more sensitive the set, the greater the need for an aerial of the maximum possible effective height. If you are always going to be content with "locals," go ahead and string some flex round the picture-rail. If you want DX—free of interference, moreover—you will never regret the expenditure of a little time and money on the erection of a really good aerial.

My own aerial, as used with this set, is about 45 ft. high at the far end, 30 ft. high at the house end, and has a total length of 67 ft. The room in which the set is used is 18 ft. above ground level. A much smaller aerial, provided that it is clear of gutters, trees, telephone wires, etc., will probably be found quite equally effective. But no picture-rails, *please*!

Simple Construction—No Snags

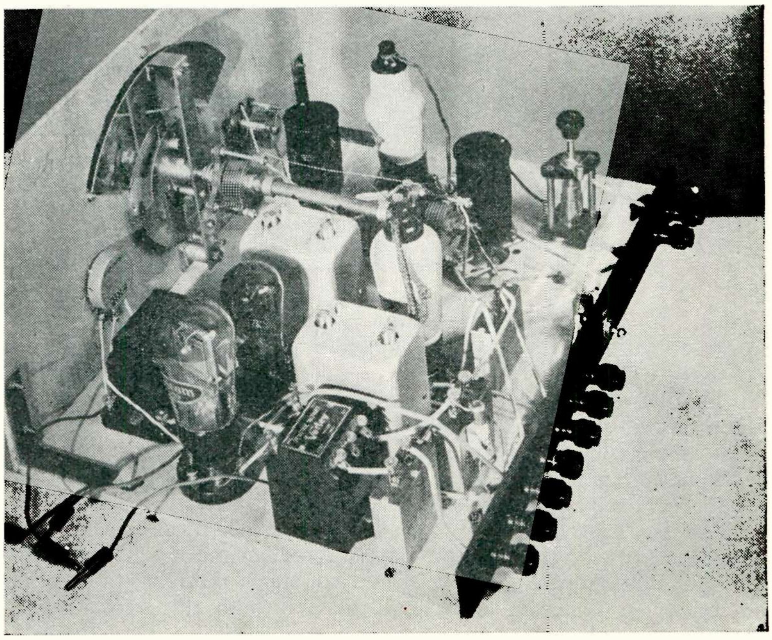
On the constructional side of the set there are no particular difficulties. It was laid out with a certain amount of thought, but no elaborate screening was found necessary owing to the excellent shielding of the I.F. transformers and the use of small-diameter coils for the detector and oscillator.

Note that a large amount of space has been given to the signal-frequency side of the set (to the right of the tuning condensers, looking from the rear). The two coils are mounted quite a long way apart, which is desirable from the point of view of inter-action, and also brings each one as close as possible to its tuning condenser.

Valve-holder Mounting

Originally the signal-frequency side of the set was screened from the rest by a vertical sheet of metal, but this was found to increase the length of several wires that should have been kept short, and its removal did not lead to the slightest suspicion of instability.

One small refinement which should be

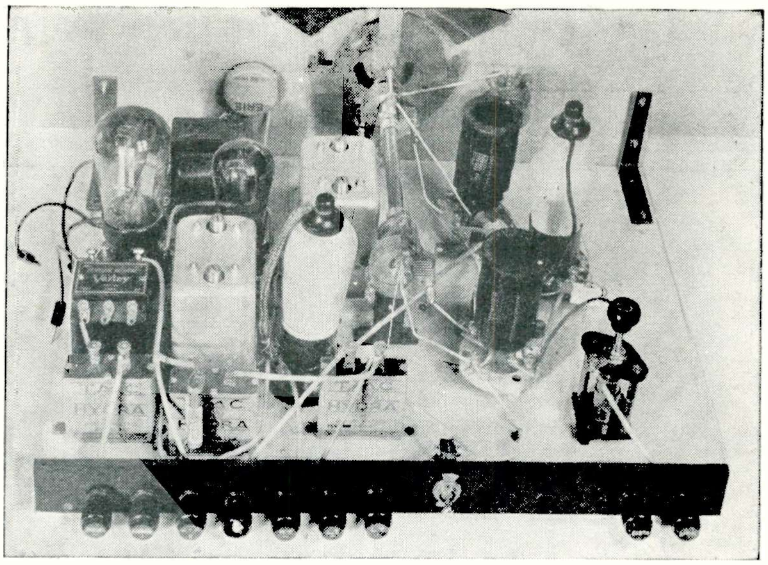


This view from the output end shows the pentode-type choke with its alternative tapping points for the loudspeaker circuits mentioned is the raising of the seven-pin valve-holder for the heptode, and the neutralising condenser, above the baseboard by means of small ebonite spacers. The baseboard is metallised on its top surface, and this little point is therefore worth while.

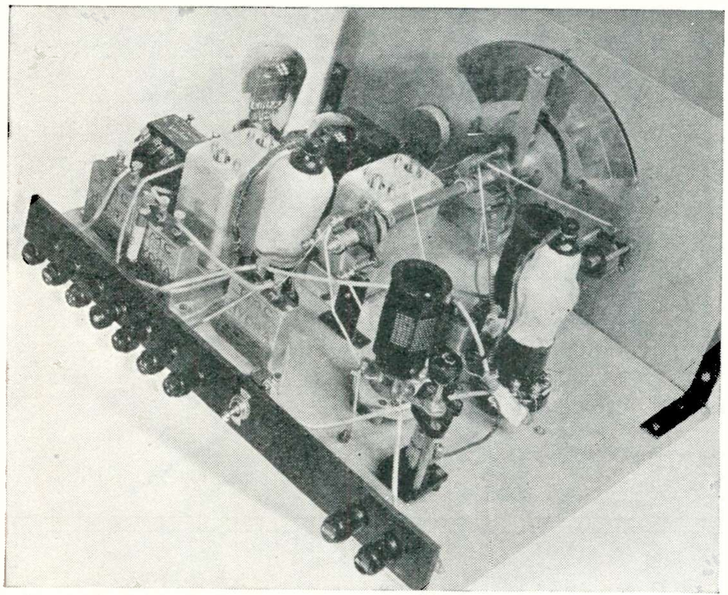
Incidentally, nowhere in the signal-frequency side of the set has the metallising been relied upon to carry earth-return currents. In several places an earthed point has been connected to the nearest point on the baseboard, but it is also wired directly to the next, and so back to the L.T.— terminal at the rear.

Earthing Arrangements

The earth terminal itself is connected to the metallising only, and so is one of the loudspeaker terminals, but all other wiring is carried out directly.



Pin-type interchangeable coils are used so that a very wide range of wavelengths may be covered



The ganging arrangement is extremely simple, employing a pair of very small variables separately mounted and connected by a suitable link device

I may possibly be criticised for not using a metal, or metallised, front panel. My experience has always been that a set is less prone to hand-capacity effects when a metallised baseboard and *plain* front panel are used. If you specially desire to make a "colonial" job of it, there is no reason why a metal panel should not be installed. Both the condensers are at earth potential, but the volume control will need an insulated bushing.

Plain Panel and Baseboard Style

The plain panel-and-baseboard style has been adhered to chiefly for reasons of simplicity in layout and wiring, as this is intended to be a simple set. I hope to make a completely different type of job of the A.C. version, which is to follow later on, but even then I think the layout will remain substantially the same.

The I.F. transformers are really intended for chassis mounting, but they are provided with brackets which raise the terminal connections (underneath, of course) well above the baseboard. In laying out the parts it will be necessary to attach four wires to the appropriate terminals (Nos. 1, 2, 3 and 5) before screwing the transformers down. The leads should be marked or numbered to avoid confusion when wiring is carried out.

The No. 3 terminals go to the anodes; No. 1 to the grids; No. 2 to grid-bias, and No. 5 to H.T. in each case.

The tapping on the primary winding (No. 4) has two uses. A regenerative I.F. stage may be arranged by using a Hartley circuit, or terminal No. 4 may be taken to the anodes instead of terminal No. 3 if any trouble with instability should arise. This was not necessary in this particular case, and I do not anticipate that any readers should need to have recourse to this plan.

Stabilising the I.F.

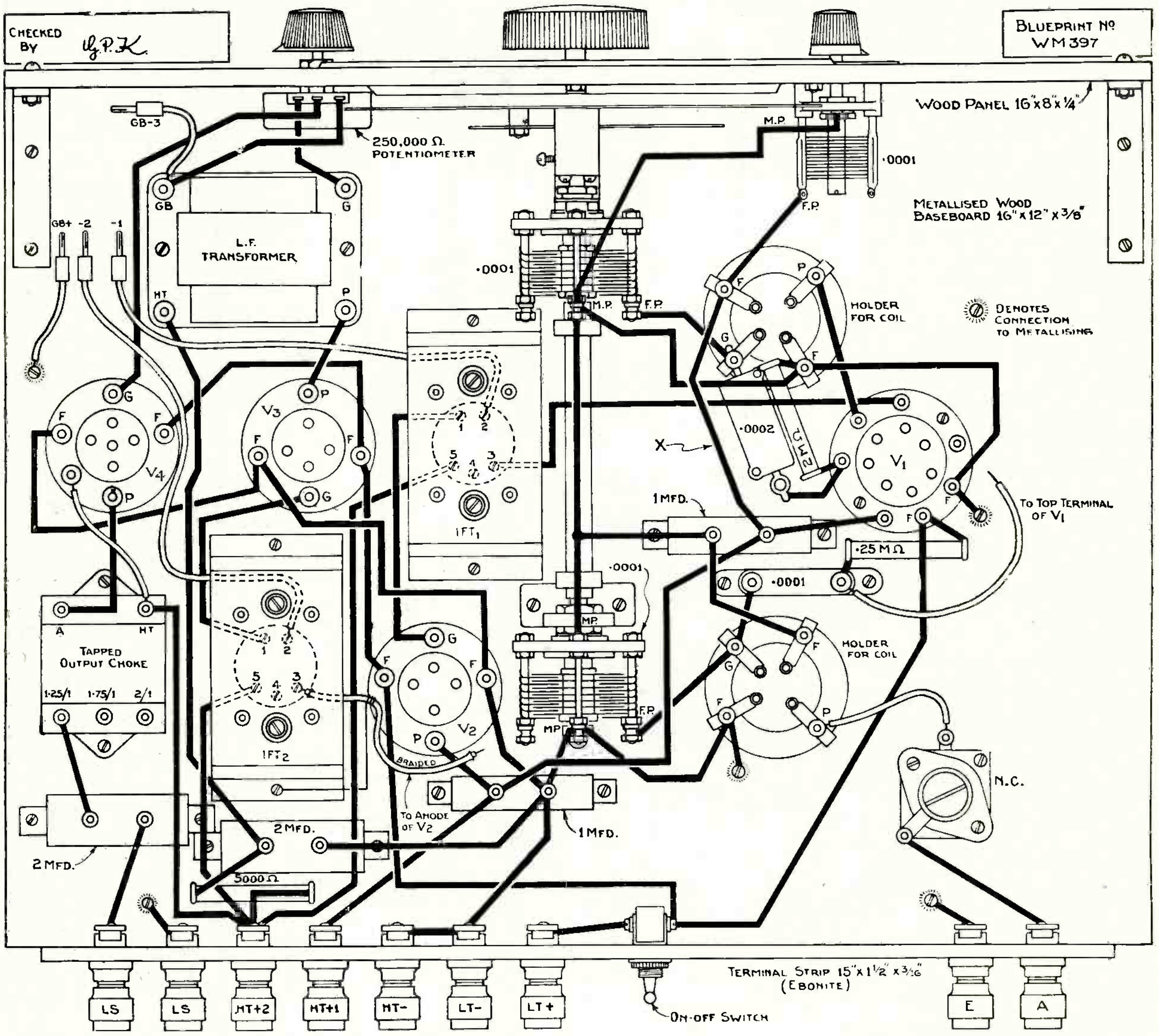
Should it prove difficult, however, for any reason, to tame the I.F. amplifier, the transference of one of the anode connections from terminal 3 to 4 will put things straight at once. This has been tried out, instability being produced by omitting to shield the lead from the anode of the S.G. valve to its connection on the transformer and by using a non-metallised type of valve.

The screens of the screen-grid valve and the heptode are both by-passed to earth at nearby points, but share a common H.T. connection, about 60 volts being applied when the full H.T. is between 135 and 150. The screened lead from the anode of the S.G. valve, by the way, is earthed straight on to a fixing screw of one of the intermediate-frequency transformers.

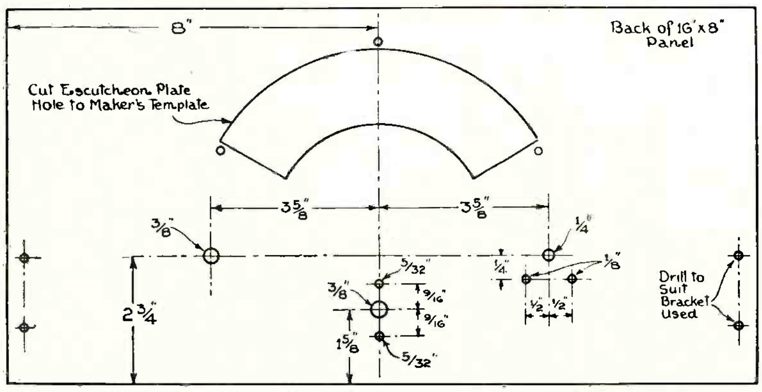
The anodes of the heptodes, S.G. and output valve are all given the full voltage, but the second detector is de-coupled by means of a 5,000-ohm resistance and a 2-microfarad condenser.

Under operating conditions the screen-grid valve

Scale Layout and Wiring Diagram



Readers who prefer to build the set from a full-size blueprint are reminded that they can obtain a copy for half-price providing the coupon to be found on the last page accompanies the remittance. Applications should be addressed to the "W.M." Blueprint Dept., George Newnes, Ltd., 8-11 Southampton Street, Strand, London, W.C. Ask for No. WM397



Only three parts are to be fitted upon the panel, dimensioned as this sketch shows. A template will be found to accompany the dial and renders accurate fitting of this component very simple

will require 1.5 volts bias and the second detector either 1.5 or 3 volts, with the pentode running at 9 or 12 volts negative. In any case, the makers' recommendations should be followed with regard to H.T. and G.B. figures.

Coming now to the actual operation of the set, it is as well first to talk about the coils. The wavelength ranges quoted on the maker's leaflet with each coil are measured with a .00015-microfarad variable condenser, and those in the set are only of .0001-microfarad. This does not mean that the ranges fail to "join up." It merely results in a substantial reduction of the amount of "overlap."

Thus, instead of ranges of 13-26, 22-47 and 41-94 metres, as on the leaflet, we have something more like 13-24, 21-41 and 40-75 metres. In actual fact, the 20-metre amateur band may be received towards the top end of the condenser with the smallest coil or the bottom end with the medium one. The 40-metre band comes in at zero with the largest coil or at the top of the condenser with the medium one.

The other bands are thus quite conveniently disposed, 16 and 19 metres coming on the smallest coil, 25 and 31 on the medium, and 49 on the largest. The designations of these three coils are LB (light Blue spot), Y (Yellow spot), and R (Red spot) respectively.

How to Make the First Tests

I suggest that on first test you plug in the two Yellow-spot coils and set the condensers at about 50 degrees. Within a very few degrees you ought to be able to pick up a fairly strong morse signal, particularly if you have the aerial coupled directly to the grid coil, as suggested earlier on.

Uncouple the rear (detector tuning) condenser from the shaft and rotate it separately, easing the vanes round with a pencil or something similar, until the signal you have chosen is at its strongest. Tuning on the rear condenser should be pretty flat, and you should have no difficulty in finding the best setting on your signal and " locking " it on the shaft again.

Trim up finally by adjusting the aerial-series condenser. The whole set should require no more than this simple operation for ganging. If you find that signals are weak on one coil, try re-adjustment of the ganging and then go back and compare with the original coil.

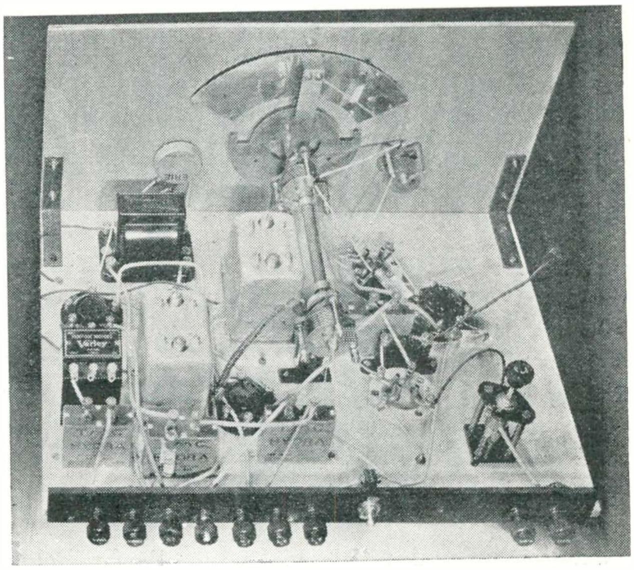
" Real " Ganging Not Necessary

Detector tuning should be so uncritical that real ganging, in the true sense, should not be necessary.

If C.W. signals are actually heard as muscial notes varying in pitch, the I.F. stage is oscillating. Adjustment of screen voltage and careful adjustment of coupling and trimmers on the I.F. transformers should stop this at once without reducing signal strength.

A complete absence of signals almost certainly indicates an error in the wiring or the failure of the oscillator section of the heptode to oscillate. There is, of course, the adjustable " reaction " condenser to watch ; but the oscillator derives its high-tension from the same tapping as the screen, and if the screen voltage has been reduced to *too* low a figure (to cure instability, for instance) the oscillator may possibly " pack up " too.

Be prepared for quite sharp tuning and a disconcertingly silent background. It took me a long time to decide that the set *was* working, after all, when I first switched it on. I rather imagined that something was disconnected, owing to the complete absence of hiss or mush. It will probably give you the idea of being a thoroughly insensitive set until you find signals coming through at respectable strength.



The objects with the light-coloured cases are the intermediate-frequency transformers : they are of the air-core type with an adjustment of coupling between primary and secondary windings

Please don't pave the way for disappointment, though, by expecting anything ear-shattering. After all, there is only I.F. stage and one L.F., and you can't expect loudspeaker reproduction of Hong-Kong on that ! But, for home readers, the stronger Americans will certainly be loudspeaker stations and, for overseas listeners, I sincerely hope the Empire stations will be.

The list of stations on page 281 will give some idea of the kind of dial settings to start your searching on. Don't be surprised if yours don't come within a few degrees, however.

LIST OF PARTS NEEDED FOR THE "W.M." SIMPLIFIED SHORT-WAVE SUPER

	£	s.	d.
BASEBOARD ASSEMBLY			
1—Plain wooden panel, 16 in. by 8 in. by ¼ in., say		1	0
1—Metallised baseboard, 16 in. by 12 in. by ⅜ in., say		3	0
CHOKE, LOW-FREQUENCY			
1—Varley Pentode Nichoke ...		11	6
COILS			
2—Sets of Eddystone 4-pin coils, types LB, Y and R	1	1	0
2—Varley Air-tune I.F. transformers, 465-Kc.	1	10	0
CONDENSERS, FIXED			
1—Dubilier .0001-microfarad, mica type 620		1	3
1—Dubilier .0002-microfarad condenser, type 670		1	0
2—T.M.C.-Hydra 1-microfarad 250-volt working		4	6
2—T.M.C.-Hydra 2-microfarad 250-volt working		6	0
CONDENSERS, VARIABLE			
1—Eddystone .0001-microfarad micro-condenser		5	0
2—Eddystone .0001-microfarad micro-condensers, type 900 ...		7	6
1—J.B. neutralising condenser ...		3	6
DIAL			
1—Eddystone wide-vision vernier dial, type 973		10	6
RESISTANCES, FIXED			
1—Erie 2-megohm grid leak, 1-watt type		1	0
1—Erie 250,000-ohm, 1-watt type		1	0
1—Erie 5,000-ohm, 1-watt type ...		1	0
RESISTANCE, VARIABLE			
1—Erie 250,000-ohm (volume control)		3	6
SUNDRIES			
1—Ebonite strip, 15 in. by 1½ in.			
9—Belling-Lee terminals marked Aerial, Earth, L.T.—, L.T.+, H.T.—, H.T.+, H.T.+1, H.T.+2, L.S.+, L.S.— ...		4	6
1—Eddystone extension control outfit		1	3
1—Eddystone adjustable insulated bracket		1	6
SWITCH			
1—Bulgin on-off switch, type S102		1	3
TRANSFORMER, LOW-FREQUENCY			
1—Ferranti, type AF8		11	6
VALVE-HOLDERS			
2—Eddystone Frequentite 4-pin valve-holders, type 949 ...		2	10
1—W.B. 7-pin baseboard mounting valve-holder		1	6
3—W.B. 5-pin baseboard mounting valve-holders		3	9
VALVES			
1—Osram X21		18	6
1—Osram S24		12	6
1—Osram HL2		5	6
1—Osram PT2		13	6
BATTERIES			
1—Full o' Power 9-volt grid-bias, type G2.		1	3
1—Full o' Power 141-volt high-tension		14	6
1—Exide 2-volt accumulator ...		10	6
LOUDSPEAKER			
1—W.B. Stentorian, standard cabinet model, PMS2	2	4	6

Wireless Magazine. November 1935

Radio News from Abroad

New Finnish Stations :: French PTT Network Tests :: Radio Normandy to be Rebuilt :: Norway's New Underground Landlines :: Portugal's Regional Scheme :: Russia's Radio News Service

CZECHO-SLOVAKIA

IT is anticipated that the authorities will recommend the installation of a new station near Liberec for the broadcasting of programmes in the German language. The transmitter will be erected on the summit of Mount Jeschken, overlooking the city of Liberec (pre-war Reichemberg).

FINLAND

To replace the small station which relays the Helsinki programmes at Oulu (Uleaborg), the authorities intend to install a 25-kilowatt transmitter to work on 696 metres (431 kilocycles). Another 10-kilowatt relay will also be allotted to Vasa (Nikolaistad), on the coast of the Gulf of Bothnia, but the channel to be adopted is one of the common wavelengths already used by Finland.

FRANCE

Considerable progress has been made in the construction of the new PTT network. The French high-power transmitter at La Brague (Nice) will be brought into operation on 253.2 metres (1,185 kilocycles) in the course of late October or November. Radio Marseilles should be ready by December. Radio Nord (Lille), which has been recently testing, should take over its duties before the end of 1935.

Radio Normandie (Fécamp) has been authorised to transfer its transmitter from the present site to Louvetot, roughly twenty miles inland. The reconstructon of the station will comprise a modern single pylon anti-fading aerial. Further, the Ministry of Posts and Telegraphs has also ordered the removal of Bordeaux-Sud-Ouest to Cenon, to prevent interference the Bordeaux PTT transmitter.

ITALY

The Rome medium- and short-wave stations undoubtedly must now hold the record for the number of languages in which news bulletins and other announcements are broadcast. In addition to Italian, transmissions at times are carried out in the following different tongues: English, French, German, Spanish, Portuguese, Magyar, Croatian, Bulgarian, Albanian, Arabic, Greek, Roumanian and Esperanto !

By JAY COOTE

NORWAY

So far, Vadso, the northernmost broadcasting station, has taken the Oslo radio programmes via wireless link (namely, through the short-wave transmitter at Jeloy). Special underground landlines have now been installed to feed all relays, and the Jeloy station in future will be used for the transmission of the broadcast programmes to listeners overseas.

PORTUGAL

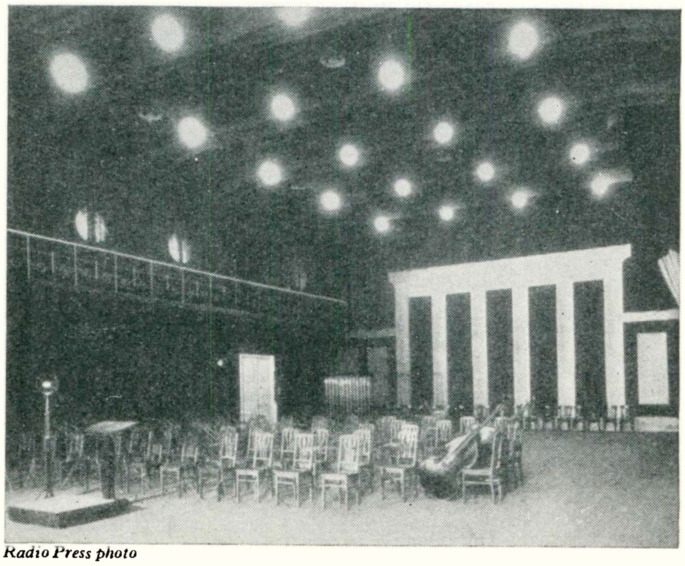
The plan for the reorganisation of the broadcasting system calls for a South Regional station to replace the private one now installed at Parede, in addition to a long-wave transmitter (1,261 metres ; 238 kilocycles). Relays are also to be installed in the Azores and at Funchal, Madeira. With a view to an improvement of the service destined to overseas listeners, the CSL short-wave transmitter will be rebuilt and its power raised to 20 kilowatts.

URUGUAY

Although Uruguay possesses a large number of broadcasting stations, with the exception of CX6 and CX16 in Montevideo—both 10-kilowatters—the majority are of small power ranging from 250 watts to 3 kilowatts. In 1936, however, CX6, working on 461.4 metres (650 kilocycles) will be transformed into a 50-kilowatt station and thus will become one of the most powerful transmitters in South America.

U.S.S.R.

For the supply of official news bulletins to the provincial newspapers, the Soviet authorities are making nightly use of the high-power broadcasters at Moscow and Leningrad until the short-wave wireless stations are completed. At the conclusion of the day's programmes, you may hear these stations calling distant cities such as Kiev, Samarkand, Vladikavkaz, and so on. There then follows a slow dictation of official news paragraphs, the word *stotcka* (comma) appearing at frequent intervals. Russian newspapers are not allowed to print any news other than that supplied through Government sources !



Radio Press photo

Vast broadcasting studios to accommodate the largest of orchestras are being built all over the world. Here is the huge orchestral studio recently opened by the Bucharest authorities

Mains Transformer Faults

Simple Methods of Finding them are explained by GEORGE R. COOPER

This article is specially intended for radio, public-address and relay engineers. It has been assumed that the reader has access to a few simple measuring instruments and possesses a reasonable knowledge of his job, but not a specialised knowledge of transformer construction and design

IT is not often that we are bothered with faults in receivers that can be traced to the mains transformer. However, everyone whose work and hobby bring them into contact with set servicing should have the knowledge to deal with such a fault. Common symptoms calculated to direct one's attention to the mains section of the receiver can be classed as follows.

Common Symptoms

(*a*) Failure of voltage, either high or low tension, when the set or amplifier is switched on.

(*b*) Rectified high-tension voltage found to be above or below the normal level.

(*c*) Transformer running hot.

(*d*) Fuses continually blowing.

Taking these troubles in order, we first have to consider how we can test the transformer if the voltage fails either wholly or on one of the secondary windings. If a multi-range A.C. voltmeter is available the procedure is obvious. If not, it is possible to make such tests with the sole aid of a 25-, 40- or 60-watt lamp.

First Simple Test

Connect any available lamp directly across the terminals of the primary of the transformer and switch on the mains. The lamp should glow to its full brilliance, thus proving that the supply to the transformer is satisfactory. Next connect the lamp in series with the transformer primary (see Fig. 1) and, having removed all the valves from the set under test, again switch on.

Since all valves have been taken out of the set there will be no load upon the transformer and the only current passing through the primary and the lamp will be the " magnetising " or " no-load " current. This may or may not be sufficient to make the lamp glow. The magnitude of this glow is of no importance provided it does not approach the full brightness that would be expected with the supply connected directly to the lamp.

The next step is to short-circuit each of the secondary windings in turn. As this is done the lamp should glow brighter owing to the additional current taken by the short-circuited winding. No harm will be done to the transformer provided the period of the short circuit is brief since the primary current is limited by the series lamp.

If the short-circuiting of a winding or section of a winding (say a centre-tap to one side) produces no sympathetic response in the lamp it will be a sure sign that the winding under observation is not continuous.

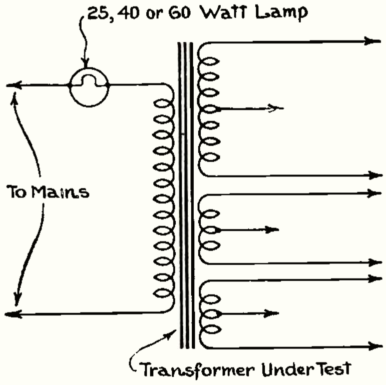


Fig. 1.—Showing an ordinary electric lamp connected in series with the primary winding of the transformer for making simple tests

Naturally, if no glow can be obtained no matter which winding is short-circuited, the probability is that the primary itself is discontinuous.

In the practical application of this test a lampholder will be connected in the leads to the set and the short-circuiting performed at the valve holders. Failing a satisfactory result the short-circuiting can be repeated at the transformer terminals and thus a disconnection in the receiver wiring may be detected.

Simple Test Gear

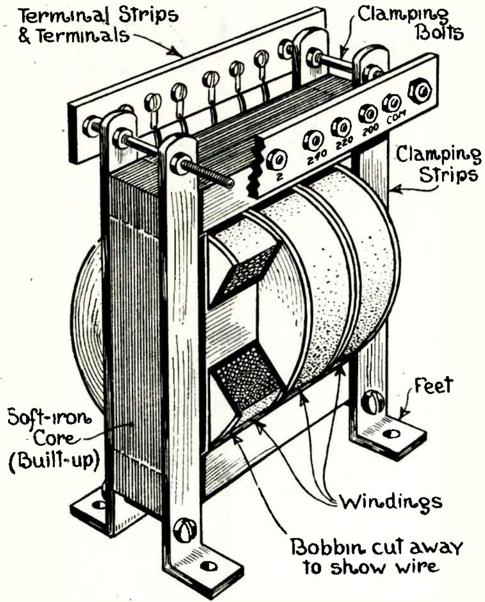
Coming now to symptom (*b*), the low-tension voltage does not usually give cause for doubt, but there are occasions when the high-tension supply is mysteriously at variance with the anticipated value. Again a multi-range A.C. voltmeter will decide the accuracy of the voltage delivered by the transformer H.T. winding, but if this is not available a reliable figure can be obtained by using the " hook up " shown diagrammatically in Fig. 2.

Inspection will show that this consists of the normal rectifier connections up to the first 4-microfarad reservoir condenser across which is connected a high-resistance D.C. voltmeter of suitable range. When the rectifier valve has become fully warm the voltmeter reading will be 1.4 times the R.M.S. voltage of the high-tension secondary.

Maximum Error

Each half of the winding can be tested by disconnecting in turn at the points X and Y. The two readings so obtained should be identical, but a maximum error of 2½ per cent can be tolerated, in which case the higher value should be the same as that obtained with both halves of the winding connected.

As already implied the D.C. voltmeter reading must be divided by 1.4 to give the R.M.S. value of the A.C. voltage. To obtain accurate results it is essential that the voltmeter resistance should be high, say 200 ohms per volt or greater. At first sight it would appear that if the valves were removed from any receiver the above test could be performed by connecting the voltmeter across the reservoir condenser without in any way disturbing the wiring. Theoretically this is true, but since the voltage developed across the condenser will be 1.4 times the transformer voltage it may be found that this value exceeds the safe voltage that can be applied to the



Some idea of the constructional layout of an ordinary mains transformer can be gained by study of this simple diagram

condenser, especially if electrolytic types are used.

Manufacturer's Fault

In the event of a transformer winding being found to give a voltage that is not consistent with the maker's rating it can be accepted that an error has been made in the manufacture and that the variation is not due to short-circuited turns. If sufficient turns were short-circuiting to give a pronounced change in the output voltage the overheating of the transformer would be the first thing to cause alarm.

Overheating

The latter remark leads us naturally to the consideration of symptom (*c*) and before dealing with the causes of overheating we must decide what is to be regarded as an unduely high temperature. If a number of identical receivers are tested and the transformer of one of them runs hotter than the others there can be no doubt that something is amiss ; but if an isolated receiver is under review it may not be so simple to state definitely whether the transformer is running at a normal heat or not.

The safe temperature rise for the usual commercial transformer is 45°.C above surrounding air temperature. This figure is such that the highest temperature likely to be encountered in use will not be sufficiently high to cause deterioration of the insulating materials employed.

It must be carefully noted that it is the temperature rise of the copper winding that is important and unfortunately this is by no means the same as the temperature rise of the outside surface of the transformer. The centre of the windings is the hottest part and the temperature slowly falls off towards the surface of the windings. The larger the transformer the greater will be the divergence, hence a small transformer can run with a higher surface temperature than a large transformer. Vaguely one may say that in the case of a transformer of the 250-0-250 volt 60-milliampere type with 20 watts low-tension the surface of the windings can with safety feel almost uncomfortably warm to the hand. One should be able to hold the hand firmly pressed to the windings and have the sensation that if they were a little hotter the position would be uncomfortable.

With a larger transformer, say of the 500-0-500-volt 120-milliampere type with 56 watts low-tension the surface of the coils should not rise above a very comfortable hand temperature and with no suspicion of a burning sensation.

It is not generally appreciated how long a mains transformer takes to reach a temperature approaching the maximum value. This period depends upon the size and the curves given in Fig. 3 show the temperature rise plotted against time for the two types of transformers already mentioned. It will be seen that a minimum run of about two hours is required to obtain a satisfactory indication.

Excluding faulty design and use on wrong voltage or periodicity, the causes of overheating may be, (1) excessive difference between the D.C. currents in the two halves of the high-tension winding, (2) overloading on one or more secondaries, (3) short-circuited turns within the windings.

Item (1) can be checked by connecting a milliammeter in the two anode leads of the rectifying valve. The readings obtained should be identical but a difference of up to 10 per cent is not serious. Should the difference exceed this limit it is a good plan to reverse the transformer connections to the two anodes. If the test be repeated and the same anode gives the lower reading it will be clear that the rectifying valve is faulty.

Electrical Centre Tap

If, on the other hand, the reversal of connections causes the lower reading to change from one anode to the other one can deduce that the transformer high-tension centre tap is not at the electrical centre and there is no alternative but to reject the transformer.

Turning to item (2) the currents being drawn from the various windings should be checked and compared with the rated output of the transformer. The high-tension is the most usually abused winding and many do not realise how great an overload can be caused by an increase of only a few milliamperes. For example, if a transformer rated to give an H.T. current of 60 milliamperes is overloaded to 70 milliamperes the percentage increase is 17. The heating effect of the current in the winding varies as the square of the current, hence the high-tension winding will develop 36 per cent more heat than with the normal load.

Owing to the "square law" the life of all electrical apparatus is greatly reduced by the application of a relatively small continuous overload and, conversely, to underload slightly is to add considerably to the margin of safety. If after satisfactorily checking items 1 and 2 the trans-

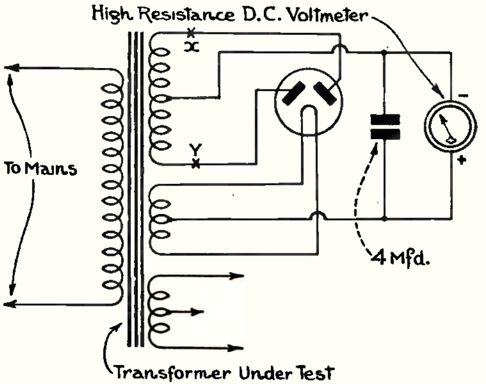


Fig. 2.—An arrangement for measuring the high-tension output from a mains transformer. The voltmeter reading is 1.4 times the R.M.S. voltage of the high-tension secondary winding

former under suspicion still runs abnormally hot it may be due to short-circuited turns in one of the secondaries.

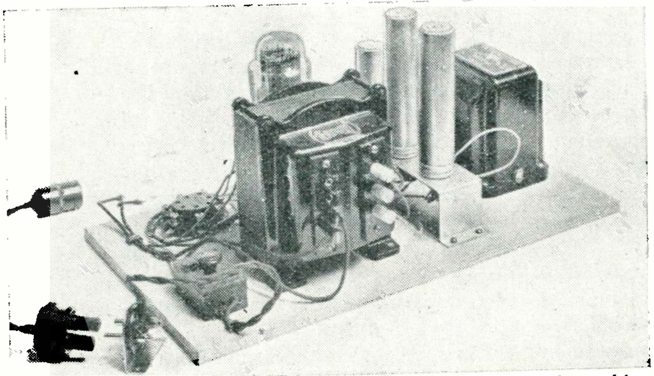
Here again the high-tension winding is the more usual offender. Unfortunately there is no quick and simple test that can be made to decide the point at issue. If many turns were short-circuiting the overheating would be sufficient to burn the insulation and cause smoke to be emitted.

Detecting the Hot Spot

Hence in the case of overheating, short of actual burning, the number of turns involved will be small and a careful check of output voltages would fail to give a conclusive result. Probably the only test which can be performed without special apparatus is to disconnect all secondaries, switch on the mains to the primary and leave the transformer on no load for two or three hours. If the transformer is in order the "magnetising" or "no-load" current will not be sufficient to cause any appreciable heating of the windings, but if short-circuited turns are present the coils will gradually warm up and a local hot spot can usually be detected after several hours.

We are now left with symptom (*d*) which covers the continual blowing of fuses when the set or amplifier is switched on. In a case of this sort there are reasons why it is best to take the transformer out of the set and to test it apart from the associated circuits.

First inspect it thoroughly for any obvious short-circuiting between the external wires and then connect it to the mains with a lamp in series as illustrated in Fig. 1. The mains can now be switched on and if the transformer is short-circuiting internally the lamp will glow to its full brilliance. If this proves to be the case the test is concluded, but as likely as not the lamp will glow but dimly indicating that disconnecting the transfomer has removed the short circuit. The latter event does not prove that the trouble was in the associated circuits as a few moments reflection will show.



Constructors will find the simple test methods described in this article of great value should their sets go wrong. Builders of the Harris 1935 A.C. Radiogram have an ideal subject in their mains unit on which to experiment with the simple methods described

If the insulation between the high-tension or a filament winding and the core is faulty a section of the winding will be short-circuited when the centre tap is connected to earth although the fault may not be apparent while the C.T. is not earthed.

All possibilities will be covered if the insulation between the windings and core, and between each winding and the remaining windings, is tested. This must be done with a high voltage at least comparable with the voltage the insulation is called upon to withstand in operation.

Fortunately no additional apparatus is required. The full high-tension winding will provide the required voltage and the series lamp will serve as the indicator. All that has to be done is to connect one side of the H.T. winding to the core and (leaving the H.T. centre tap free) the other side to each of the remaining windings in turn. The procedure is to switch off the mains while connection is being made and then switch on momentarily.

If one of the windings is shorting to the core the H.T. will obviously be short-circuited and this, in turn, will cause the series lamp to glow more brightly when the mains are switched on.

The primary winding must be tested similarly to the others but greater care should be taken. One side of the mains will most certainly be earthed and therefore the full high-tension voltage will be applied to the core of the transformer. This makes it imperative that the transformer should be placed upon a non-conducting surface (wooden bench, table or even a stout cardboard) and under no circumstances should the transformer be touched while the mains are on.

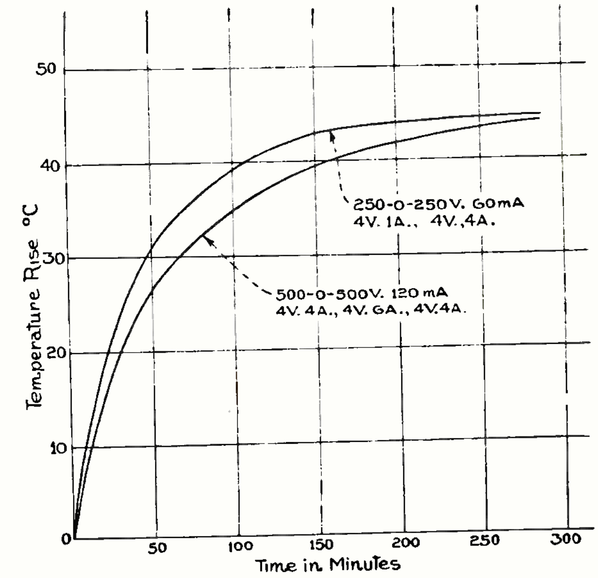


Fig. 3.—Showing the temperature-rise curves of two typical mains transformers. Note that the smaller transformer reaches its maximum temperature more rapidly than the larger one. The temperatures plotted are those of the innermost (hottest) section of the windings

From this stage it is a simple step to test the insulation between each of the windings. Connect one side of the H.T. winding to any selected L.T. winding and connect the other side of the H.T. winding to each of the remaining windings in turn, observing the effect on the series lamp.

One must not lose sight of the magnitude of the voltage being handled in the above test. In the case of a small 250-0-250-volt transformer the test voltage will be 500, while in the case of a large 500-0-500-volt type the test voltage will be 1,000. Great care should be taken to avoid a shock, but

(*Continued on page* 270)

Compiled by JAY COOTE

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

***Call* 12RO3 12RO4**

ROME (Prato Smeraldo)

(*Italy*)

***Metres* 31.13 25.42**

Kilocycles 9,637, 11,801: Power 20 kw., 20 kw.

Geographical Position: Approximately 12° 14′ 00″ E.; 41° 42′ 00″ N.
Distance from London: Approximately 880 miles.
Standard Time: Central European (G.M.T. plus one hour).
Languages: Italian (and at different times, Spanish, Portuguese, English, French, German, etc.).
Announcer: Woman.
Call (phon.): "Eh-yah (E.I.A.R.) Radio Roma."
Times of Transmission (G.M.T.): 12*RO*4—daily, 13.15-14.00, for East Africa; 14.15-15.15, for Far East; 17.00-18.00, for East Africa; 17.45-22.15, omnidirectional. Monday, Wednesday, and Friday, 23.00-00.30, for U.S.A. Tuesday, Thursday, and Saturday, 00.30-02.00, for South America. 12*RO*3—Sunday, 00.45-02.15. Monday. Wednesday, and Friday, 23.00-02.00, for America. Tuesday, Thursday, and Saturday, 00.30-02.00, for South America.
Special news bulletins given in English, G.M.T. 21.00-23.00.
Occasionally the above channels are used for special relays from the medium-wave Rome station.
Closes down with Puccini's *Hymn to Rome.*

***Metres:* 34.29**

HONGKONG (ZCK3)

(*China*)

***Kilocycles:* 8,750**

Power: 0.5 kw.

Geographical Position: 114° 10′ 42″ E.; 22° 18′ 30″ N.

Distance from London: Approximately 5,970 miles.

Standard Time: G.M.T. plus eight hours.

Announcer: Man.

Language: English.

Call: "This is station ZCK3 at Hong Kong, relaying a programme from ZBW" (medium-wave station).

Times of Transmission (G.M.T.): 09.00-15.00 or 16.00 daily.

Weather report and time signal given at G.M.T. 11.00.

Closes down with "That concludes the day's programme from the Hong Kong broadcasting station ZBW, on 34.29 metres (8,750 kilocycles). Good-night, listeners; good-night."

***Metres:* 36.5**

QUITO (HCJB)

(*Ecuador*)

***Kilocycles:* 8,214**

Power: 250 watts.

Geographical Position: 78° 32′ 00″ W.; 0° 13′ 00″ S.

Distance from London: Approximately 5,730 miles.

Standard Time: G.M.T. less five hours.

Languages: Spanish and English.

Announcer: Man.

Opening Signal: *March Patria* (record).

Call: "HCJB, Lar Voz de los Andes." (In English: "HCJB, H as in Harry, C as in Chicago, J as in Jones, B as in broadcast.")

Interval Signal: Four notes on gongs.

Times of Transmission (G.M.T.): 00.30-02.45 daily (except Monday).

Closes down with Ecuador National Anthem.

***Metres:* 48.94**

HAVANA (COCD)

(*Cuba*)

***Kilocycles:* 6,130**

Geographical Position: 82° 32′ 00″ W.; 23° 08′ 30″ N.

Distance from London: Approximately 4,610 miles.

Standard Time: G.M.T. less five hours.

Languages: Spanish, English, and French.

Announcer: Man.

Call: "You are listening to station COCD on 6,130 kilocycles."

Times of Transmission (G.M.T.): 22.00-06.00 daily.

Closes down with *Smoke Gets in Your Eyes* (record), the words 'Buenos Noches and good-night," followed by record of *Good-night, Song* (Ted Lewis' band).

MAINS TRANSFORMER FAULTS—*Continued from page 269*

no fear need be entertained for the insulation of the transformer. A good commercial product should stand a test pressure of 2,000 volts R.M.S. without danger of breakdown.

To conclude, a few notes concerning the magnitude of the primary current in a transformer on no-load and full-load will be given. The no-load current depends upon the physical dimensions of the core and the flux density at which the iron is operated. Unless one possesses a knowledge of design a measurement of the no-load current would be quite meaningless; it may be anything from 10 to 50 per cent of the full-load current.

The current passing through the primary when the transformer is delivering its normal load is a fairly definite figure and a comparison between the measured value and the calculated value forms a useful check.

The first step in the calculation is to determine the total volt-amperes or apparent watts. In the case of the low-tension windings it is the sum of the products of the volts and amperes delivered by each winding. The high-tension windings are rather more difficult and only an approximate value can be deduced; this is given by the product of the direct current delivered to the set and the A.C. voltage of one half of the transformer H.T. winding plus 50 per cent.

By adding the figures for the L.T. and the H.T. windings we obtain the total output volt-amperes and to this must be added a further 10 per cent to allow for the efficiency of the transformer. To obtain the primary current in amperes it is necessary to divide the volt-amperes by the mains voltage. Two examples will serve to illustrate :—

Example 1: Transformer delivering 250-0-250 v. 60 ma., 4v. 1 amp., 4v. 4 amp.

L.T. V.A. $=(4\times1)+(4\times4)=4+16 =20.$

H.T. V.A. $=(250\times.06)+\left(\frac{250\times.06}{2}\right) =15+7\frac{1}{2}=22\frac{1}{2}$

Total V.A. output $=20+22\frac{1}{2}=42\frac{1}{2}$

Total V.A. input $=42\frac{1}{2}+10\% =47$ say.

Primary current on 200-volt mains $=\frac{47}{200}=.23$ ampere approx.

Primary current on 250-volt mains $=\frac{47}{250}=.19$-ampere approx.

Example 2: Transformer delivering 500-0-500 v. 120 ma., 4v. $2\frac{1}{2}$ amp., 4v. 8 amp., 6 v. 2 amp.

L.T. V.A. $=(4\times2\frac{1}{2})+(4\times8)+(6\times2) =10+32+12=54$

H.T. V.A. $=(500\times.12)+\left(\frac{500\times.12}{2}\right) =60+30=90$

Total V.A. output $=54+90=144$

Total V.A. input $=144+10\%=158$

Primary current on 200-volt mains $=\frac{158}{200}=.79$ ampere approx.

Primary current on 250-volt mains $=\frac{158}{250}=.63$-ampere approx.

Between Ourselves

Broadcatcher's Monthly Gossip on Radio Topics that Matter

One of the great advantages of having a radiogram with an automatic record changer is that after loading one can sit down to a thoroughly enjoyable half-hour of recorded music chosen by yourself. This happy-looking group is using an H.M.V. 33-guinea autoradiogram

LAST month I mentioned that the American Naval Department had been conducting a very promising series of experiments with a ray projector that enabled targets to be picked up by an invisible beam in the darkness. I am very glad to see that a British inventor, Commander P. McNeil, has produced something which is at least as good, if not actually better.

The McNeil apparatus makes use of an infra-red beam which has the property of penetrating fog, falling snow, or even smoke screens with the greatest of ease. It is stated by experts who have witnessed demonstrations that detection is instantaneous, that is to say there is no lag between the finding of the target and its becoming visible to the eye.

The worst of inventions is that they are so apt to be turned to warlike purposes. This one has even more important peaceful applications. By means of the apparatus, ships can locate one another when fogbound, and only those who have been at sea in foggy weather on one of the big shipping routes can realise what this means. It is the most difficult and deceptive business in the world to get the approximate bearing of another ship in thick weather when the sound of her syren is the only guide.

Seeing Through Clouds

Still more wonderful, navigators may no longer be prevented by fog or overcast skies from obtaining their exact position by means of the sextant. Though it is invisible to the human eye, infra-red beams can enable the sun to be " spotted " and bearings taken.

What a marvellous aid to seamen the thermionic valve has proved itself—or perhaps instead of the thermionic valve I should say the vacuum tube, which was the parent of all valves. Even before these infra-red ray inventions, the wireless set enabled the mariner to rise superior to the vagaries of his chronometers, since he could receive minutely accurate time signals from the world's big transmitting stations.

Short-wave directional wireless makes it possible for him to ascertain his position, no matter what the weather may be, when he is nearing land and not a few of the world's great harbours now have in operation radio guides which are infallible pilots in the worst of weather.

Aircraft, Too

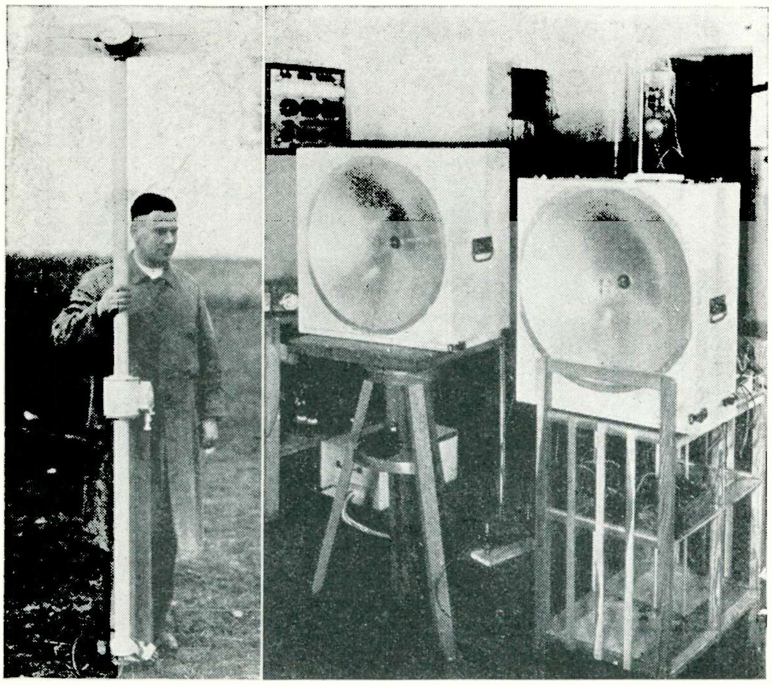
It is not the least exaggeration to say that but for wireless the great air routes of the world could never have been developed as they have been. By means of wireless the air pilot on a long-distance flight is kept constantly in touch with the weather conditions he is going to meet. No matter how poor the visibility may be, he can always ascertain his approximate position by calling up the ground stations.

How this is done you may discover, if you don't know already, by listening for a short time to transmissions from the airports of this country on the next misty day. The pilot calls, asking for his position. He is asked by the airport operator to transmit for some seconds on receiving the signal to do so. Meantime, the airport operator gets into touch with a second aerodrome some distance away and requests his opposite number to bring his direction-finding apparatus into use.

How Aeroplane Bearings are Taken

Each operator takes the bearing of the aircraft and in a matter of seconds the cross bearings are plotted on a large-scale map. The pilot is then told just where he is and full instructions are given to ensure a correct course and a safe landing.

The big feature of this year's wireless sets is the



Telefunken, a leading German radio manufacturing concern, has just marketed a transmitter and receiver for working on the extremely low wavelength of 10 centimetres. Our illustration on the left shows the receiving aerial at the top of its special stand and on the right the beam transmitting aerials behind which is the actual transmitting gear

wonderful diversity of "boiled-down" superhets—sets I mean which, though true superhets, contain no more than three purely wireless valves. When it first made its appearance the superhet was definitely a multi-valve set. The minimum outfit, in fact, appeared to be about seven valves. These were: first detector, oscillator, first and second intermediate-frequency amplifiers, second detector, first low-frequency and output. And that, mind you, was for a set without automatic volume control. If you wanted a preliminary high-frequency stage the total of valves was increased to eight; automatic volume control (unless you used a Westector) brought it up to nine; and if any kind of push-pull output were desired the total rose to ten.

The three-valve superhet of today is probably at least as efficient as its seven-valve counterpart of a few years ago as regards selectivity and sensitivity, and very much more efficient, if well designed, in the matter of second-channel suppression. The overall amplification given by present "portmanteau" valves is, in fact, so great that a second intermediate-frequency stage would hardly be usable. Modern valves can perform so many different functions at once, and perform them really well, that astonishing things can be done with a mere trio.

There is, of course, a fly in the ointment, as there usually is with anything in wireless that appears to be giving you something for nothing. The multi-electrode valve is not cheap, and if it should break down you may have a striking instance of the truth of the old saying about putting a multiplicity of eggs (for eggs, read electrodes) into one basket (for basket, read bulb).

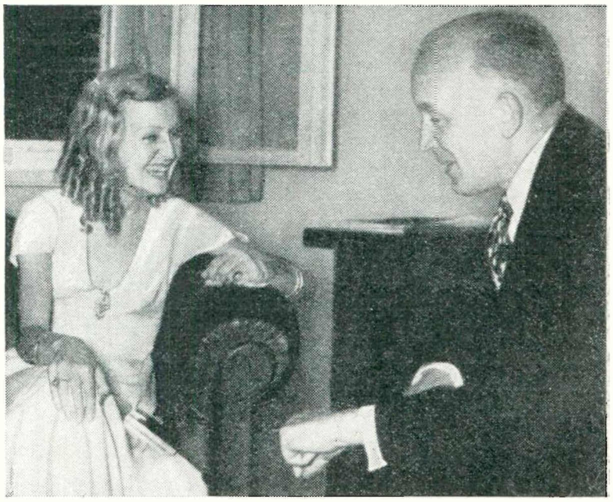
Variable Selectivity

Variable selectivity has been hailed as one of this season's great discoveries. It isn't, of course, anything so novel as all that, for those of us who built single-valve sets in the just-post-crystal days had, thanks to our reaction coils, variable selectivity whether we wanted it or not. The same thing applies very much to any kind of straight set today, so long as it is of the regenerative type, as 99.999 per cent of straight sets are.

Anyone who was brought up on the straight set knows from experience that you will always get far better quality from the local station when the reaction coupling is made as weak as it can be, than from a distant foreign station when it has to be tightened up almost to the point of oscillation in order to cut out some interfering transmission. Stations whose field strength is so great that they do not require much reaction come in nearly as well as the local; but the smaller fry are always lacking in "top" when the straight set is being worked close to its maximum selectivity.

The reason is that the more you increase your selectivity the smaller you make the *audio*-frequency band to which the set can respond. Hitherto, the majority of superhets have been provided with fixed selectivity, which had to be of a rather high order to make it possible to separate all kinds of stations from one another on the medium and long wavebands.

It followed naturally that the set of this class that would separate say the London National from Horby did not give you the best possible quality from the former. Variable selectivity, which is a feature of many of the medium-priced superhets this year, allows you to give the local station its full fling—with admirable results upon the quality of reproduction—and yet to make the tuning knife-edged when the need arises to separate two stations on neighbouring wavelengths. A really big advance that is well worth the extra cost.



Mr. Royal, Programme Director of the National Broadcasting Company of America, has been touring Europe to gain first-hand information of the many different methods of programme presentation. Here he is seen with Miss Lilian Harvey, the famous film actress

From correspondence in the lay papers, as well as from personal experiences, I gather that the nuisance of the too-loud loudspeaker is on the increase. Few of those who offend probably realise that they are doing so, or have any conception of the suffering that they inflict upon their neighbours. The other evening, when I was at the house of some friends, the noise from the next-door speaker was so nerve-racking that the choice lay between closing the windows and suffocating—it was a very warm evening—or leaving them open and having one's ears continually jarred.

The worst of it is that you can't sit and listen to speech or music that comes to you in this way owing to the frightful distortion that usually occurs at some distance from the loudspeaker. In this particular instance, nothing could be heard but continual loud and distressing " woomphs," whether speech or music was coming through.

Do, I beg you, have a little thought for your next-doors. It is no bad thing when your set is turned on at about the volume that you usually employ to take a walk outside your house and see at what distance it is audible. If it can be heard a long distance away a reduction of the volume is called for. " Live and let live " is a pretty useful motto.

Limiting Output

I have heard of one or two cases of people enamoured of very great volume who were positively abusive when approached by their neighbours with petitions for a little less of it. This kind of thing is pretty bad. If you have unwittingly erred on the side of over-great volume and a polite hint is conveyed, do remember that few people make complaints of this kind without justification. Why not go into the other man's house, leaving your own set switched on, and hear for yourself what he has to put up with ? A little sweet reasonableness of this kind goes a very long way and usually matters can be settled amicably.

On the other hand, should you be a sufferer whose plaint provokes no friendly response from the offending neighbour, your position is rather a difficult one as the law now stands. In many towns and rural districts there is a by-law to the effect that anyone causing a nuisance by barking dogs, noisy loudspeakers, and so on, must abate the said nuisance within fourteen days on receiving notice to do so signed by three householders. This is all very well so long as there *are* three householders affected *and* you can get them to sign. Too often, only one household suffers and short of applying at vast expense for an injunction in the High Court there is no legal redress.

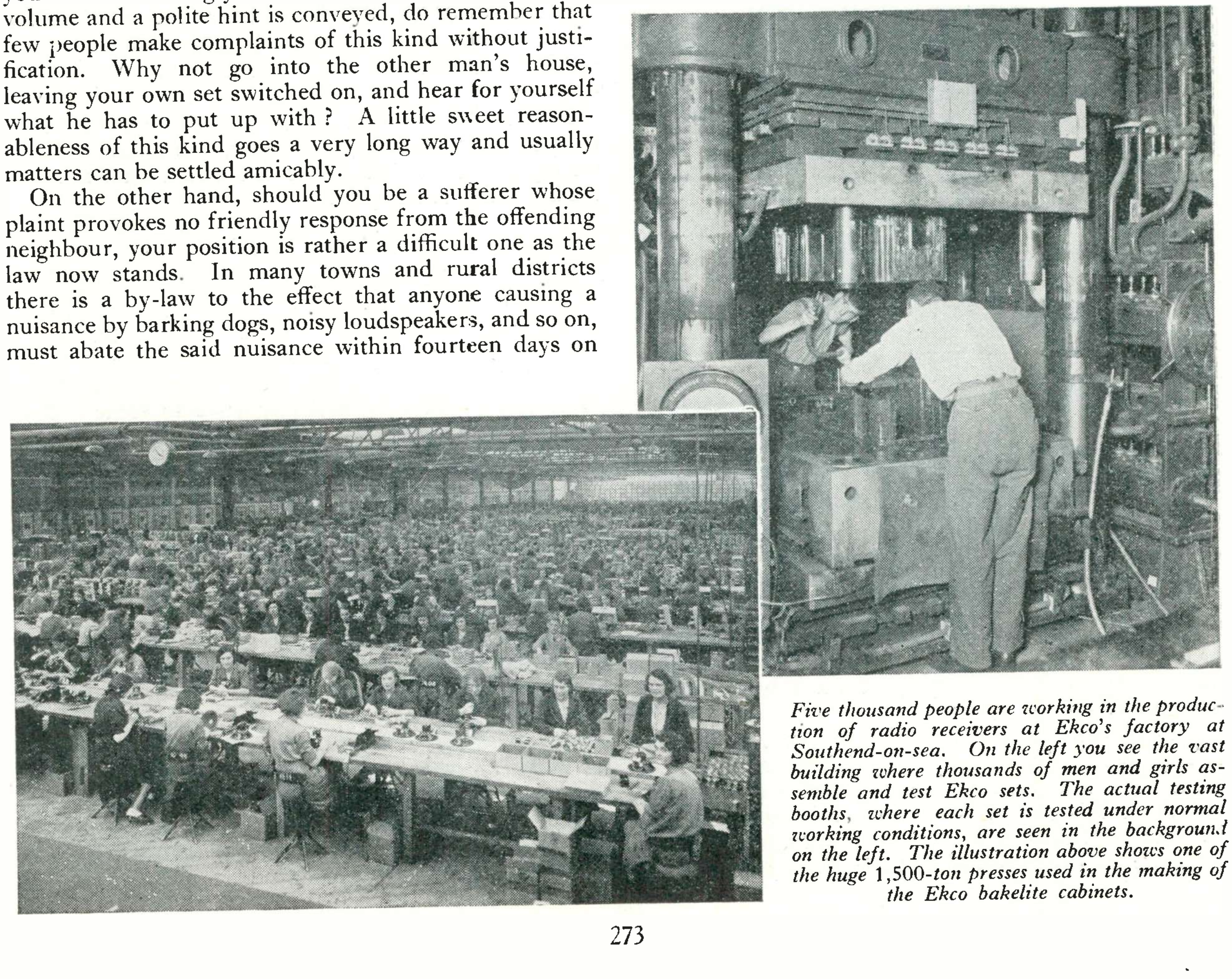
In France there is a movement on foot to limit the output wattage of receiving sets in private houses. The proposal has been sympathetically received by the authorities and something may come of it. Myself, I should be sorry to see any such legislation in this country, but if it does happen, those who make nuisances of themselves will be entirely to blame.

Weak Points in Receiving Sets

Anyone who is concerned with servicing wireless sets will tell you that a large proportion of breakdowns are due to absurdly small causes. A chain is proverbially only as strong as its weakest link and some ridiculous fault may suffice to put an umpteen-valve set entirely out of commission for the time being.

Here is a case that I came across recently. The set was a brand new one of first-rate make and one had only to glance at its " works " to see that it was a really sound job. It was, however, completely silent, except for barely audible hum, when plugged in to the lighting mains and switched on.

That fault might have taken a long while to locate if a happy inspiration had not made me look at the jack into which a pick-up plug can be inserted. With the pick-up not in use the jack should be closed, thus allowing



Five thousand people are working in the production of radio receivers at Ekco's factory at Southend-on-sea. On the left you see the vast building where thousands of men and girls assemble and test Ekco sets. The actual testing booths, where each set is tested under normal working conditions, are seen in the background on the left. The illustration above shows one of the huge 1,500-*ton presses used in the making of the Ekco bakelite cabinets.*

impulses from the plate of the previous valve to reach the output stages. The points of the jack were clearly in contact with one another and the pressure of the spring blades was ample. But tests showed that though those points were firmly pressed against one another there was no *electrical* contact between them. A minute piece of dirt had made its way in, its presence sufficing to put the set entirely out of action. When the points were cleaned all was at once well.

Jacks, as a matter of fact, are things which can cause quite a bit of trouble at times. Generally, they are so completely satisfactory that one hardly bothers about them when making a first examination of a set that won't function. But just once in a way the sort of thing that I have described takes place, giving rise sometimes to the most mysterious symptoms. It is not a bad rule when a broken-down set contains a jack to look this component over carefully at an early stage of the proceedings.

Volume Controls, Too

Another component that can make itself very unpleasant at times is the volume control of the variable high-resistance type used to regulate the input to the low-frequency department of the set. A few weeks ago, I was able to show a worried friend that the misbehaviour of an erstwhile most satisfactory receiver was due entirely to the packing up of the volume-control potentiometer.

During Jubilee Year H.M.V. is presenting to all purchasers of one of its radiograms an album containing three classical records. Here you see a corner of the Hayes factory where the records are being packed into very attractive albums

Usually, when this kind of thing happens, there is an infallible premonitory symptom; crackles, grating noises, and bangs come from the loudspeaker as the volume control knob is turned slowly from minimum towards maximum. The aforesaid crackles, grating noises, and bangs are conclusive proof that the moving arm of the component is failing to make proper contact at certain points of its travel over the resistance element.

But in this case there was nothing to speak of in the way of crackling, grating, or banging. What happened was that when small volume was exceeded the set began to squeak and howl like a lost soul. Suspecting that the volume control *was* to blame, I suggested extracting it and replacing with another. The effect was magical, the set resuming at once its former good behaviour.

Berlin Steals a March

The Germans can certainly award themselves a pat on the back for having left us standing in television developments, and we may award ourselves something stronger than a pat and applied rather lower down for having allowed them to do so. Since the Spring the Germans have had an 180-line television service in operation from Berlin and from a relay station in the Brocken Mountains. At the Berlin Wireless Exhibition a special feature was made of television.

Within the next few months a telephone-cum-television service will be available between Berlin and Leipzig. So far, Germany has not gone beyond 180 lines, except for experimental purposes; but the odds are that as she develops her country-wide services she will jump straight from this to 320 lines.

Meantime, what are we doing? After months of delay, the Alexandra Palace was chosen for the London television station and at least a further six months will be needed before this station comes into action. There was no television display at Radiolympia and there are no regular transmissions on the ultra-short waves available for experimenters or for the research departments of the many manufacturing firms which should shortly be turning out television receivers. Is it good enough?

Had it not been for red tape and the unprofitable and exasperating "exploring of avenues," we could have had a temporary television service in the London area from the beginning of this year.

Good-bye, 30 Lines

The B.B.C. has decided to bring its 30-line television transmissions to an end, and I cannot myself feel that many tears will be shed over this. Though they were interesting up to a point to the experimenter, these transmissions have never had the smallest real entertainment value, and they probably were to some extent harmful by causing the man in the street with no technical knowledge to invest in 30-line apparatus in the belief that it would give him all that was going at the moment and could subsequently be converted for high-definition reception. Of course, no such conversion is possible, though the terminals of the old set might come in handy, like the laces of the boots that the tramp took to the cobbler for repair.

What worries me is that the B.B.C. should close down the 30-line transmissions without offering us anything in their stead until about next March. I know that the Baird station at the Crystal Palace could take on a temporary service at short notice, and I understand that the E.M.I. people have a complete outfit in working order at Hayes.

Why shouldn't we have short programmes once a week from each of these stations in the meantime to keep us and our interest going?

The A.B.C. of Automatic Grid Bias

A Very Simple Explanation

By G. P. KENDALL, B.Sc.

The grid-bias arrangements of the modern mains receiver constitute one of its most important details, yet to many people they are by no means easy to understand or to work out in practice to meet the needs of a given case. This very clear explanation should enable anyone to get a real grasp of the subject and calculate his bias resistances with ease

WHEN the trick was first performed there seemed to be something rather magical about making a valve provide its own grid bias, and the slight air of mystery associated with the process has persisted to this day. If one may judge by readers' letters, quite a number of people find the subject rather difficult to understand, although, as I hope to show, it is really a perfectly straightforward affair if one can manage to forget all the misleading names that have been given to it.

Misleading Names

Such terms as " free grid bias," " self bias," and so forth, are really responsible for most of the difficulties; if we had called it quite simply " mains bias," we should probably have found it no more troublesome to understand than " mains H.T."

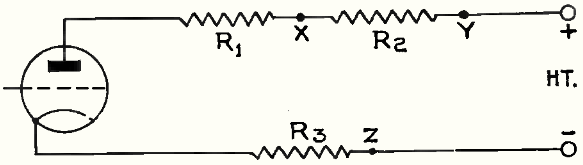
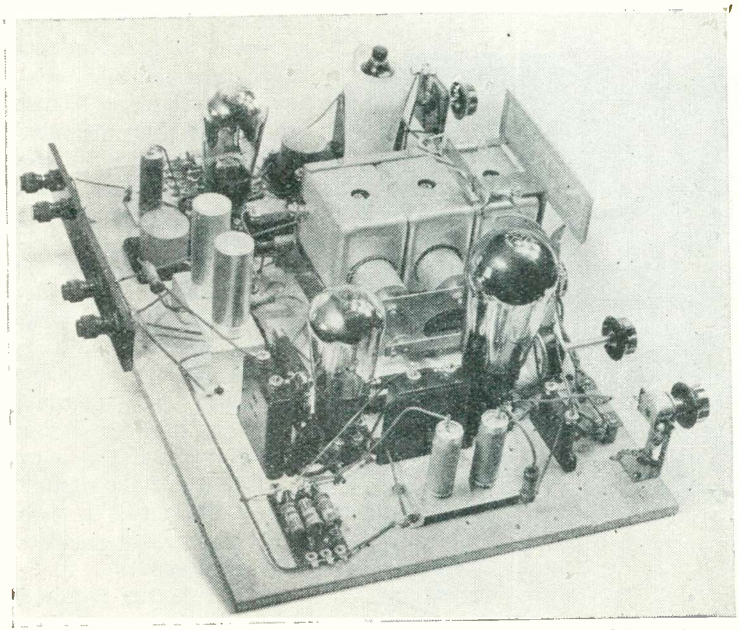


Fig. 1—This simple little circuit is all you need to understand the basic principles of mains bias

That, after all, is precisely what it is, so let us try looking at it in that light. We do not find any difficulty in grasping the idea that by inserting resistances in series in the positive high-tension lead to a valve or group of valves we can tap off various *positive* voltages; surely, then, it is not hard to understand that we can obtain *negative* voltages by placing resistances in the *negative* high-tension lead ?



An example of the modern type of mains receiver in which the bias resistors are by-passed with very large capacity electrolytic condensers (actually the 1935 *Radiogram, described by the Editor in the April issue)*

Instructive Analogy

Looked at in that light it becomes obvious that the bias obtained in this way is *not* " free," since it is merely a part of the available high-tension voltage, nor is it any more " automatic " than the anode voltage derived from the same source. We don't talk about " automatic high tension " when we tap off a lowered anode voltage for a particular valve, so why should we speak of " automatic " bias?

Then again, painstaking but mistaken persons have endeavoured to " simplify " the matter by offering some such explanation as this: " There is a voltage drop across the bias resistance which makes the cathode positive with respect to earth. Since the grid is connected to earth, that means that the cathode is made positive with reference to the grid also. If the cathode is positive to the grid, the grid must be negative with respect to the cathode." All quite simple to anyone accustomed to this negative-positive jugglery, but just a string of words that don't mean anything to everyone else!

Really Very Simple !

It is all so unnecessary, too, for there is a much simpler way of dealing with the business. Just look at Fig. 1 and note the presence of sundry resistances in both the negative and positive high-tension leads to the valve depicted therein.

Start at the anode of the valve and proceed towards high-tension positive; on the way you will come across R_1 and R_2, and there will, of course, be voltage drops across each because the anode current of the valve is passing through them. Observe point X; this is farther along towards the high-tension positive than the anode of the valve and therefore the voltage drop across R_1 will be such as to make this point more positive than the anode. Similarly, point Y will be still more positive, and will actually be positive with respect to X.

Exploiting Resistance Drops

Next look at the lead from the cathode of the valve to high-tension negative. Here there is the resistance R_3, again with a voltage drop across it because the anode current is making its way through to get back to the cathode. Since point Z is electrically nearer to high-tension negative it is evident that this point must be more negative than the cathode. If there were no resistance here the cathode would be at the same potential as high-tension negative, but with the resistance we establish the point Z, which is more negative than the cathode, by the amount of the voltage drop across R_3.

Here we have obviously got the essentials of a grid-biasing scheme. Suppose we connect the grid circuit return (bottom end of transformer secondary or grid leak) to point Z; inevitably we shall thereby make the grid negative with respect to the cathode by the amount of the voltage drop across R_3.

This voltage is manifestly controllable by adjustment of the value of R_3, and so we can apply any desired amount of bias quite simply. Moreover, if we know the correct working anode current of the valve we can calculate the proper value of R_3 to produce a given bias very simply with the aid of nothing more formidable than Ohm's Law.

Adding an Earth

Nothing very abstruse about all that, is there? I think the difficulty really comes in when one tries to convert the elementary circuit of Fig. 1 into something practical, because it then becomes necessary to add an earth connection somewhere and this is apt to create confusion if we don't keep a tight grip on our commonsense; it is only too easy to be led off into that labyrinth of positives and negatives in which the abstract theory merchants love to wander.

For a start, imagine the earth joined direct to the cathode of the valve. That, surely, cannot cause us any trouble, for it can obviously make no difference to our voltage-dropping and biassing system when in *that* position.

Unfortunately that's just where we must *not* put the earth connection if we have more than one valve in the receiver; in all normal multi-valve circuits the earth must be put on the high-tension negative line, and that is what seems to cause all the confusion of ideas. The negative line is then to be regarded as being at zero potential, and there is some temptation to start all that " positive cathode " business again.

All the same, there is no need to go wandering up that particular garden path unless we want to do so. Look at it this way: We have already made up our minds that the voltage drop across R_3 results in the application of a negative bias to the grid simply because the grid circuit return is connected to the point Z; very well, then, how can the addition of an earth connection to *any* single point on the circuit make any difference to the voltages *between a pair of points* therein? The answer is that it cannot, and the whole question is entirely irrelevant; it makes no difference to the bias system *where* the earth is connected.

In practice, then, all that we do is to place a suitable resistance in series with the lead from cathode to earth (high-tension negative, in other words) of each valve, and take advantage of the voltage drop set up across the resistance by the anode current as it makes its way through on its journey back to the cathode.

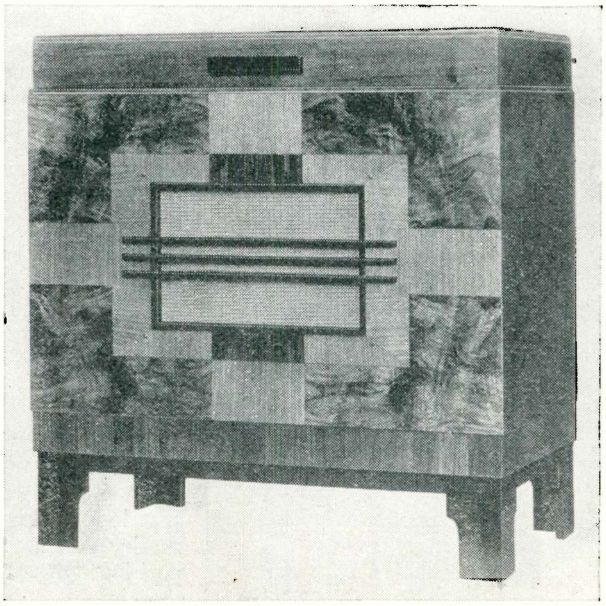
Providing a By-pass

To avoid undesired effects we almost always place a condenser in parallel with the resistance to act as a shunt path for the alternating part of the anode current. The value of the shunt condenser naturally depends upon the frequency of the currents we desire to by-pass; for high-frequency currents a comparatively small capacity will serve, and .1 microfarad is the more or less conventional value.

Low-frequency currents, on the other hand, require a much larger capacity to provide effective by-passing; at one time we had perforce to be content with about 4 microfarads, but now that the electrolytic principle has made the " mfds." so cheap we usually indulge in from 10 to 50 of them and get slightly better by-passing.

Finally, it may perhaps be useful to indicate how the value of the bias resistance is calculated. The first step is to turn up the valve makers' data slip for the type and see what anode current is passed at the high-tension voltage applied, and what bias is recommended at that voltage. This tells us what current will be flowing through the bias resistor and the voltage drop we must arrange to produce across it. Obviously, if we know the current and the desired voltage drop, it is a very simple matter to calculate the ohms needed.

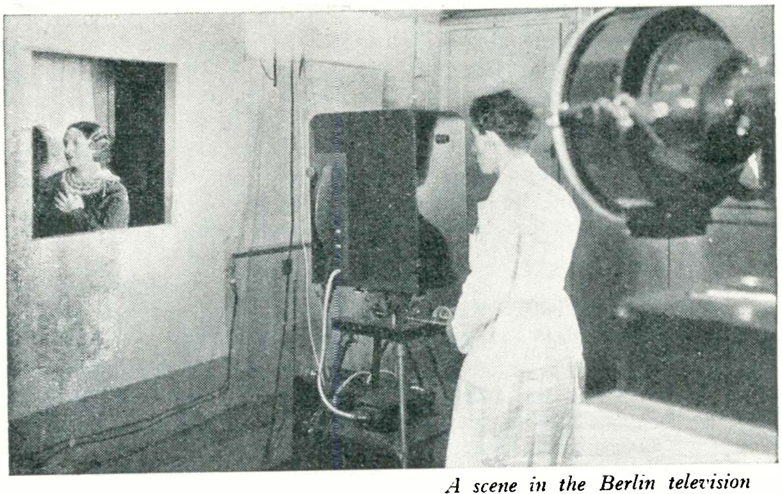
Just divide the required voltage by the current (expressed as a fraction of an ampere, not milliamperes) and there is the answer!



One of the new season's super radiograms is the A.C. Gloria, made by Ferranti, Ltd. It incorporates a powerful push-pull output stage giving 6 watts. The price is 45 gns. with an extra 7 gns. for an automatic record changer

Television for the Busy Man—No. 3

Percy W. Harris, M.I.R.E. continues his simple explanation of the fundamental principles of television by dealing with the Iconoscope and Farnsworth methods of scanning. He also explains the elements of the television receiver, showing how the modulated signal picked up on the aerial can be reconstituted into a visible picture



A scene in the Berlin television studio. An artist is seen before the "electric eye," the action of which is explained in the accompanying article

Scanning Systems and Principles of the Television Receiver

LAST month I described the most elementary form of television scanning, and those readers who would like to see what historic apparatus looks like will find some of Mr. Baird's original equipment in the television exhibits in the Science Museum at South Kensington.

Although there are many methods, I will now describe two new forms of scanning which are of great importance in modern high-definition television. It will be realised that with spotlight scanning we are limited to studio work and it is quite impossible to televise an outdoor scene. In the first of these new scanning devices, known as the Iconoscope, we set up a device which closely resembles an ordinary photographic plate camera, for it has a lens, bellows, and something corresponding to a ground-glass screen.

Separate Charges

The lens focuses the image to be televised upon this screen, which is made up of a very large number of tiny little globules of a silvery substance. Each tiny globule becomes charged with electricity when light falls upon it, the amount of the charge being dependent upon the amount of light. Thus when the lens forms the image, it creates a large number of separate little electric charges of varying intensity all over the screen.

This electrically charged screen forms part of a large vacuum tube inside which is formed a stream of electrons called a "cathode ray." By electrical means this ray is made to sweep backwards and forwards across the electrically charged screen like a searchlight sweeping across the sky.

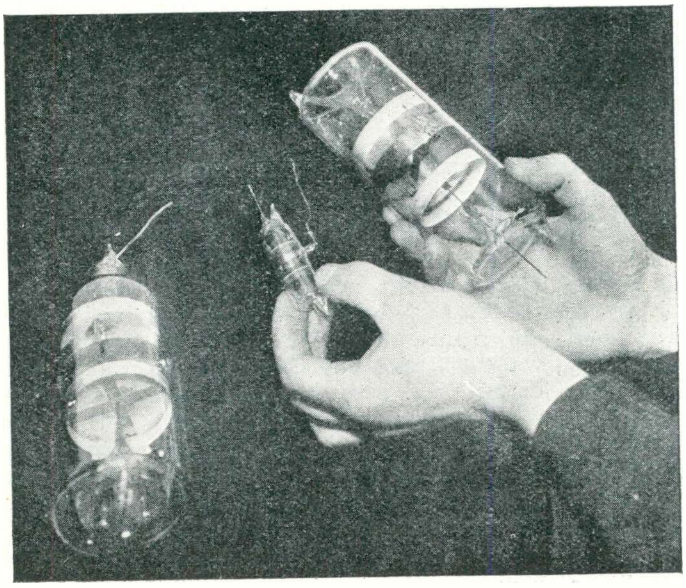
Method of Scanning

Wherever this electron beam touches, it discharges a particular group of little photo-electric-cell globules, the speed of the scanning and the sharpness, so to speak, of the tip of the beam being such as to give us our necessary 240-line scanning.

These periodic discharges form little electric currents which are magnified up and we obtain in this way exactly the same effect as we get with spotlight scanning in the studio.

Definition

The great advantage of this scheme is, of course, that both studio and outdoor scenes can be televised equally well, the definition being dependent upon the sharpness of our beam and the size of the tiny little photo-electric globules. As these can be made much smaller than is required, the advantage of the Iconoscope is obvious.



Showing three Farnsworth multiplier tubes. One of these tubes forms an essential part of the electron camera as will be seen from the illustration on page 279

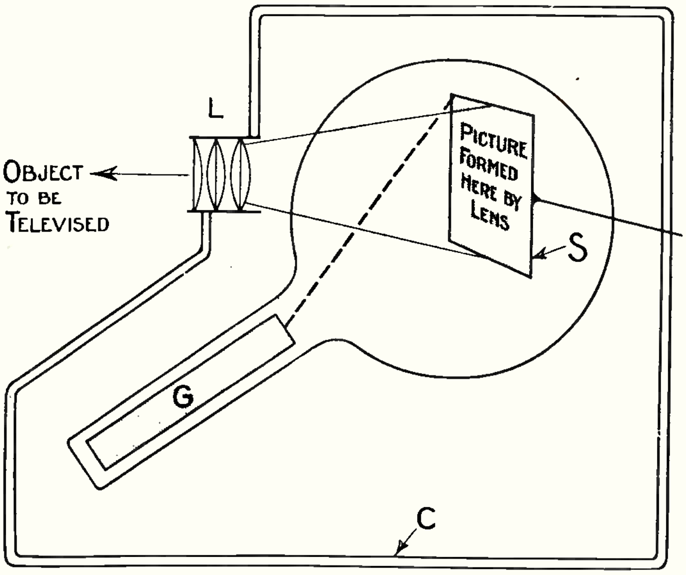
Another device, which superficially resembles the Iconoscope but is really based on somewhat different principles, is the Farnsworth Dissector Tube. Here again we have a camera with lens and screen but, this time the screen is of a continuous photo-electric substance and not in any way cut up into discreet globules or squares.

Farnsworth Scanning

When the image of the scene to be televised is focused upon this photo-electric screen the whole of the surface is emitting electrons, the strength of emission at any given point being dependent upon the strength of the image. By electrical means this solid beam of electrons is bodily moved backwards and forwards over a small aperture of such a size as to give 240-line definition.

The movement or scanning is done electrically and there is no mechanical movement whatever of any part, either in the Iconoscope or in the Dissector Tube, but whereas in the Iconoscope a sharp beam sweeps across a stationary surface of tiny cells, in the Dissector Tube the solid beam of radiation is moved backwards and forwards over a small aperture through which a tiny pencil of electrons escapes and is collected by a special device. We thus see that with the Dissector Tube also we can televise both outdoor and indoor subjects.

Think over the whole subject of scanning and get it firmly impressed in your mind that what we are doing, by any of the known methods, is simply to explore the picture to be televised, point by point, in a series of lines, at a steady rate, so that varying electric currents can be set up.



A diagram showing the arrangement of the Iconoscope. L is the lens, C the light-tight casing, S the screen on which the image is formed by the lens, and G the cathode-ray gun

Difference of Frequency

These varying currents modulate the strength of the radiated electric wave, so that when the receiver is tuned to the wavelength used for television transmission similar variations of strength are set up in the receiving circuit.

The difference, then, between a speech or music signal and a television signal on the same wavelength, is merely in quality of the signal. If you tune in to a television signal on a receiver designed for speech and music you will hear a kind of buzzing noise insofar as the modulations come within the limits of audibility.

In the case of the old low-definition television signals on the broadcast band, most listeners must have heard them, but here, as I explained in last month's article, the highest frequency was still comparatively low, or well within the limits of audibility. In the case of high definition, however, when we are going up to extremely high modulation frequencies ; the finer modulations, being beyond audibility, will not affect our ears at all.

Here and there in semi-technical articles one occasionally sees mysterious references to some wonderful new invention which will make possible high-definition television on the normal broadcast wavelength without causing interference. Claims of this kind have frequently been made and cropped up again recently in a book on television I have just been reading. Close examination shows that the idea is the old one of " frequency-modulation " in place of the customary " intensity-modulation."

The idea is that instead of having a constant-frequency carrier wave on which are superimposed lower frequency modulations (which have been found to produce sidebands) the modulation is made to vary the fundamental *wavelength* of the carrier, increasing and decreasing its frequency accordingly.

This is supposed, by some people, not to cause any sideband interference and not to affect any receiver not sharply tuned to the fundamental wavelength. The idea of frequency modulation is by no means new and a great deal of work has been done with it in an attempt to make it practical.

Very Difficult Problem

The Westinghouse Company in America, for example, has spent very large sums investigating the problem. As, however, no one has yet succeeded in making frequency modulation practical for normal broadcasting with frequencies up to only 10,000 cycles, it calls for a great deal of optimism to expect frequency modulation to solve the television problem where we require frequencies up to a million or more !

In our elementary talk on scanning we have explained the method by which the picture is traversed by the scanning spot from top to bottom, then starting at the top again but a little to one side, traversing the picture once more to the bottom and again jumping to the top. In modern high-definition television it is more usual to make the scanning lateral, but the principle is exactly the same.

We can, as explained last month, illuminate the whole scene and scan the picture optically, or we can run a spot of light across the scene and scan in this fashion. Similarly in the Iconoscope and Farnsworth methods of electron beam scanning we go across the picture or down the picture in successive lines in a similar fashion.

The Fly-back

There is one point common to all of the methods of scanning so far mentioned to which I would now like to direct special attention. When the scanning point reaches one end of the picture it has to jump back again to the opposite end before it can re-start. We are thus scanning discontinuously. A very ingenious scanning scheme of a *continuous* nature is worth mentioning.

Continuous Scanning

In the Scophony system invented by Mr. G. W. Walton, an ingenious optical system is used by which the picture, *before it is scanned*, is cut up into strips the width of one scanning line, these strips being so to speak, laid end to end. The appearance is similar to that which would be obtained if we took one of this magazine's illustrations and cut it into, say, 240-strips and stuck the strips end to end so as to make a long, thin picture 240-times as long and 1/240th of the width of what it is now.

The scanning spot can now be made to traverse this picture from end to end without discontinuity. You will realise, of course, that the fundamental principles of scanning remain the same by this method, and at the receiving end the re-constitution of the image is also done optically. Whether or not this method will receive practical application in the public television service remains to be seen.

Reception Problems

And now let us consider the elements of the television receiving set and how the picture which is coming over the ether as a modulated signal can be re-constituted into a visible picture. So far as the radio portions of the television receiver are concerned, these are, in all essential principles, the same as those of the speech and music short-wave receiver, but owing to the wide band of modulation frequencies received special care has to be taken to include without cut-off all of the frequencies we need and to receive them with a minimum of distortion.

To the student of normal broadcasting it may seem strange—even impossible—to design a *tuned circuit* which will receive not only the carrier but frequencies of a million or so on each side, when on normal broadcast wavelengths we have the greatest difficulty in satisfactorily receiving modulation frequencies up to even 7,000 or 8,000 without cut-off or bad distortion.

The problem will appear a little simpler, however, when we remember that in a resonance curve we are not really considering the modulation frequencies as such but as *proportions of the carrier-wave frequency*. I am afraid I have not space to discuss this fully here, but if you will think it out you will realise that, to take the simplest possible example, a type of resonance curve which will satisfactorily receive modulations up to 10,000 (1/100th of the carrier-wave frequency) on 300 metres (1,000,000 frequency) will, on 6 metres (50,000,000 cycles) accept frequencies up to 500,000 without distortion (still a hundredth of the carrier-wave frequency).

For the reception of sound it is only necessary to choose a wavelength just beyond the " spread " of the television signal, and as modulation frequencies for speech and music are very low compared with those for television, the total space occupied by a television signal and its accompanying sound signal need not be much larger than that taken by the television signal alone, seeing that the sound signal only requires about 1/100th of the width of the television signal.

Actually it is possible in a form of short-wave superhet receiver to receive both television and sound signals in the first receiving circuit and to separate them afterwards. As they are of different carrier frequencies the separate oscillator will, of course, produce two different " beat " frequencies simultaneously, one for the vision and the other for the sound.

Split Channels

Separately tuned circuits will now accept respectively the vision and the sound, the latter being passed on and amplified in the usual way so as to operate a loudspeaker. The vision signal, after suitable amplification (which must, of course, be distortionless) will reach such a strength that it can be made to modulate in intensity some source of light.

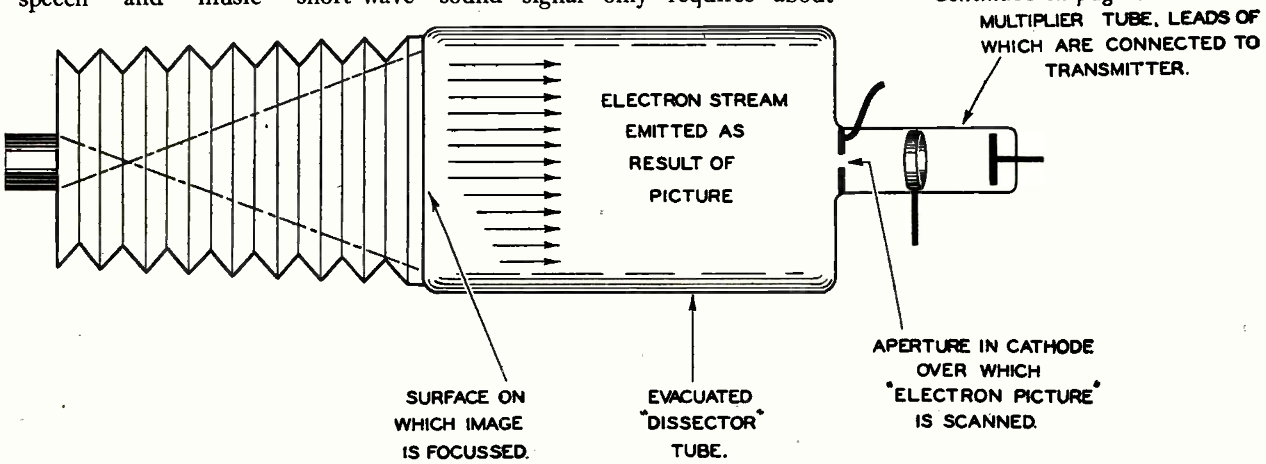
Let us see what happens if we try to vary the light of an ordinary electric lamp (such as we use for house lighting) by means of a television signal. We know that the light of a lamp varies with the voltage, the higher the voltage the brighter the light.

Simple but Impracticable

It would seem, then, the simplest idea to take an ordinary electric lamp, to amplify the television signal to a sufficient degree and then to pass the signal through the lamp filament. Variations in intensity of the signal would thereby vary the light given by the lamp, and this would seem to provide us with the basis for television reception.

Now there are two main objections to this procedure. First of all in the

Continued on page 317

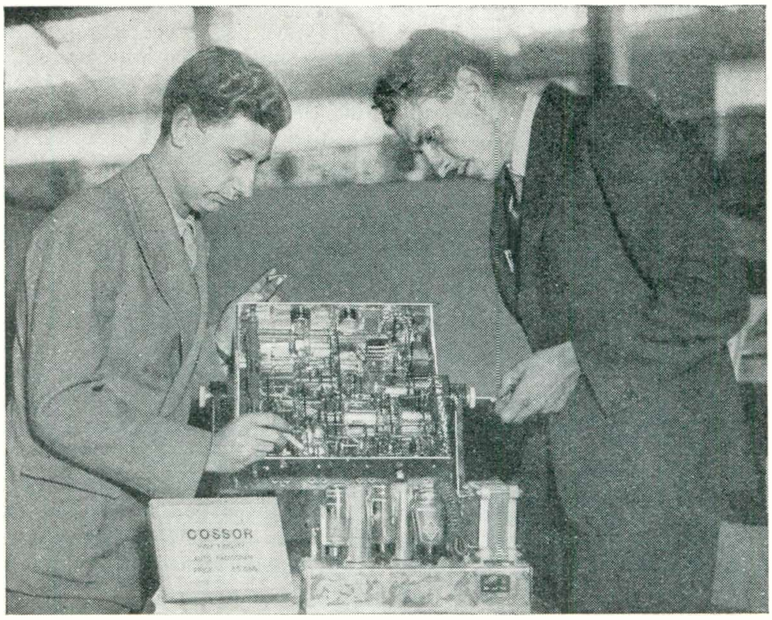


A simple drawing showing the principle of the electron camera. Ordinary outside scenes can be televised by this camera, even if the light is not good

Conducted by G. P. Kendall, B.Sc.

Hints for the Service Engineer

Dealing with the danger of using instruments for routine testing without preserving one's powers of deduction, and the good points of the purely diagnostic method of fault-finding



When routine individual component testing takes a long time: the modern multi-valve chassis often offers great opportunities for the use of the diagnostic method on the rare occasions when it does *go wrong*

Of all the really tiresome faults, commend me to those that occur in grid circuits at points outside the path of the grid-bias voltage on its way to the valve. I heard of a case the other day illustrating the point beautifully, so let me describe it; there is a moral hidden in the affair.

The receiver was built from a press design by a knowledgeable amateur who made a pretty sound job of the work and was at first fairly well pleased with results, although he had a suspicion that the upper register wasn't quite so good as the circuit design seemed to promise. As time went on the top got a little weaker, and volume began to go down too; there came a time when there was a comparatively rapid further loss in power and the owner realised that something was amiss.

Difficult Case

The trouble took him quite a long time to find, and although I think a professional would have located it pretty quickly, it would only have been by means of routine component testing: actually to diagnose it would have been extraordinarily difficult.

All valve currents were normal and the only sign of misfunctioning that could be detected with meters was a slight tendency on the part of the output valve to kick its milliammeter needle around at moderate volume levels. This might have been thought to suggest trouble in the output circuit, but a change of filter choke and condenser and also of loudspeaker had no effect at all.

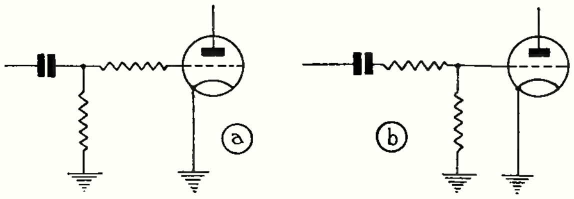
The fault was eventually traced to the grid circuit of the output valve. Here there was a grid-stopper resistance and this was found to have gone up to an unknown number of megohms; it had quite probably started life well above its rated value, and that was why there had seemed to be something a little peculiar about the set from the first.

One might have expected that such a fault would have led to acute grid choking and other significant symptoms, but it so happened that the grid-stopper resistance was connected between the grid condenser and grid, while the grid leak went straight from grid to earth line, instead of being placed in the more usual position between grid condenser and earth line. The effect was to take the defective resistance out of the direct grid return path and so suppress the more easily recognised symptoms (see Figure).

Another Puzzle

And the moral? I may be old-fashioned, but it seems to me very clear: It is all very well to rely entirely upon instruments and routine test methods, but there are times when the ability to diagnose faults accurately from their symptoms may save a great deal of time.

Here is another example in support. Some little while ago I had the very great pleasure of watching a certain rather "modernistic" young serviceman of my acquaintance in his struggles with a small commercial receiver belonging to one of my neighbours; he has in the past been rather inclined to try to tell me what wonderful things he could do with a rather elaborate testing set of his own design and construction, and has gone so far as to offer quite attractive odds in favour of his finding any fault whatever by routine testing in less time than anyone using the diagnostic method.



(Right) The circuit referred to in Mr. Kendall's notes. That on the left has the advantage of showing up resistance faults more clearly

I have never felt inclined to take him

on upon those terms, partly because he certainly *is* quick and clever with his confounded instrument, but chiefly because I have felt that given time he would get his lesson quite naturally and without any attempt at interference on my part.

And so it happened. The set to which he was called was giving slightly reduced volume and most unpleasant quality with very little bass and abundant signs of blasting on quite modest signals. The performance on distant stations was unaffected, apart from the quality, so he set to work first on the low-frequency circuits, although I thought that was hardly fair, since it savoured of the diagnostic method.

Anyway, he drew a complete blank, and so had to continue through the whole circuit. Still no results, so he drew a bow at a venture and did a little valve-changing. That didn't get him anywhere either, so he very wisely told the owner of the set that he must have it on his own test bench where he has sundry quite useful auxiliary gear of his own construction.

Was It There?

Apparently he still had considerable faith in his elimination methods, because he invited me to go along too, which, of course, I did, having by now got a suspicion that I knew what must be wrong with the set.

Various attempts at an overall test with a modulated oscillator proved as little help as the previous ones with a D.C. test set and things were beginning to look bad for the "modern method" when I inquired if it was against the rules to make a suggestion. The answer wasn't exactly enthusiastic, but I gathered that I might try it at my own risk, so I asked why he didn't swap the loudspeaker, includings its associated transformer.

Magical Solution

The reply was that he didn't see the point of so doing, because the results had been just as bad on the owner's extension speaker. I had noticed that, but still urged him to try it and this he eventually did. He was certainly much more surprised than I was to find that the fault had been cleared!

The diagnostic or deductive method can be a great help on such occasions, for it enables one to locate faults outside the scope of one's test gear. In this particular case the trouble was really a large section of shorted winding in the primary of the output transformer, and that is something no ordinary D.C. test can show up at all clearly.

The effect, of course, was to reduce the output load on the valve so much that its functioning was completely upset, not merely in the defective speaker but in the extension instrument as well. That explained the easy overloading of the valve on quite modest signals although the anode current was quite normal and the bias voltage correct.

My young acquaintance was naturally somewhat struck with all this and was sufficiently sporting to suggest that I should recount the story of his undoing in this section with a view to warning others of the danger of concentrating too much on the routine use of instruments without due exercise of one's powers of logical deduction.

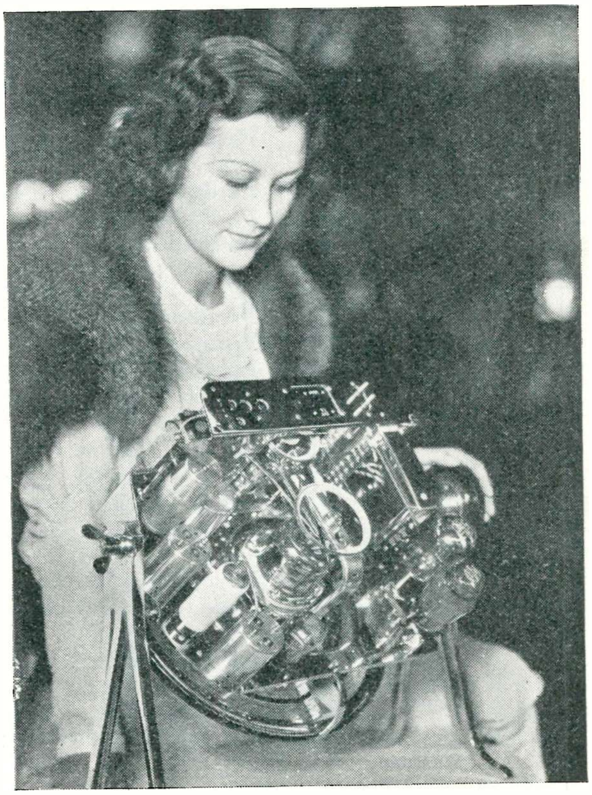
This repeated mention of instruments reminds me to make some reference to the literature I have recently received from the firm of Ernest Turner describing their servicing gear. It contains descriptions of some very interesting instruments at prices one must confess are very moderate.

There is, for example, an ohm-meter and continuity tester priced at £4 4s., which covers a multitude of the normal serviceman's requirements. It measures ohms directly in two ranges (0-100 and 0-100,000) with the aid of a self-contained battery and has a sensitivity of 1 milliampere for full-scale deflection. The scale length is 2½ in.

Other types listed include a power-level indicator, a useful selection of multi-range current and voltage measuring instruments, constant-impedance A.C. voltmeters and so on. Altogether a decidedly interesting range of apparatus.

Station Log of the "W.M." *Simplified Short-wave Super*

Station	*Dial Reading*
LB (Light Blue Spot) Coil	
Daventry, GSG	30
Bound Brook, W3XAL	31
Schenectady, W2XAD	55
Wayne, W2XE	56
Pittsburgh, W8XK	57
Daventry, GSF	58.5
Amateurs (20 metres)	65-75
Y (Yellow Spot) Coil	
Amateurs (20 metres)	0-5
Pittsburgh, W8XK	30
Rome, I2RO	31
Daventry, GSD	33
Pontoise, FYA	34
Madrid, EAQ	40
Lisbon, CT1AA	44
Sydney, VK2ME	45
Daventry, GSC	46
Schenectady, W2XAF	48
Rio de Janeiro, PRF5	49
Ships on 36 metres	66-70
Amateurs (40 metres)	90-100
R (Red Spot) Coil	
Amateurs (40 metres)	0-8
Moscow, REN	20
Caracas, YV3RC	27
Pittsburgh, W8XK	29
Wayne, W2XE	31
Bound Brook, W3XAL	32
Skamlebaek, OXY	34
Miami, W4XB	35
Vatican City, HVJ	37
Air Force Stations (60 metres)	55-70



The new Ekco concentric assembly system produces a very interesting-looking chassis with excellent accessibility

W.M. Short-wave Data Sheets—No. 1

Short-wave Identification Signals

Interest shown by ordinary listeners in the reception of short-wave broadcasts is steadily increasing. " W.M." intends to foster this hobby and to do all in its power to assist the listener to get the very best results. We are publishing a series of data sheets, of which this is the first, containing a mine of useful information that will help the listener to identify the many kinds of signals he will log on his short-wave receiver. Our list this month gives a number of stations with the signals which can easily be identified

Station.	*Country.*	*Identification Signal.*	*Station.*	*Country.*	*Identification Signal.*
		BIRD CALLS			
CT1AA	Portugal	Cuckoo	VK3ME	Australia	Kookaburra (" laughing jackass ")
PRADO	Bolivia	Cuckoo			
		MUSIC			
FYA	France	La Marseillaise	CJRO	Canada	O Canada
FIQA	Madagascar	La Marseillaise	CJRX	Canada	O Canada
CNR	Morocco	La Marseillaise	RV59	Russia	Internationale
EAQ	Spain	Rachmaninoff's Prelude	FIQA	Madagascar	Ramona
British stations		God Save the King	HC2RL	Ecuador	Ecuadorean Anthem
ORG	Belguim	La Brabanconne	HVJ	Vatican	Laudateur Jesus Christus
ORK	Belguim	La Brabanconne	H1IA	Dominican Republic	Anchors Aweigh
ORP	Belgium	La Brabanconne			
		WORDS AND PHRASES			
LKJ1	Norway	Broadcasting Oslo	HJ2ABA	Colombia	La Voz del Pais
HJ4ABN	Colombia	Ecos del Occidente	OAX4D	Peru	La Voz del Peru
Riobamba	Ecuador	Estacion El Prado	HI1A	Dominican Republic	La Voz del Yaque
COH	Habana	Estacion de onde corte Say-o-achay	British stations		London calling
HP5B	Panama	Estacion Miramir	SRI	Poland	Polski Radjo Poznan
OER2	Austria	Hallo, hier radio Wien	HVJ	Vatican	Pronto, Pronto Radio Vaticano
BC2RL	Ecuador	Hello, America	PRBA	Brazil	Radio Club do Brazil
RV59	Russia	Hello, hello, here is Moscow	CP5	Bolivia	Radio Illimani
FYA	France	Hello, hello, ici Paris	CP6	Bolivia	Radio Illimani
SRI	Poland	Hello, hello, Polski Radio Poznan	CP7	Bolivia	Radio Illimani
ORG	Belgium	Ici Bruxelles	CR7AA	Mozambique	Radio Lorenco Marques
ORK	Belgium	Ici Bruxelles	HBL	Switzerland	Radio Nations
ORP	Belgium	Ici Bruxelles	HBP	Switzerland	Radio Nations
CNR	Morocco	Ici Radio Rabat dan Maroc	I2RO	Italy	Radio Roma Napoli
HCJB	Ecuador	La Voz de los Andes	FIQA	Madagascar	Radio Tananarive
HJ1ABB	Ecuador	La Voz de Barranquilla	OER2	Austria	Radio Wien
YV11BMO	Venezuela	La Voz del Lago	I2RO	Italy	Radio Napoli
			PHI	Netherlands	This is Huizen
			HP5B	Panama	Voice of Panama
		CHIMES, GONGS, Etc.			
British stations		Clock chimes and gongs	HCJB	Ecuador	Chime notes (2)
FYA	France	Clock chimes and gongs	HJ1ABB	Colombia	Chime notes (4)
EAQ	Spain	Clock chimes and gongs	German stations		Chime notes (8)
RV59	Russia	Midnight chimes, 5 p.m. e.s.t.	JVR	Japan	Gongs (2 and 1) and chime (1)
OXY	Denmark	Midnight chimes, 6 p.m. e.s.t.	HJ3ABD	Colombia	Gong (1)
HVJ	Vatican City	Clock ticks	CJRO	Canada	Gongs (4)
CNR	Morocco	Metronome	CJRX	Canada	Gongs (4)
OER2	Austria	Metronome	TI4NRH	Guatemala	Bugle call
			DFB	Germany	Whistle notes (3)

A Simple Way of Making an Extension Loudspeaker

By James Shipley

AN extension loud-speaker can be made at quite small cost in these days when a moving-coil unit can be purchased for 30s. or less and the cabinet to house it can be made at home for a few shillings.

A permanent-magnet type should, of course, be chosen so that no connection with the mains will be necessary for field excitation. If the commercial set maker stipulates a certain make of extension loud-speaker nothing will be gained by departing from his recommendation unless you are experimentally-minded and want to try something different.

The woods most commonly used for loud-speaker cabinets are oak, mahogany and walnut. The last two mentioned are the easiest to work, but oak is, undoubtedly, the best on which to get a nice finish.

From personal experience the writer would certainly recommend the use of oak for a home-constructed cabinet, as nothing detracts from the appearance of a cabinet so much as poor finish.

The extension loudspeaker illustrated is of very simple construction, yet nothing which would detract from its efficiency has been omitted. If the constructor likes to add moulding or beading here and there no harm will be done, but the temptation to make a complicated fret for the speaker opening should be guarded against, as a fret, however small, obstructs the free passage of sound waves from the diaphragm.

The dimensions given are suitable for a moving-coil unit having a diaphragm of about 6 in. or 7 in. diameter. If a unit having a larger diaphragm is to be used the cabinet dimensions should be increased in depth as well as in length and breadth.

When the parts are finally assembled, the cabinet should be given a rap here and there with the knuckles when if anything is loose a rattle will be heard which should be located and remedied before putting the speaker into use.

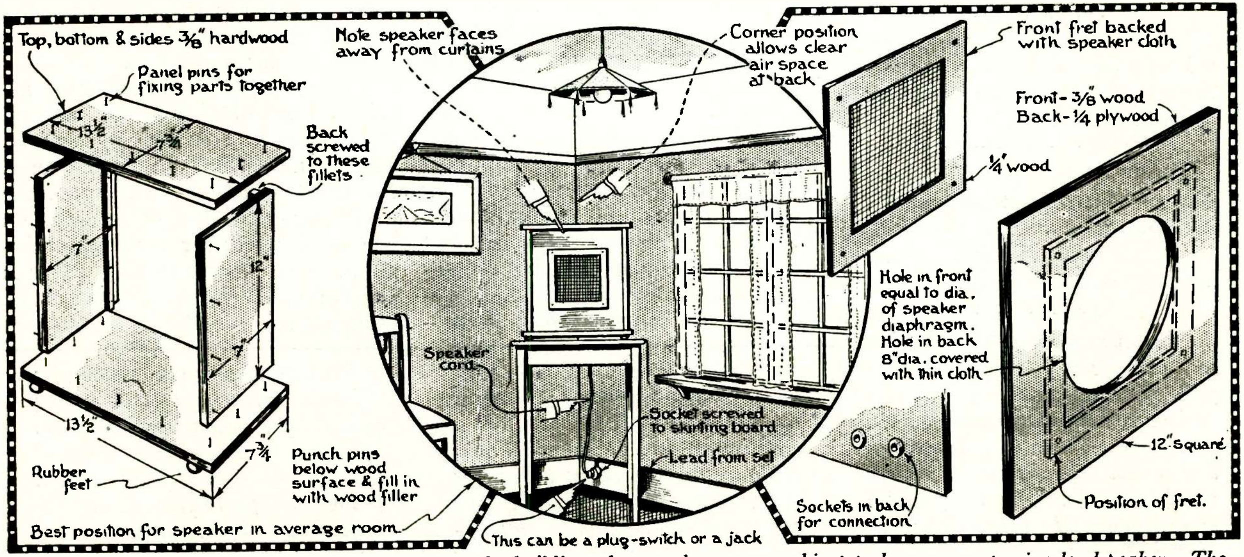
REGARDING the final surface finish for the cabinet the choice must be left to the constructor. There are various proprietary stains, polishes and varnishes on the market which may be utilised and which will give good results, providing the instructions given with them are carefully followed.

If oak is used a wide choice of finishes is available such as fuming and wax polishing, staining and wax or oil polishing, staining and french polishing, etc.

To obtain a quick yet quite pleasing finish on an oak cabinet the writer can recommend the following method: obtain a few crystals of Vandyke Brown from an oil and colour dealer, say sufficient to fill an egg cup, and drop them into a 1 lb. jam jar; boil up some water and pour in the jar until it is about three-quarters full. Stir until the crystals have dissolved.

When the solution is cool apply it with a brush to the surface of the cabinet (which should have been well smoothed previously with fine glasspaper) so that an even shade of brown is seen all over.

Allow to dry thoroughly. If the finish is not dark enough apply a second coating of stain, and when this is dry rub over the whole cabinet gently with unboiled linseed oil, using a wad of cotton wool or soft rag. Further applications of oil can be made when the previous one has soaked in until the cabinet assumes a pleasing dull-polish finish.



This drawing gives full constructional details for the building of a wooden corner cabinet to house an extension loudspeaker. The dimensions given are for a cabinet of suitable size for a moving-coil unit of 6 or 7-in. diameter; for larger units, the dimensions, including depth, should be increased. In fact, the larger the baffle area the better will be the results obtained

The Set Buyer

The "W.M." Set Selection Bureau

SINCE the last day of Radiolympia the Set Selection Bureau has literally been snowed under with letters from, shall we say, non-technical set buyers seeking advice before they finally decide on their new radio. The magnitude of the task can be realised from the fact that in one week alone we helped these readers to spend between £2,000 and £3,000.

Those readers who are living catalogues of all the commercial sets on the market will realise on looking through some of the teasers on these pages that we have had no easy job.

Take, for instance, the question of quality. A new type of listener is arising from the ashes of the past knob-twiddlers. This new listener has been "educated" by our B.B.C. into enjoying good music and, naturally, he wants the set that will give him the best quality. Many regard cost as of no importance at all.

Take, for instance, the problem of the Tonbridge reader. He has fifteen good guineas to spend on an A.C. mains receiver on which he only requires to receive the two local stations, but he must have the purest reproduction. The ordinary set maker has not yet realised that thousands of listeners have at last discovered that the best and clearest entertainment is obtained from the two local stations. And therefore it is only natural to expect that set buyers will discover that for fifteen guineas they should be able to buy a local-station receiver giving really superb quality of reproduction. There is a new commercial set market awaiting exploration by go-ahead manufacturers, which will—and we are talking from facts—bring them in a good return for their labours.

Again you will see from this Tonbridge letter and others that even the delightful handsome cabinets are of secondary importance in this quest for super reproduction. Can we safely visualise a return to the old days with a loudspeaker screwed behind a substantial baffle and hidden away in the corner of the room?

The trouble experienced from interference in a Brighton flat is common all over the country. People go to the trouble and expense of buying a really good radio receiver; they install it, only to find that reception is spoilt, often beyond listening limits, by electrical interference caused by bells, vacuum cleaners, lifts, refrigerators or trolley-buses.

If the trouble is caused by your own appliance you can remedy it by fitting some suppression device marketed by such firms as T.C.C., Ward and Goldstone or Belling Lee.

On the other hand, if the nuisance is not your fault you can only ask the offender to fit such appliances; if he is a radio listener you can rest assured that he will thank you for the advice; if he is not a radio listener, then you have to make the best of a bad job and try and cut out as much of the crackle as you can.

The introduction of all-wave receivers has roused a certain amount of curiosity in some set purchasers. Many ask us whether the addition of the short waveband will affect the performance of the other two, on which they rely for their entertainment. The answer to that query is simple: An all-wave receiver has to be designed very carefully if satisfactory

An optimist from North London writes: "I should like to be able to receive Australia with as much certainty as possible, yet not pay more than £15. I have not the patience to fiddle with knobs for hours on end in the hope of picking up something; I want to be able to hit it first time, however weak the reproduction may be."

* * *

From Hull (Yorks): "About short waves; are they worth listening to, or do they come in with a lot of fumbling in the same way as the B.B.C. relays from America? I have not heard a short-wave set and I wonder if the quality, not quantity, is the same as with English medium- and long-wave stations."

* * *

Trouble in Brighton which we are asked to solve: "An A.C. D.C. transportable for use in a flat; no aerial or earth available; passenger lift installed, and in constant use. Automatic control and press buttons cause loud bangs in most receivers. The owner of the flats will not have suppressors fitted (as advised by the G.P.O.) owing to expense."

* * *

From Walsall (Staffs.): "I am prepared to pay £15 to £20 for a mains-driven A.C. receiver. I want to receive most of the British stations and the Empire short-wavers. A wireless set required, not an elaborate piece of furniture!"

* * *

A Colne (Lancs.) reader says: "The price and appearance are immaterial, but true reproduction of music is essential."

* * *

From Cornwall: "Some have told me that twin-speaker models are unsatisfactory in Cornwall, but I can't see how locality can have any bearing on that."

* * *

A reader of Osterley (Middlesex) writes: "I am prepared to pay £50, and a little more if undoubted advantages would result. First and foremost, I want the best possible reproduction as regards tonal qualities. Anything which gives artificial drumminess or high-frequency cut-off will not satisfy me."

From Tonbridge (Kent) comes the following problem: "I want to pay about £15 15s. for a receiver to get the Regional and National only. It is to be for A.C. mains operation and give the purest reproduction. Appearance and gadgets are of secondary importance."

From Pontypridd (Glamorgan): "I place great importance on the quality of reproduction and tone. For this reason I am inclined towards a twin-speaker model. I am not particular about the appearance of the cabinet, but I would prefer the set housed in a cabinet of large dimensions."

Talks About His New Set

Analyses Some of His Many Problems

results are to be obtained on the short waves. It means more care all round, and the result is that the medium and long wavebands are, as far as the superhet type of receiver is concerned, capable of an extremely brilliant performance.

On the straight types of sets, the extra band should introduce no marked ill effects, but here rather more care is necessary to avoid any flattening of the tuning on the medium and long bands.

We hope that our North London optimist is the only one who is prepared to pay £15 for a set that will bring him Australia without hours of knob-fiddling. The whole secret of the success of operating an all-wave receiver on the short waves lies in slow, patient tuning. In fact, the slower the knob is turned the more chance has the listener get of logging a signal from the other corner of the earth; he will never get Australia, unless through a great stroke of luck, if he tries to tune-in the short-wavers as he tunes in the medium—and long-wave broadcasts.

Our Hull correspondent raises an interesting query in his letter concerning the entertainment value of short-wave stations. As explained by L. W. Hayes, of the B.B.C. engineering staff, in our June issue, the B.B.C. uses many aerials at its Tatsfield receiving station, where the American signals are picked up in this country, so that fading is cut down to the absolute minimum.

If the B.B.C.'s relays are not good enough for our friend, he is bound to be dissatisfied with the results he will get using only a single-wire aerial. However, we have been using short-wave receivers in our labs. for a number of years and we can assure him that there are times when reception is quite comparable with, say, the reception of medium-power Continental stations.

On the other hand, a good short-wave or all-wave receiver can give reception at most times of the powerful Continental short-wave stations (Rome, Berlin, Radio Coloniale, Moscow, etc.) in daylight at a constant strength and with reproduction that bears comparison with the B.B.C. locals.

Our Worcester correspondent who reports that he can only get Droitwich and Midland Regional has nothing to blame except his nearness to the Droitwich transmitters. He informed us that his present set is not a superhet.

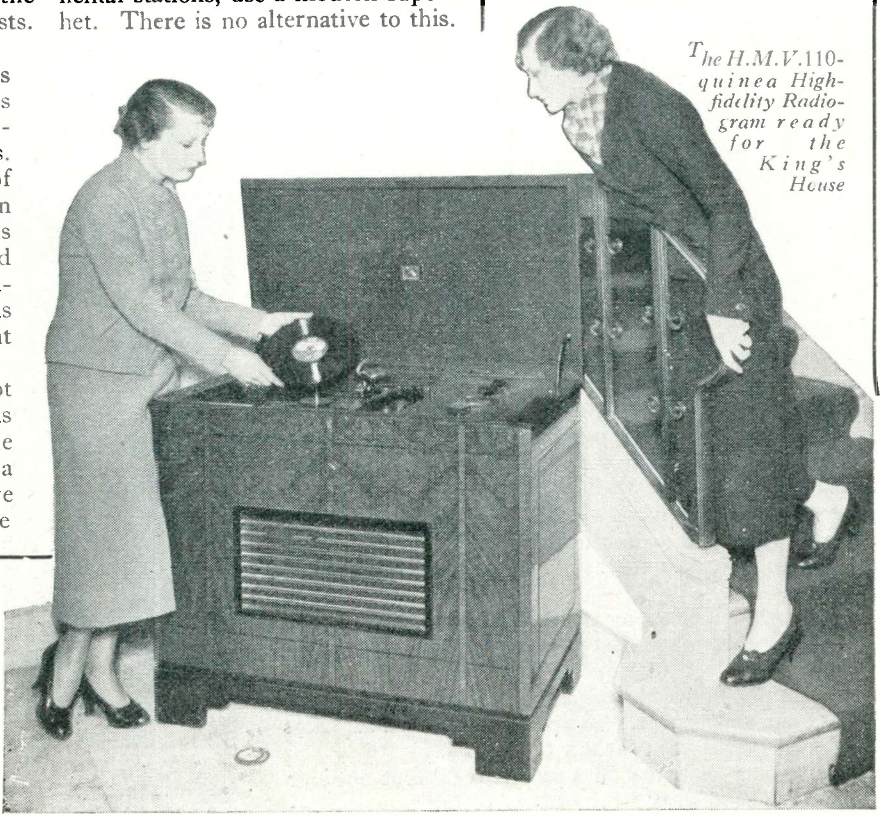
Any reader who lives within an area of ten miles round a Regional transmitter must, if he requires reception from even a few Continental stations, use a modern superhet. There is no alternative to this.

From a reader of Lee (London, S.E.12): "Will you be good enough to advise me as to which make of set (commercial or otherwise) produces to your definite knowledge the best quality of reproduction on both radio and gramophone. The reception of broadcasts from foreign stations is not required. I am interested in local stations only and the highest possible fidelity of reproduction. This is the primary consideration, irrespective of cost."

◆ ◆ ◆

A chorister of Worcester Cathedral writes: "Quality must be good. I am very keen on good tone. I am a very sensitive musician, having been in our Worcester Cathedral choir for fifty years. Please put me on to a set that will bring the ends of the world to Worcester, not leaving out our own British stations. I have had my present set for some years, but I can only get the National and Midland stations on it."

A compliment from Sittingbourne (Kent): "My foremost considerations are tone and selectivity, pick-up terminals, sockets for extension loudspeaker, and plain, modern appearance. I should like to state here that I consider "W.M." to be easily the best value in wireless publications."



The H.M.V. 110-guinea High-fidelity Radiogram ready for the King's House

Burndept Universal All-wave Receiver

BRIEF SPECIFICATION

BRAND NAME: Burndept.

MODEL: All-wave Universal.

PRICE: £10 10s.

VALVE COMBINATION: Three receiving valves, rectifier, and barretter. The combination consists of a high-frequency amplifier (Mazda VP/1321), detector (Mullard VP13) and pentode output (Mazda Pen3520). The rectifier is a Brimar 1D5 and the barreter a Philips C1.

POWER SUPPLY: A.C. or D.C. mains, 180-250 volts.

MAKERS: Burndept, Ltd., Erith, Kent.

THIS Burndept all-mains all-wave receiver selling at ten guineas was one of the many minor sensations at Olympia this year. Briefly, the set itself is a three-valver of the H.F.-Det.-Pen. variety, a well-tried combination, the capabilities of which have been explained many times in these pages.

The wave-range covers, in addition to the 200-550 metre and 800-2,150-metre broadcast bands, the short waves from approximately 17.5 to a little over 50 metres.

The set is housed in quite an attractive-looking cabinet. The conveniently laid-out tuning scale is an integral part of the loudspeaker-fret design, and consists of three semi-circular scales—one for each waveband—calibrated in metres.

In the two top corners is a list of medium-wave stations with wavelengths, the long-wave stations are marked in red in the top centre of the scale, while the principal short-wavers are listed at the bottom. Although the scale is illuminated, we found it advisable to have some form of exterior lighting to read the station lists.

Controls follow standard practice; the tuner is above the wave-change switch in the centre; the on-off switch combined with the volume control is on the left; reaction on the right. There is no provision for the use of a pick-up.

The importance of carefully reading the operating and installation instructions was brought home to us on connecting up this set for test. The set was unpacked; valves inserted in their appropriate sockets; aerial and earth and mains connections made, after which we switched on.

Nothing happened so we got down to reading the instructions to find out what bloomer we had made, if any. We found this : "see that the pilot lights are screwed well home in their sockets as these are directly in the filament circuit, and if loose the set will not function." Then the set worked !

The set is especially well made and the loudspeaker, of the moving-coil energised type, is of good size having a 7-in. cone. On the back of the set chassis are the usual aerial and earth connections and an aerial trimmer. There are two aerial connections, one marked "Day," the other "Night." Actually the socket marked "Day" is a direct tapping to aerial coil, and the tapping marked "Night" is presumably connected via a pre-set condenser, the capacity of which is controlled by the knob near the aerial socket. This arrangement enables the set to be used with any type of aerial.

One further interesting point about the design of the receiver is that no adjustment for mains voltages is necessary; the set will operate on any A.C. or D.C. mains supply between 180 and 250 volts without any adjustment whatsoever. The frequency of A.C. mains used must be between 50 and 100 cycles.

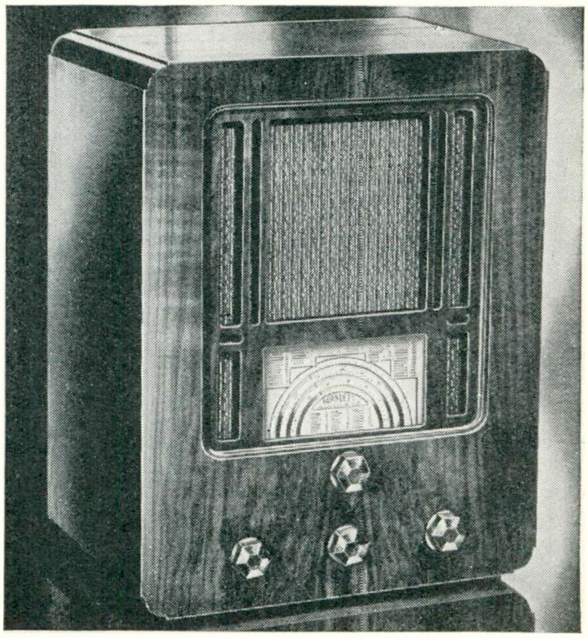
Our tests were made on a standard 30-foot outdoor aerial and a good earth—the makers' recommendation—in South London. We were more than satisfied with the performance on the broadcast bands. One can work wonders in selectivity by careful use of the volume and reaction controls—the art of tuning is commendably explained in the instructions.

We could get Frankfurt and Radio Normandy clear of London National; and Toulouse and Milan quite clear of the Regional. This is certainly no mean feat for a straight three under modern conditions. With careful tuning there is no reason why twenty or more alternatives to the medium-wave locals should not be logged.

Long-wave results, too, were well up to standard, selectivity being ample to separate Droitwich from Warsaw and Radio Paris. Quality was well up to a "straight" set's standard.

And now for the all-important short waves. We spent a couple of hours touring Europe. All the more-important stations together with plenty of morse and queer noises from amateur transmitters provided endless pleasure. We did manage to log three American signals; W2XAF on 31.48 metres coming through particularly well.

The set's overall sensitivity on the short waves seems well up to standard, but very careful handling of the tuner and reaction control is essential.



" This set is housed in quite an attractive-looking cabinet . . . the conveniently laid-out tuning scale is an integral part of the loudspeaker-fret design."

G.E.C. A.C. Mains Four

IT is indeed a pleasure to be able to comment favourably on an A.C. mains receiver costing less than £10; a pleasure, because we can sincerely tell the man with very moderate means that he can acquire an all-mains receiver which we know will give him good entertainment.

This G.E.C. three-valver under review (four valves if we count the rectifier) is in every respect worthy of the G.E.C.'s reputation for reliability coupled with good performance.

The illustration shows you exactly what the set looks like; the cabinet—17 in. high, 14 in. wide and 9 in. deep—is of moulded bakelite pleasantly relieved with chromium-fronted controls and three simple bars across the speaker opening.

Right in the centre is the main tuning scale—not illuminated—calibrated in steps of 25 metres for the 200-550-metre band and in steps of 100 metres for the 800-2,200-metre long waveband. The three controls at the bottom follow standard practice and, from the left, are combined volume control and on-off switch, wave-change switch, and reaction control.

Technically speaking, the circuit and design is highly commendable. The incorporation of stranded-wire coils (known to give very high efficiency) in the two tuned circuits, and the use of a tetrode detector followed by a steep-slope output pentode give this set an extremely high performance for its class.

The loudspeaker is of the energised type with a diameter of 8 in., and employs a new type of cone; certainly the quality is particularly good. The set has all the refinements of many larger sets, and makes provision for the use of an external loudspeaker and pick-up. Incidentally you will see from the specification panel that models for use on "freak" mains are available.

Those whose job it is to test all types of sets always have a good word to say for the solidity of G.E.C. set chassis; they are well built and only robust materials are used.

On the back of the receiver the makers provide a short length of rubber-covered wire primarily intended for picking up the strong local stations. We tried the set with this short aerial and we marvelled at the G.E.C.'s modesty. In South London we could log a matter of twenty stations in addition to our two locals on the medium waves.

Some people believe that with such an aerial it is possible to get greater selectivity than with, say, a 50 ft. outdoor wire. This does not by any means follow. For example with this G.E.C. set we could, with the indoor aerial, get Berlin, 10 metres away from London Regional very faintly and with a background of the local station. When we used the outdoor wire we could *by the method of "minimum volume control and maximum reaction"* get Berlin at nearly full strength quite clear of the local.

BRIEF SPECIFICATION

BRAND NAME: G.E.C.

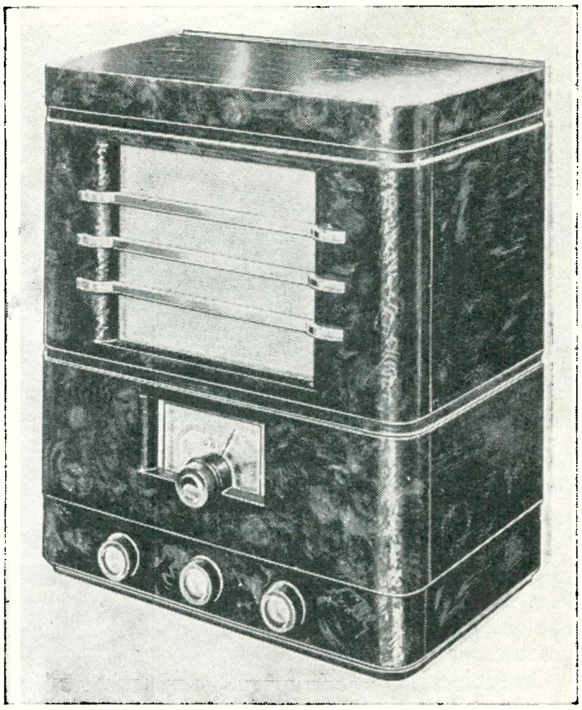
MODEL: A.C. Mains Four—BC3630.

PRICE: £9 9s.

VALVE COMBINATION: Straight three-valve receiver with one high-frequency amplifier (Osram VMS4), screened-grid detector (Osram MS4B) and high-slope output pentode (Osram N41). The valve rectifier is an Osram U12.

POWER SUPPLY: A.C. mains, 190-250 volts, 40-100 cycles. Receivers for use on mains frequencies between 25 and 100 cycles, and on 110-130 volts/210-230 volts, 40-100 cycles can be obtained for an extra charge of 6s.

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



"The cabinet is of moulded bakelite pleasantly relieved with chromium-fronted controls and three simple bars across the loudspeaker opening"

There is no doubt that on the modern H.F.-det-pentode receiver, such as this G.E.C., it is possible to get selectivity approaching that of a superhet providing the method of tuning is carefully studied.

On our large outdoor wire at night we could log a matter of thirty signals worthy of the phrase "entertainment value" quite easily. We found that sensitivity was constant all over the scale; such stations as Athlone and Budapest at the top, and Frankfurt at the bottom of the range, came in at full strength.

There is no means of controlling the tone, but our opinion is that such control in this receiver is quite unnecessary. On certain stations, notably Luxembourg on the long waves, it would be of assistance in reducing the whistle, but as interfered-with stations of any entertainment value do not amount to more than half-a-dozen, there is no need to worry unduly on that score.

Real proof of the set's sensitivity was demonstrated during our daylight tests.

During one morning we heard every worth-while long-wave station, and on the medium waveband our log included Radio Normandy, Hilversum, Poste Parisien, and Cologne at volume comparable with the locals.

We need say little about quality. It was crisp with a fair amount of bass. The undistorted output is just over 2.5 watts.

Ekco Model AC86

Norman Long, the radio entertainer, with his Ekco AC86

BRIEF SPECIFICATION

BRAND NAME : Ekco.

MODEL : AC86.

PRICE : £13 2s. 6d. with walnut finish (Black and chromium finish, 10s. 6d. extra).

VALVE COMBINATION : Eight-stage superhet in horizontal moulded cabinet. The valve arrangement consists of a combined detector-oscillator (Mullard FC4), intermediate-frequency amplifier (Mazda AC/VP1), second detector and A.V.C. (Mullard 2D4A), first low-frequency amplifier (Mullard 354V) and pentode output (Mazda AC/Pen). The valve rectifier is a Mullard 1W3.

POWER SUPPLY : A.C. mains 200-250 volts.

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

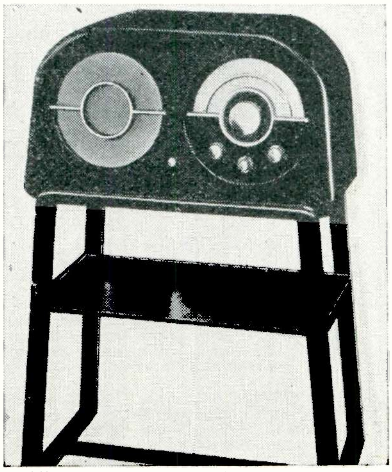
OUR tests of Ekco's AC86 extended over a period of six weeks, and our conclusion is that we have been handling one of the finest value-for-money propositions of the new season's radio. Ekco deserve great credit for marketing a moderately-priced receiver that gives, to say the very least, an outstanding performance.

The cabinet is unusual, but after all it has been designed for radio efficiency's sake as well as with an eye to modern tastes. We consider the black cabinet with chromium-plated controls on its neat wooden stand a tasteful asset to any home.

Every worth-while modern technical development is to be found in the specification of this AC86. There are five receiving valves arranged in superhet sequence with a sixth as mains rectifier.

Refinements include automatic noise suppressor, full delayed Q.A.V.C., variable tone control—and this is tone-compensated enabling good quality to be obtained at all settings of the control—internal loudspeaker switch, and the large Ekco circular tuning scale with its light beam and shadow indicator.

Controls are extremely simple to understand. The five knobs are grouped underneath the huge tuning scale—calibrated in wavelengths and with the names of some sixty stations. In the centre of the scale is the easy-to-handle tuning control over 2 in. wide; then from left to right are the tone control, on-off switch combined with the volume control, noise-suppressor control and, finally, the combined wave-change and gramo-radio switch.



The black and chromium AC86 with its neat wooden stand is certainly a modern-looking outfit. The stand costs £1 9s. 6d.

Ekco are talking a lot this year about "clear-cut reality." We were especially satisfied with the quality, not only on the locals, but on most foreigners as well, and at all settings of the volume control. At full volume one gets an undistorted output of 3 watts—this is twice as much as even noisy people want for a full-size living room. Probably the most outstanding point about the reproduction is the entire absence of boom, and yet (mark this) there is *ample* bass response. Top notes, too, are well in evidence. Furthermore there is no hum whatsoever.

There is nothing like rattle and vibration to annoy technical men as well as those with "musical ears." Even with the AC86 at uncomfortably full volume there is a remarkable absence of "buzz."

We hitched the set up to our standard 30 ft. outdoor aerial for the night tests. Our observations showed that the station markings on the dial are accurate, and incidentally during a run round both medium and long waves *we did not come across a single second-channel whistle*. Evidence of good design!

Selectivity was well up to standard. In all cases where there was slight hissing by the next door station we found that it could easily be cut out by the tone control. The presence of this slight interference (on about six foreigners only) is a particularly good sign for it shows that the top notes have not been cut in order to get super selectivity.

It is more satisfying to get a little better quality from forty or so stations than to get interference-free yet lifeless reproduction of the whole galaxy of Europe's broadcasters.

We made a test one evening to see how many *programme alternatives* we could get to the two locals on the medium waves. We got thirty-seven; and we were quite content!

Long waves; very good. Eight programmes at entertaining strength with clarity that should be enough for the practical listener.

We consider that the overall performance of this Ekco AC86 is of very high order, both from the point of view of sensitivity, ease of handling and in the ability to give *good* quality.

Kolster Brandes 425 AC/DC Transportable

A VERY useful receiver this K.B. 425. It is a five-valve superhet transportable for operation off A.C. or D.C. mains. Put another way ; it can be used on any mains between 200 and 270 volts; one adjusts the set for the voltage of the mains to be used, pushes in the plug and the receiver is ready to be switched on.

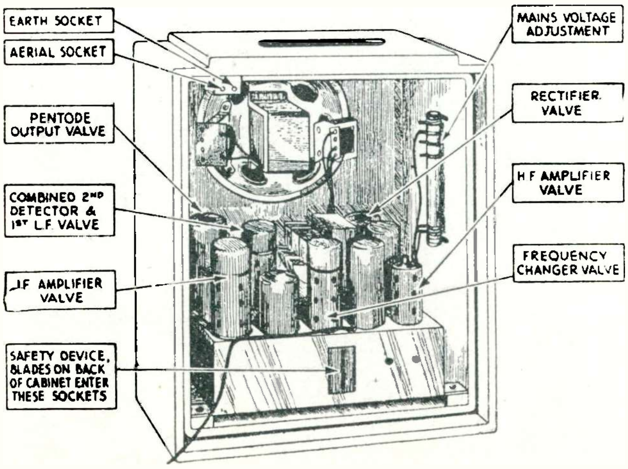
It is, without doubt, the most convenient mains receiver available today. As you can see from the illustration the 425 looks exactly like an ordinary table receiver; the only external differences are that a small leather carrying handle is let into the top of the cabinet, and that a turntable is fixed on the bottom.

BRIEF SPECIFICATION

BRAND NAME : K.B.
MODEL : 425, Superhet Transportable.
PRICE : £15 15s.
VALVE COMBINATION : Five-valves (excluding rectifier) in superhet sequence. There is a preliminary stage of high-frequency amplification using a high-frequency pentode (Brimar 9D2) followed by a heptode frequency-changer (Brimar 15D1), intermediate-frequency amplifier (Brimar 9D2), double-diode-triode second detector, A.V.C. and first low-frequency amplifier (Brimar 11D3) and output pentode (Brimar 7D3). The rectifier, of the half-wave type, is a Brimar 1D5. Cossor valves can be used as alternatives.
POWER SUPPLY : A.C. mains 200-270 volts, 40-60 cycles or D.C. mains 200-270 volts.
MAKERS : Kolster Brandes, Ltd., Sidcup, Kent.

Put briefly, its main use is that the set can be moved from room to room, plugged into the electric light socket, and everything is ready for the entertainment.

There is an idea abroad that a portable or transportable receiver is limited in its ability to pick up foreign stations. Let us dispel that notion once and for all. Without any external aerial and earth we found the 425 behaved like a perfectly normal table superhet. The only real difference is that in daylight the range is somewhat restricted. However, if the user requires foreigners in daylight he can connect his aerial and earth to the two sockets provided on the back of cabinet.



Showing the arrangement of the interior of the K.B. 425. Every component on top of the chassis is housed in a metal can.

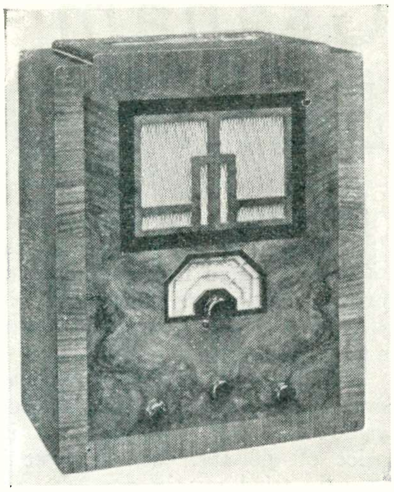
A glance at the specification panel on this page will show the advanced nature of the circuit. The high-frequency amplifier before the pentagrid frequency-changer ensures a complete absence of second-channel whistles and also gives that added fillip to the set's overall performance.

The circuit also incorporates delayed automatic volume control, which we found to work exceedingly well. The cabinet is a really elegant piece of furniture ; it is of walnut, handsomely figured, and so robustly constructed that we believe it will stand up to any possible strains and stresses imposed by being carried about.

In the centre of the front panel is a large and well illuminated tuning scale, calibrated in wavelengths and with the names of some fifty medium and long-wave stations, with the tuning control as part of the design.

Underneath, from left to right, is the wave-change switch ; tone control ; and combined on-off switch and volume control.

To put the set into operation one removes the back, then adjusts the receiver for the mains supply on which it is to be used ; this is done by taking the rubber-covered flex lead and screwing it to the mains resistance (on the right of the set just above the chassis).



The K.B. 425—"A really elegant piece of furniture."

It is important to note that the set cannot be operated with the back off ; only when the back is put in position is the mains supply connected to the receiver. Note also that there is *no* provision for the use of a pick-up.

Our daylight tests showed the 425 to be extremely sensitive. Using the set as it stood (without external aerial) we easily tuned-in all the more important British stations and the usual easily-received foreigners such as Normandy, Poste Parisien, Hilversum, Brussels No. 1, and Cologne. We found, however, the advantage of the frame aerial in these tests. When the frame was pointing in the direction of the station being received there was a perceptible drop in the amount of background noise.

With an external aerial connected, these stations were heard with almost no trace of background. We are often asked about hum on A.C./D.C. receivers ; we would like to make it quite clear that there was no trace of any hum whatsoever with this K.B. receiver.

Continued on page 319

Graham Farish Model 333 Battery Three-valver

It is a pleasure for us to review a Graham Farish receiver for the first time in these pages ; you probably know this firm for its well-known kits of parts for building a set, and for its components.

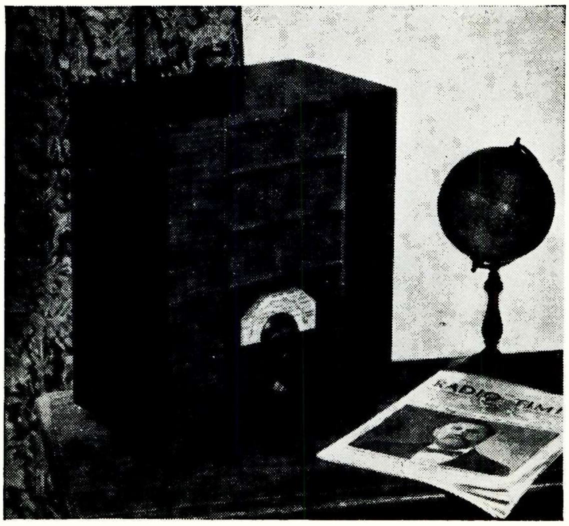
The model 333 battery receiver under review is certainly a good value-for-money proposition at its price of £6 10s. Before a set is actually tried out in our labs, we naturally take stock of its circuit and accessories, and the amount of engineering and finish put into the job.

In the first place we could not but notice the solid cabinet ; of a very quiet and tasteful design. It is finished in walnut with three simple chromium bars in relief across the loudspeaker fret.

The four controls are mounted underneath a full-vision scale calibrated with the names of about two dozen stations as well as wavelengths. When the set is switched on a narrow beam of light appears on the scale and this moves as the main tuning knob is turned. We would record here the accuracy of the calibrations.

The main tuning knob just underneath the scale in the centre has a smaller knob superimposed which actuates a small trimming condenser mounted on the end of the two-gang assembly. This we found particularly useful, for with it one could get the minutest adjustments when tuning in distant stations.

For a simple set it may seem a rather unnecessary control, but we would assure readers that this is not the case. When tuning in foreign stations with the set in its most selective condition (that is with the reaction set on the verge of oscillation and the aerial-series condenser as near to minimum as possible) this trimmer makes all the difference between finding a station and losing it altogether. More about this later.



The Graham Farish model 333 battery receiver has "a solid cabinet ; of a quiet and tasteful design"

The three controls from left to right underneath are the aerial-series condenser, combined wave-change and on-off switch, and reaction.

When one takes the back off the cabinet one realises the neat work put into the receiver. In the first place the permanent-magnet moving-coil loudspeaker is really hefty ; it has an 8 in. cone, and Graham Farish tells us a new nickel aluminium alloy magnet used gives an amazing flux-density figure.

The set chassis itself is extremely well finished in grey cellulose and in the back of it are the neat "American-type" connections for aerial and earth, and a pick-up. It is important to note that when a pick-up is used it should incorporate its own volume control (the makers recommend their own model which complies with this condition).

There is ample room on the "floor" of the cabinet for the high-tension battery and the accumulator. There is no grid-bias battery to worry about for the makers have incorporated automatic bias. This is a feature not often found in battery sets, but is extremely valuable for it ensures good quality during the whole life of the high-tension battery.

BRIEF SPECIFICATION

BRAND NAME : Graham Farish.

MODEL : 333.

PRICE : £6 10s. without batteries.

VALVE COMBINATION : Screen-grid high-frequency amplifier (Graham-Farish Ring SX2), triode detector (Graham-Farish Ring DX2) and Pentode output valve (Graham-Farish Ring PT2).

POWER SUPPLY : 2-volt accumulator and 120-volt high-tension battery.

MAKERS : Graham Farish, Ltd., Bromley, Kent.

For our tests we used a 50 ft. outdoor aerial and a good earth (very necessary), and recommended batteries ; these tests were made in South London.

First of all we must give quality of reproduction its due. The volume is ample to fill an ordinary living room and the quality is very pleasant. There are no signs of chatter, or dither, in fact someone who was with us when we were giving the 333 its tryout remarked that he liked the quality in preference to that of a mains receiver "because it is so much sweeter."

At night-time one can twiddle the main tuning control and log up to twenty or so stations on the medium waveband without any ado. The long waves will give another four or five and altogether the set gives striking proof that the straight three is not obsolete. Anyone who has technically the knowledge to work this set in its most selective state will be able to get many more stations.

For instance on our outdoor aerial we could get Berlin nearly clear of London Regional ; the secret is just that method of tuning with minimum aerial coupling and maximum reaction to which we referred earlier on.

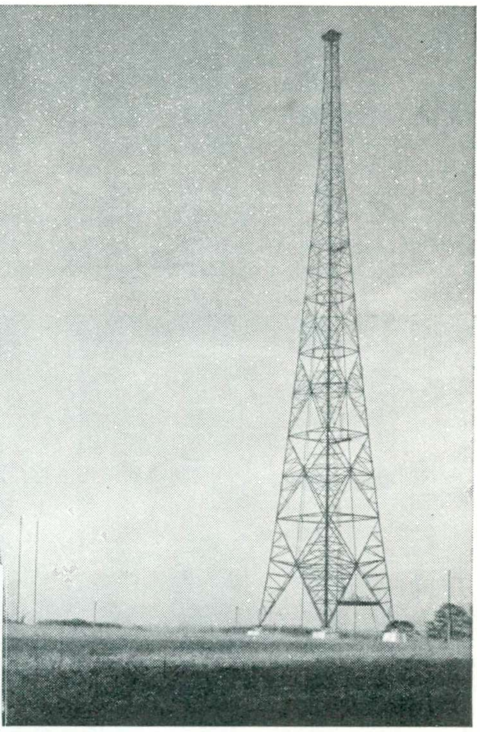
In daylight the set rather surprised us in its capability to get foreigners. We managed to log Fécamp, Hilversum, Poste Parisien, Cologne, Brussels, as well as the majority of the British Regionals and Nationals.

The burning question with

Continued on page 319

Britain's Broadcasting Service for Its Empire

Everyone at home knows that the B.B.C. provides a comprehensive broadcasting service destined primarily for listeners in the British Empire. Here L. MAXWELL WHITE gives, in effect, a miniature history of the service and shows how it has grown into the largest world-wide short-wave organisation. The information on the wavelengths used and the times of the broadcasts will be invaluable to overseas listeners. If readers at home have friends in far-off places they will be doing them a good turn by sending them a copy of this month's "W.M."



(Above) The two 350-ft. towers at the Empire Broadcasting Station at Daventry used to support the experimental short-wave aerials

(Left) Eric Fogg conducting the Empire Orchestra in Studio 8A at Broadcasting House, London

BROADCASTS specially intended for the British Empire began late in 1927, when the B.B.C., by arrangement with the Marconi Wireless Telegraph Co., built an experimental short-wave transmitter at Chelmsford. The service provided stimulated interest and enthusiasm in the Dominions and Colonies and it became obvious that there was a definite demand for a regular service. In 1930 the B.B.C. submitted a scheme to the Colonial and Imperial Conference for an Empire service, hoping that some form of financial assistance would be offered.

Very British-like, after learning that no contributions would be forthcoming, the B.B.C. decided that prestige demanded the establishment of a regular service. And so true Empire broadcasting came into being when, on December 19, 1932, the B.B.C. inaugurated special short-wave transmitters at Daventry, where the present Empire transmitters still remain.

EMPIRE CALLS AND WAVELENGTHS

			kc/s.	metres.
GSA	*A for Aerial*	... ...	6,050	49.586
GSB	*B for Broadcasting*	...	9,510	31.545
GSC	*C for Corporation*	...	9,580	31.315
GSD	*D for Daventry*	... ...	11,750	25.532
GSE	*E for Empire*	... ...	11,860	25.284
GSF	*F for Fortune*	... ...	15,140	19.815
GSG	*G for Greeting*	... ...	17,790	16.863
GSH	*H for Home*	... ...	21,470	13.972
GSI	*I for Island*	... ...	15,260	19.659
GSJ	*J for Justice*	... ...	21,530	13.934
*GSK	*K for King*	... ...	26,100	11.494
GSL	*L for Liberty*	... ...	6,110	49.100

* The use of this wavelength is not contemplated at present

That the service has met with unanimous approval overseas is evident from the fact that in 1934 the governments of two of the Colonies decided to appropriate sums of money in their budgets as a contribution towards the cost of the service.

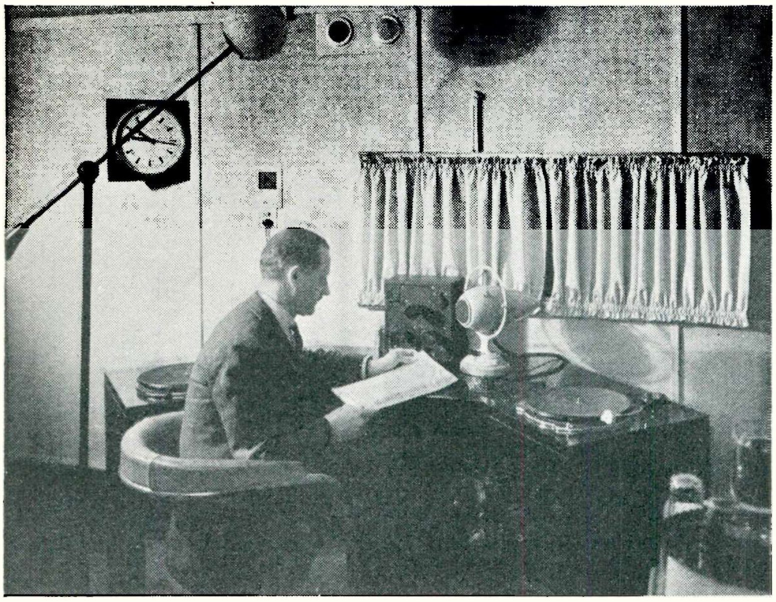
Since its inauguration in 1932 the service has steadily developed. Some idea of the great enthusiasm can be gauged from the fact that over 35,000 reception reports and letters about programmes had been received at Broadcasting House up to the beginning of May last.

Now let us see how the B.B.C. caters for its huge overseas audience. The programmes are divided up into a number of separate transmissions, each of which is designed to coincide with the evening period of the part of the Empire for which it is intended. For instance, a transmission broadcast in the early hours of the morning intended for reception in Australia and New Zealand is sent out on a wavelength known to be favourable for reception in that part of the world at that time.

At the same time it must be remembered that overseas listeners in other parts may be able to pick up that particular programme though perhaps not as satisfactorily as if it were intended primarily for them.

Strange as it may seem to non-technical listeners at home, the B.B.C.'s Empire programmes are not generally receivable in England, but they do provide a daily programme for *every* part of the Empire at suitable times providing reception conditions are reasonably good.

In these pages we give a list of the call signs and wavelengths of the Empire broadcasters. Usually two wavelengths are in use and it is up to the listener abroad to determine which is the better for his reception. One may be good one night, the other may be the star turn the next: it all depends upon the seasonal and atmospheric conditions prevailing at the time.



An announcer reading the Empire News Bulletin in studio YA at Broadcasting House. News bulletins form an important part of the Empire programmes

At present the broadcasts are divided into six periods, but these are subject to alteration as the service develops and extends.

Period One is intended for late afternoon or evening reception in the Antipodes; the programmes can be heard at correspondingly earlier hours in countries between England and Australia in an easterly direction. The transmissions can also be picked up occasionally in Western Canada on the previous night (local time in Western Canada). In mid-winter this transmission is broadcast from 8.30 to 10.30 G.M.T. and in midsummer between 4.30 and 6.30 a.m.; there is a gradual change between these times in intervening months. It is important to note that the times given are G.M.T.; readers abroad can adjust these times to their own local times quite easily without any explanation from us.

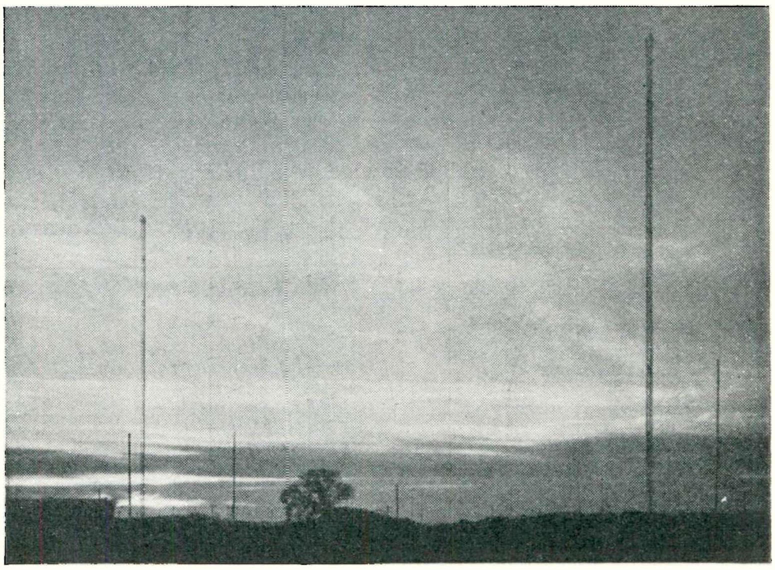
Period Two is for evening reception in Malaya, the Far East and Western Australia and takes place approximately from 11 a.m. to 2 p.m. Listeners to this programme hear part of the home programmes together with electrical and Blattnerphone recordings of the special events and an Empire news bulletin.

Period Three from 2 p.m. to 5 p.m. G.M.T. gives an evening programme for listeners in India, Burma and Ceylon, an afternoon programme for those in the Near East and Mediterranean countries and also a morning concert for those in Eastern Canada and the U.S.A. These listeners have the same type of programme as those in period two, but they also come within the time when running commentaries are broadcast in the home programme.

Period Four is from 5.15 p.m. to 10.45 p.m. G.M.T.—the longest Empire transmission—and is divided by a short interval. The first half is for evening reception in South and East Africa and Mediterranean countries and the second part for West Africa, British West Indies and Britishers in South America. Parts of this programme can be heard well in North America and New Zealand.

Listeners to period four hear the ordinary home programmes, but the programmes also contain special Empire news bulletins and recordings of the day's leading events which may have been broadcast in the home programmes.

Period Five serves Canada, Newfoundland, the West Indies and North and South America, generally from 11 p.m. to 1 a.m. G.M.T. Being mainly outside home broadcasting hours, except for dance music, these listeners have a specially arranged programme of music by the B.B.C.'s Empire orchestra together with recordings of special events and news bulletins.



The 500-ft. masts originally supporting the long-wave aerial for the old 5XX transmitter are now used to support short-wave aerials for the Canadian and East African transmissions

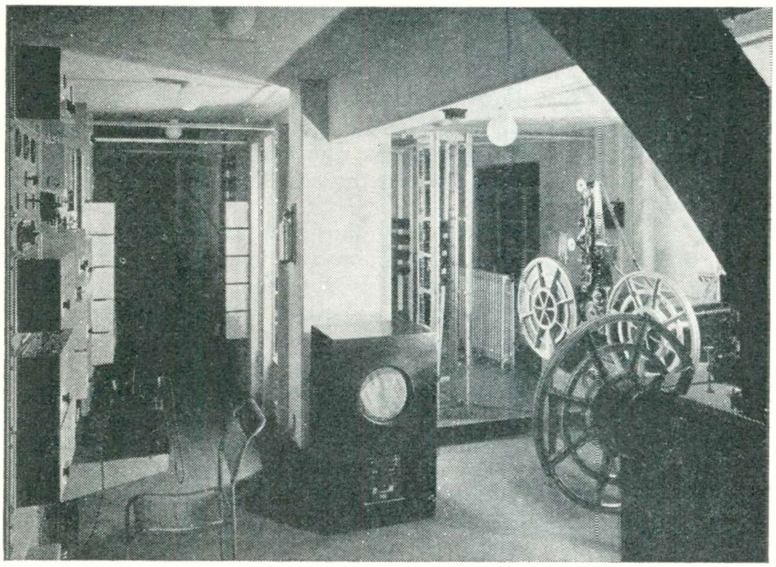
Period Six, from 3 a.m. to 4 a.m. is purely an experimental transmission intended for evening reception in Western Canada. As reports of these transmissions are received at Broadcasting House so the B.B.C. will consider extending the hours. So if you hear this programme well, listeners in Western Canada, it is in your own interests to write to the B.B.C. and tell them so.

Incidentally "W.M." will be pleased to have reports from any Empire listeners, on the strength and entertainment value generally of any of the six periods.

There is no reason why the Empire programmes should not be heard as well as those of any other European broadcasting organisation, for the B.B.C. has spent a lot of money to ensure that the service shall be up to the mark in every way.

The Empire programmes, like all our home programmes, have to pass from the studios to the main control room at Broadcasting House from where they are sent by landline to the transmitters at Daventry

The Daventry transmitters have a splendid overall frequency characteristic similar to that of the B.B.C.'s modern medium-wave transmitters, and therefore it is obvious that providing conditions are favourable towards reception, quality should be as good as home listeners receive from the National and Regional stations—and this is of a very high order.



The steel-tape recordings for the Empire programmes are made at the B.B.C. new Maida Vale studios. On the left are the input amplifiers, in the centre the check loudspeaker, and on the right two steel-tape recording machines

Much experimental work has been done and is still being continued in the matter of aerial design of the short-wave transmitters. Each of the six transmission periods has its own particular aerial system. Originally the aerials were simple in construction and were supported by 80 ft. masts. However experiments recently carried out indicate that high aerials give better results than the original low ones.

In spite of the many aerial systems only two transmitting plants are used: each is capable of supplying a power of some 10 to 15 kilowatts to the aerial.

Standard Telephones & Cables, Ltd. has just received an order from the B.B.C. for a new high-power station for the Empire service. It is believed that the power of the new station will be rated at about 25 kilowatts. The new transmitter will employ a system known as "high-power modulation," which has not hitherto been used in any of the broadcasting stations in this country.

We have given very brief details of the programmes in the section dealing with the six periods. It is however important to remember that all Empire transmissions open with the chiming or striking of Big Ben, and the chimes are also used during intervals in the transmissions. All programmes finish with the National Anthem.

Each period has its own special news bulletin specially intended for the area covered; the bulletin deals with all important events that have taken place in the world during the past twenty-four hours.

Outside broadcasts of important ceremonies and sporting events find a regular place in the programmes. As a rule use is made either of the Blattnerphone or an electrical gramophone recording.

"Live" programmes figure largely in these broadcasts and the B.B.C. has a special Empire orchestra of about twenty musicians under Eric Fogg. It is nothing to see members of this orchestra walking into Broadcasting House round the midnight hour and emerging, after entertaining listeners thousands of miles away, at four, five or six in the morning.

Talks, of course, form an important part of the programmes and leading statesmen, critics, travellers, and leaders in various walks of life often come to the microphone for five or ten minutes; the talks are kept short and informal.

That very briefly is the outline of the fine service provided for our countrymen overseas. And what is more pleasing to us listeners at home is the fact that we know these exiles enjoy every minute of every broadcast.

Wireless Magazine. November, 1935

More About the Varsity Four

How to get the Best from "W.M.'s" Variable-selectivity Superhet

In his further discussion of the Varsity Four Paul D. Tyers has some interesting things to say about variable selectivity in general; the subject is one of increasing importance, and we commend this article to the special notice of readers

LAST month I designed a very simple but effective variable-selectivity receiver called the Varsity Four. Variable selectivity can definitely be regarded as the most interesting development and essential feature in modern receiver design.

I explained at some length the various facts that have probably lead up to the introduction of the new system. Like most innovations, unless their true intent and purpose is properly appreciated the full advantages will not be derived.

It is very necessary, therefore, that readers should properly understand how and when to take advantage of the variable-selectivity properties of a modern superhet. It should be very clearly understood that the subject of selectivity and quality are unfortunately intimately connected. This is not due entirely to electrical causes, but is an outcome of what one might best term the political or economic basis governing modern broadcasting conditions.

Sidebands Explained

Let me point out once again that when a carrier wave is modulated other radio-frequency waves are produced. These waves are known as the sidebands and they are equivalent in frequency to the carrier frequency plus and minus the speech frequencies respectively. The higher harmonics on both speech and music extend into audio frequencies which are really quite appreciable.

For example, quite a lot of the harmonics which give the characteristic tone of any particular musical instrument or even speech extend well above 5,000 cycles. If there were unlimited room in the ether, or if there were only a few transmitting stations, it would be quite possible to make very unselective receivers which would accept more or less equally all the sidebands.

Limited Response of Our Receivers

Modern conditions, however, are such that it is necessary to cram into a very compact space an exceedingly large number of transmitting stations. To do this it is absolutely essential to limit the response of our receivers, as otherwise reception would be a complete jumble. Without going into any very technical reasoning it should be more than obvious that as soon as we limit the response of our receiver there must inevitably be a difference between the characteristics of the transmission and the reception. We cannot, in short, cut out something and make the reproduction identical with the original.

One might immediately imagine that if this is the case the variable-selectivity receiver must be quite a useless device because if we are going to vary the selectivity to such an extent that it is possible to receive a very wide range of sidebands, and thereby obtain good quality, we must inevitably spoil our quality with the resultant general interference that must arise.

That this is not the case is due entirely to the matter of relative field strengths. Readers will realise that if we were to erect a simple receiver comprising perhaps a detector and low-frequency valve operating a pair of telephones or a small loudspeaker, and tune it to the local station with a very poor condenser and a very poor coil, we should have a very unselective device.

At the same time the sensitivity would be so low that we should obtain no interference from the other British stations and the many Continental transmissions operating on adjacent wavelengths. In short, we are actually able to take advantage of a wide acceptance band and still obtain no interference, simply because either the gain of our receiver is too low or the relative field strengths are widely different.

Dependent on Local Conditions

Just how far we can take advantage of variable selectivity on a wide acceptance band depends entirely upon local conditions, the aerial in use, the gain of the receiver, and also the actual stations to which one is listening.

Readers will see immediately, therefore, that there is no chance of obtaining a wide acceptance band on a weak station which is operating between two other stations on either side of about the same or even greater field strength. If this is done, then interference will inevitably result.

There is, however, one other aspect of the question to which I must again give considerable emphasis. One might imagine from what I have said that variable selectivity is only useful when listening to local stations. Reflection will show, however, that if one is listening to a fairly powerful Continental transmission and on either side there are two weaker Continental transmissions, then there should be a definite possibility of obtaining a fairly wide acceptance band without much interference of the extreme sidebands.

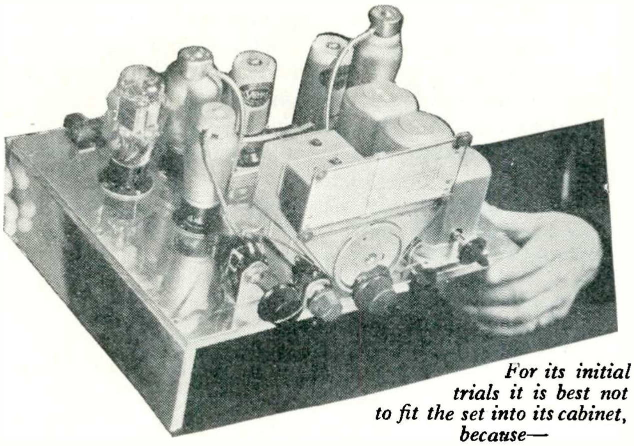
Detector Demodulation

Luckily, however, a certain action takes place in the receiver which very materially helps the results. This is known as detector demodulation. When a strong carrier is present in relation to sidebands of adjacent transmissions, the effect will be that of cutting down the interference due to the adjacent sidebands.

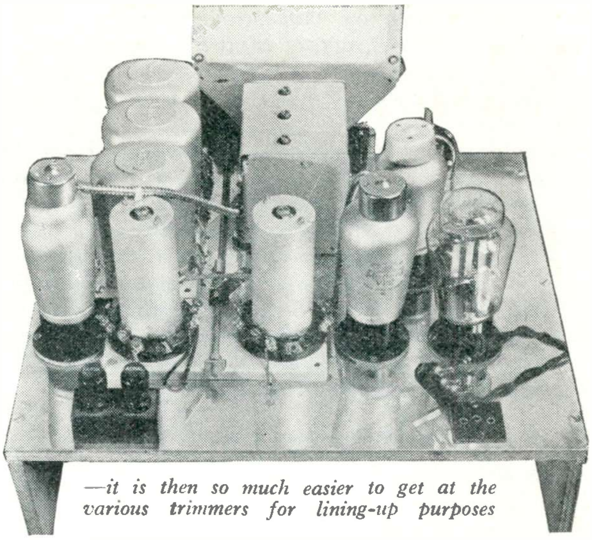
Readers who are interested in this particular subject may remember that I dealt with this very fully when describing the theory underlying the action of the Stenode receiver. In short, therefore, it will be seen that we can take advantage of the variable-selectivity properties of a receiver in order to widen the acceptance band whenever we are dealing with a station considerably more powerful than that of the adjacent transmission.

Readers who have clearly followed this point should

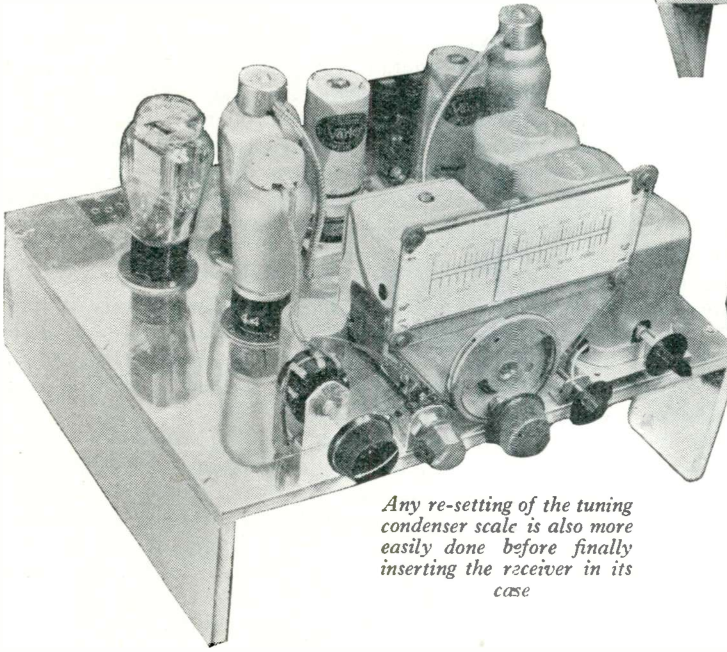
Continued on page 296



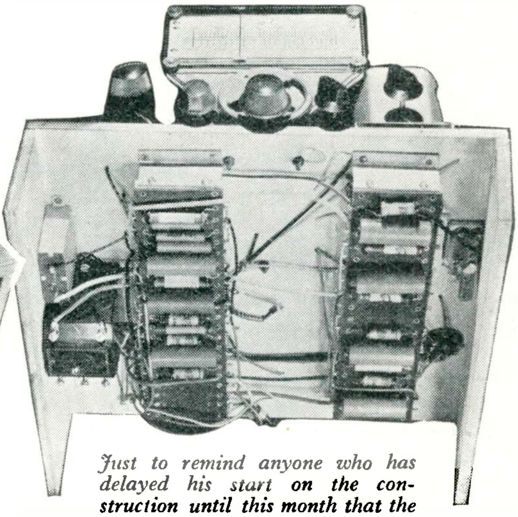
For its initial trials it is best not to fit the set into its cabinet, because—



—it is then so much easier to get at the various trimmers for lining-up purposes



Any re-setting of the tuning condenser scale is also more easily done before finally inserting the receiver in its case



Just to remind anyone who has delayed his start on the construction until this month that the condenser and resistance strips call for special attention in fitting

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

then be in a position to obtain the maximum value of the variable-selectivity property of the receiver which I described last month. Accordingly it will be well to consider one or two important operating points in some detail.

In some forms of variable-selectivity receivers the variable-selectivity control is combined with the volume arrangement so that whatever may be the setting of the selectivity control the receiver always delivers a constant output. In the set under consideration, which is designed on very simple lines, the volume control and selectivity control are independent. Moreover, on the proprietary variable-selectivity intermediate-frequency transformers used, the degree of coupling is very considerable and a large amount of variation is obtained.

Variable-selectivity I.F.'s

It is well to consider here what actually occurs when the variable-selectivity control is adjusted. Movement of the control shaft varies the coupling between the two tuned circuits in each I.F. transformer. Assuming that both these circuits are tuned to 110 kilocycles, which is the intermediate frequency used, variation in coupling will alter the response curve from a single peak to a double hump, and at the same time the skirt will tend to widen.

If the coupling is made too much the resultant wave shape may become very bad. It will be definitely asymmetric and badly peaked and not in any way desirable for correct functioning.

Readers should, therefore, avoid turning this control too far, as otherwise the resonance form will become bad and the great change in coupling may also even affect the resonance frequency of the circuits with the result that the tune point will shift slightly on the scale, and instead of obtaining a band-pass wide-acceptance band one may obtain a series of peaks and a very badly asymmetric resonance shape giving strong voltages at an altogether undesirable frequency.

Another point to remember in using the set is that the gain and sensitivity are both quite high. This means that considerable use must be made of the local-distance switch. This switch should always be turned to the local position when receiving the local stations, and the switch should also be in this position when receiving strong foreign transmissions.

Operating the Control

The setting for other stations depends entirely, as already explained, upon the conditions actually obtaining. An endeavour should always be made to work the set with the selectivity control advanced to give the widest acceptance band possible consistent with freedom from interference.

It is important to point out that quality and selectivity are not only controlled in the intermediate stages, and depend really upon the ganging of the whole receiver. It is well, therefore, to mention in some brief detail the correct procedure for ganging the receiver.

First of all the intermediate-frequency transformers should be ganged with the selectivity control at about the mid position. The four trimmers should always be adjusted so that, working entirely by ear, maximum sensitivity or output is obtained from a weak station. Readers who happen to possess a modulated oscillator will, of course, be able to gang each circuit very accurately, setting the oscillator to 110 kilocycles.

To gang the preselector and oscillator circuits the procedure is briefly as follows. First of all the set should be adjusted to a known station, such as one of the local transmitters, and if the programme does not tune in at the exact setting on the dial, adjustment of the tuning control and the oscillator trimmer should be made simultaneously, either advancing or bringing back the oscillator trimmer until the desired station tunes in at the right setting on the scale.

Ganging Hints

Volume is then brought to a maximum by adjusting the band-pass and aerial trimmers. It may be necessary to make a minute variation to any of the trimmers in order to effect the best compromise by checking the adjustment at various points on the scale. It should be realised that a set very rarely trims accurately with every trimmer on every point of the scale, owing to manufacturing tolerances. Slight adjustment to give a compromise is, therefore, the best arrangement.

So far as the long waves are concerned, nothing must be touched in order to bring these into gang other than the long-wave padder. This is mounted to the right-hand of the set and the control is accessible through a small hole in the top of the panel.

Matching of the Output Stage

The only other point likely to affect quality to any extent is the matching of the output stage. It should be realised that a double push-pull valve is used, and unless the two halves are accurately matched there will be a certain amount of distortion.

Readers are here warned to pay particular attention to the valve makers' recommendation. The matching is obtained by varying the screen voltages. Double Q.P.P. valves are supplied with a code or similar identification, and from this it is possible to obtain, by reference to the manufacturers' leaflet, the exact voltage that must be applied to the two screens. When these conditions have been fulfilled the possibility of distortion of any type being obtained is reduced to a minimum.

Reference is again directed to the voltage table published in the October issue, showing the voltages existing at various parts of the circuit when correctly adjusted. It should be understood, however, that slight variations in the characteristics of valves may make a very small difference to the observed readings, and a few volts difference from the published values need not be taken as indicating that there is anything wrong.

"Extremely Satisfactory Results"

Tests of the receiver in a number of localities show that extremely satisfactory results are obtained both as regards quality and selectivity, and the excellent gain of the set must not be overlooked.

In short a variable-selectivity receiver is definitely one of the most interesting types of sets that has recently come into the hands of the home constructor. It is thought that the present example, which takes advantage of perfectly standard practice elsewhere, should prove an exceedingly interesting starting point for any experimental work in variable selectivity. *Simultaneously the constructor has a set which can be relied upon to give high-fidelity programmes of real entertainment value.*

News of the Short Waves

By G. HOWARD BARRY

That Eleven-year Sunspot Cycle!

SHORT-WAVE conditions show distinct signs of settling down to their winter characteristics. The stations below 30 metres are already fading out quite early, but this loss is counter-balanced by the fact that the 40-metre and 49-metre bands " wake up " at a much earlier hour of the evening and are, by now, almost free from atmospherics.

On the other hand, the very short waves have been giving exciting results, mostly during daylight. On the 10-metre amateur band there have been several two-way contacts between this country and South America—a feat never accomplished until this year—and an Australian has been heard in Great Britain for the first time.

A Winter Characteristic

The fading-out of the shorter waves is purely a winter characteristic, and is in no way attributable to the eleven-year sunspot cycle, which is still " climbing." Ten metres, next year, should be providing long-distance contacts with the utmost regularity.

An interesting letter and log is to hand from a reader in Cape Town. It is rather strange to note that these logs from overseas readers rarely contain the call-signs of any stations that we do not hear in the Home country ; it does show what a perfect world-wide range the average short-wave receiver gives.

In Cape Town

All the Europeans, whom we are rather apt to regard as pests, figure in this particular list at good strengths. Lisbon (CT1AA), for instance, is received at R8 ; EAQ likewise ; DJA at R7, GSB, and ORK at R8, and so on. Japan, Java, and all the Americans also have their positions in the list.

The best of the Americans, as logged in Cape Town, are W8XK on 48.86 metres and W2XE on 49.02. The latter is a little surprising, as we very seldom seem to notice him as an outstanding transmission over here.

The amateur bands, which always give a very reliable idea of conditions as a whole, have been more consistent in their behaviour than I remember them to have been for several years. I have not missed many opportunities of listening on 20 metres during the early afternoons, and the same crowd of stations always seem to be coming in, at very much the same strength from one day to another.

Anyone who has followed the fortunes of " 20 " for the last few years will know that this doesn't often occur ! FB8C in Madagascar, for instance, is almost a landmark on the dial. His strength is always the same, and he rarely misses an afternoon.

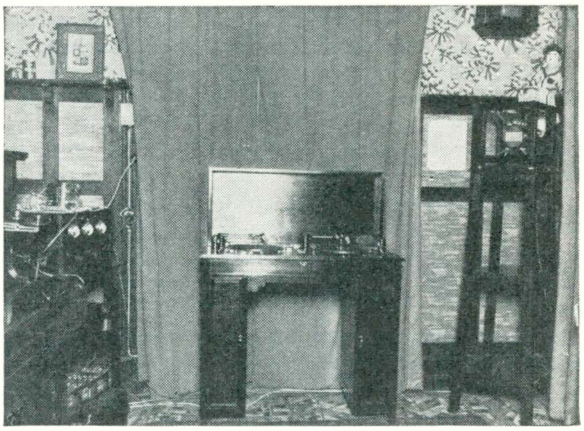
The 40-metre band, which gives more of an imitation of the 49-metre broadcast band than of any of the others, may be summed up in the words, " Europe all day, America all night." Add to that a few Asiatics during the afternoon, and Australasians during the evening, and you have the characteristics of the 40-metre band summed up.

We must not neglect the 80-metre band, either, this winter, although it will doubtless be falling off as the shorter waves improve. Experience has shown that the " optimum wavelength," if I may use the term, throughout the eleven-year cycle, is somewhere between 50 and 70 metres. As the cycle progresses, all wavelengths below this improve, and those above show signs of deterioration.

The tremendous bout of Transatlantic reception on the medium broadcast band took place during the trough of the cycle, when short waves were at their worst ; but it still continues to be quite good and 160-metre reception of America is quite a commonplace. 80 metres, therefore, should be perfectly good throughout this winter.

My Regular Log

I hope to keep a regular log of conditions on all five broadcast bands, either on the set described in this issue or on its all-mains counterpart, right through the autumn and winter. For the past five years I have kept a detailed log on the three main amateur bands—80, 40, and 20 metres—and from it I have compiled a kind of prophecy of what will be happening on the broadcast bands during the next few months.



A typical layout of a small short-wave broadcasting station : transmitter and piano on the left, twin turntables and pick-ups in the centre, and the mike on the right

49 metres should, from the look of things, be uniformly good until February. 19 metres should always be good up till about 5 p.m., with the usual inevitable bad periods lasting for a few days. 31 and 25 metres will probably be less reliable than 49, but will give a higher level of signal-strength when they *are* up to normal.

By way of a finale, I ought to mention that orders have been placed by the B.B.C. for a completely new short-wave transmitter for Daventry, and work is proceeding on a new station building. The two present transmitters will be combined to form a second high-power unit, and the Empire Station will be able to take its place as the most efficient in the world.

Records for the

A Review of the Latest

Columbia photo

Austin Croom-Johnson plays a duet with Billy Mayerl on a Columbia disc reviewed this month

OCTOBER and November are the months when we gramo-radio fans look to the record companies to start issuing really outstanding discs. On the whole the standard for the past summer has been reasonably good, but the one sorrowful spot is the lack of new artistes and new ideas ; we get the same people over and over again singing and playing the same sort of thing.

It is hardly fair to expect the recording managers to turn out new stunts and new artistes every month : there is plenty of room, however, for improvement. That is not really a grumble : I prefer to call it a suggestion.

I have played through every record that the record people have sent and my choice of the most outstanding of them is Dvorak's *Slavonic Rhapsody* played by the London Philharmonic Orchestra under the ever-vigorous Sir Thomas Beecham on three sides of two Columbia records (LX402 and 3, 6s. each). The fourth side is an equally pleasant recording of Dvorak's *Legende*. The *Slavonic Rhapsody* might almost come under the heading of light music ; such a fine combination of simple melody and stirring rhythm should have just as much appeal for the " man-in-the street " as for the avowed musician.

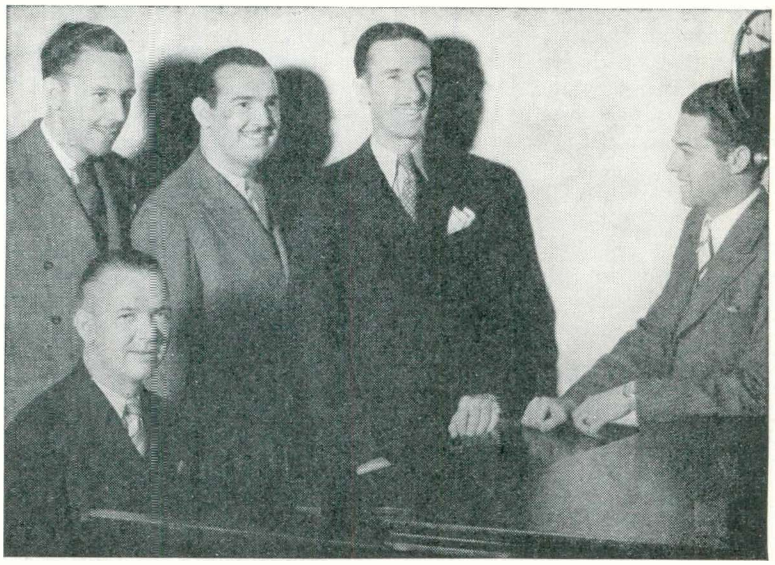
Crowds can be seen round the Tivoli every day waiting for a chance to see and hear Grace Moore's new film, *On Wings of Song*. Thousands of fans will be interested to hear that H.M.V. has produced a double-sided 12-in. record, *Memories from the Film " On Wings of Song,"* on similar line to the record they made of *One Night of Love*, with Joan Cross and Henry Wendon, both of the Vic-Wells Opera Company, taking the leading parts.

It is not generally known that Joan Cross was the anonymous singer in the first record; I am glad to see that her identity is now officially revealed. Joan Cross is a really gifted lyric soprano, and it is to be hoped that H.M.V. will issue more records made by her. This latest record is C2775 (4s.) and it should appeal equally to film fans, frequenters of the Sadler's Wells opera and music lovers in general.

You Are My Heart's Delight; I do not know quite how you personally feel about this song. My own opinion is that I did, at one time, appreciate it, but so many other people have appreciated it too, that their enthusiasm has rather damped mine. The news now is, that after all this long while, the great Richard Tauber has been persuaded to sing the song in English. (Parlophone RO20284, 4s.)

I need say nothing more about it except that Tauber sings the song with all his usual charm; it is probably Tauber's singing at its best!

I have been asked by an overseas reader if I would, every month, pick out four good light orchestral records. Here is this month's pick: a selection from *Please Teacher* by the New Mayfair Orchestra on H.M.V. C2774, 4s.; the Milan Symphony Orchestra playing the Prelude to Act Four of Puccini's *Manon Lescaut* and *Scene Poetiche* (Godard)—very tuneful and dainty this—on Parlophone E11284, 6s.; *Benedictus* (Mackenzie) and *Serenade Mauresque* (Elgar) by the New Light Symphony Orchestra on H.M.V. C2763; and finally Grainger's *Handel in the Strand* and *Mock Morris* played by Sir Henry Wood and the Queen's Hall Orchestra on Decca K767, 2s. 6d.



Columbia photo

" Red Sails in the Sunset " and " In the Middle of a Kiss " are sung by Les Allen, the one-time B.B.C. band vocalist, with his Canadian Bachelors on a new Columbia record, FB1112, just issued

Radiogram

Record Releases by T. F. HENN

Reginald Foort, the well-known cinema organist, gives us two (too) old ones on Decca F5691; they are *The Lost Chord* and *Blue Danube Waltz*. This record is interesting in that it was recorded on the organ of the Paramount Theatre, New York, which is reputed to be the world's largest cinema organ. The effects are, of course, excellent and altogether the record is a notable one from the recording point of view; but on its value as fresh entertainment opinions can differ.

Much prefer Sidney Torch's latest Columbia record (DX707, 4s.). This is called *Torchlight Music*, and is a selection of some good tunes including *Teddy Bear's Picnic* and *The Whistler and His Dog*; though *Parted* is very near the limit!

By the way, in case you are interested in tattoo records, H.M.V. has issued two "medleys" of the recent Tidworth Tattoo (C2776 and C2777). These are notable more for music than for atmosphere, but if you like good military-band music they are definitely worth having.


H.M.V. photo

Jack Jackson, of the Dorchester Hotel, with his band, admiring a 22-guinea H.M.V. radiogram. This band records regularly for H.M.V.

Something unusual. H.M.V. issue special "educational" records, and it is always worth while to look down the list every month for often one comes across a disc that "tickles the fancy." I notice that this month there is a record of the pipes and drums of the 2nd. Batt. Scots Guards playing *Highland Schottische* and *Eightsome Reel* (B8344, 2s. 6d.). This record rather appeals to me and I have ordered it. Keep your eyes open on this Education supplement.

I must bring to your notice two especially good light piano records, one sent to me from Parlophone, the other from Columbia. The Parlophone record is of Patricia Rossborough playing *In the Middle of a Kiss* and *You're All I Need*; these are very pleasant tunes, but her artistry and the excellent recording are the qualities that appeal to me. (R2118, 2s. 6d.)


Billy Mayerl, the famous syncopated pianist, joins forces in a duet with Croom-Johnson for Columbia

The other is good because it is just out of the ordinary; a record of Billy Mayerl and Austin Croom-Johnson playing duets, *Bats in the Belfry* and *Green Tulips*. They are lively tunes and I do like the neat way one pianist, sounds like Croom-Johnson, switches over to a harpsichord. Mayerl, you all know, is the famous syncopated pianist, while Croom-Johnson is the originator and producer of the radio feature, "Soft Lights and Sweet Music." (Columbia FB1115. 1s. 6d.)

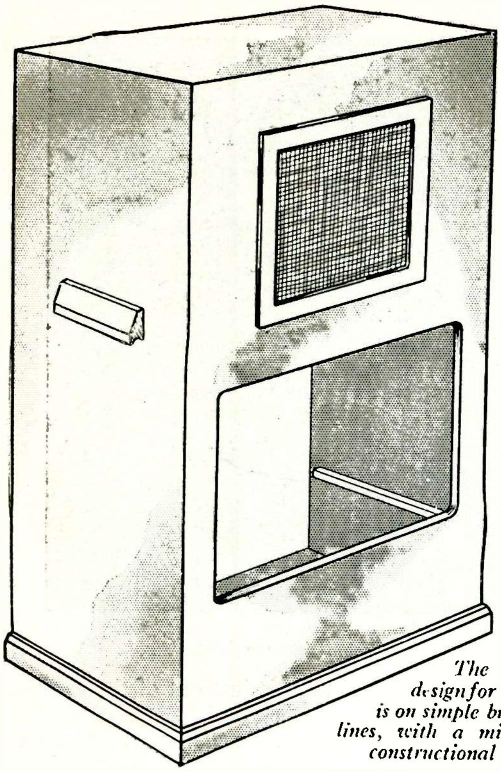
Those of you who heard the "In Town Tonight" relay from Radiolympia will remember Smith and Herbert, the two messenger boys, with their Mills-Brothers stuff and guitar. Columbia has sent me a record of them "performing" *Nobody's Sweetheart* and *You'll Still Belong to Me* (FB1111. 1s. 6d.) These two lads collar my appreciation for their plucky showing at Olympia as well as for the skill of their work. Only a deaf man would think that the two sides were the work of amateurs. A record certainly worth eighteen pence!

I know I shall offend some readers if I omit to mention two or three of the best vocal records available. There are only two that I really like this month. They are Paul Robeson singing *Swing Low, Sweet Chariot* and *On Ma Journey* on H.M.V. B8372, and Alfred Piccaver, leading tenor of the Vienna State Opera, singing *Wait* and *Love is Mine* on Decca M465. Both cost 2s. 6d.

Space is short. Worth hearing particularly is Coleman Hawkins, the famous coloured saxophonist, playing *Some of These Days* and *After You're Gone*, accompanied by the Ramblers Dance Orchestra on Decca F5581. Really brilliant!

Dance music is better than usual, but here are the best three; at least I think so. Carroll Gibbons playing *Music Puts Me in the Strangest Mood* (foxtrot) and *What Harlem is to Me* (foxtrot) on Columbia FB1101 (1s. 6d.), Jack Hylton playing *Lovely Liza Lee* and *Where the Arches Used to Be* (foxtrots) on H.M.V. BD214 (1s. 6d.) and Red Norvo and His Swing Octet playing *Tomboy* on Parlophone R2110 (2s. 6d.).

Make Your Own Cabinet for the Minitube Three!



The suggested design for the cabinet is on simple but pleasing lines, with a minimum of constructional work

Cabinet making is much easier than most set-constructors realise, and with the aid of the detailed drawings presented on these pages it becomes a simple and fascinating new branch of the hobby. G. P. KENDALL, B.Sc., the designer of the Minitube, gives some useful constructional and operating hints

CORRESPONDENCE received after the publication of the last issue indicates that the Minitube Three has attracted the attention of a number of readers who have previously built but few sets, and I gather that some further constructional details would be welcome to them at least.

Accordingly I would ask the old hands to bear with us while we go over some of these matters a little more fully than is customary. First there is the question of the woodwork; the complete chassis can no doubt be bought ready for use if desired, but there is no reason why anyone who can cut to a straight line with a saw should not make his own.

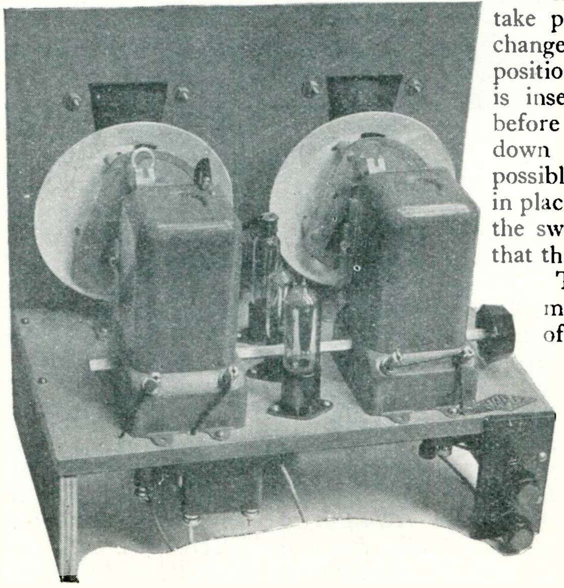
Making the Chassis

First you want a piece of metal-sprayed plywood, 6 in. by 10 in. and ⅜ in. thick. The special material called "Metaplex" (obtainable from Peto-Scott) is suggested here. Next it is necessary to screw to the ends the crosswise runner pieces of plain plywood measuring 2½ in. by 6 in., in the positions clearly shown by the photographs.

The panel is a piece of hardwood-faced plyboard 10 in. by 9½ in. and $\frac{3}{16}$ in. thick. It is attached to the baseboard and end runners by means of a few screws passed through into the edges at convenient points. I would suggest, by the way, that the most pleasing appearance will be obtained if the panel facing wood be chosen to contrast in tint with the cabinet in which the set will be housed. Failing this, of course, panel and cabinet should match as perfectly as possible.

Mounting the Components

Attaching the terminal strip will be found an obvious matter, I think, and the assembly of components comes next. I gave some general hints about this process last month, but the following miscellaneous points may also be of assistance.



The minute size of the valves makes the Minitube look quite large, but it really is a very small set!

In mounting the coils one must take pains to see that the wave-change switches are in identical positions before the control rod is inserted; this must be done before screwing the coil units down in place, and it is then possible to use the rod as a guide in placing the coils in position with the switches properly lined up so that they turn freely.

The curious-looking object mounted on the underside of the baseboard alongside the .005-microfarad fixed condenser is the low-frequency transformer, and the references to colours on the wiring diagram will be found to apply to the coloured leads fitted to this component as means of identification. These leads will be received neatly coiled in spiral form, and they are a trifle easier to fit in place if left thus instead of being pulled out straight.

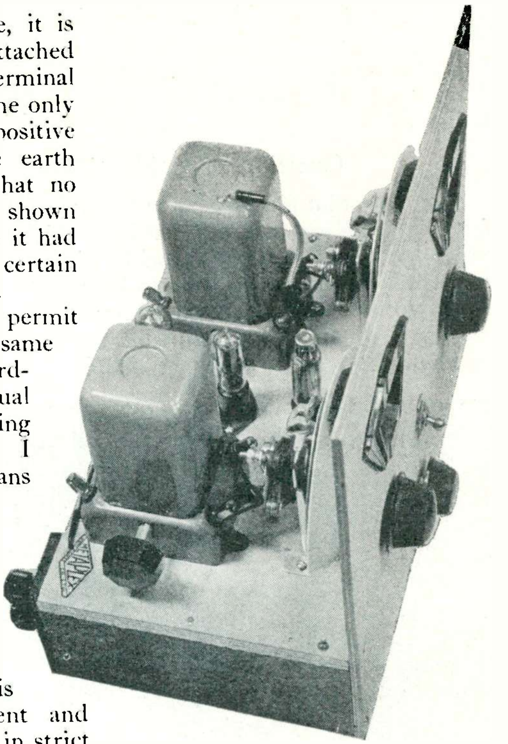
The general wiring is very simple and will not take long; I should perhaps just draw attention to the fact that wherever a wire has been taken through a hole in the baseboard that hole is given an identifying number on the wiring diagram. This number will be found against the hole on either side of the baseboard in the drawing.

Watch the Insulation

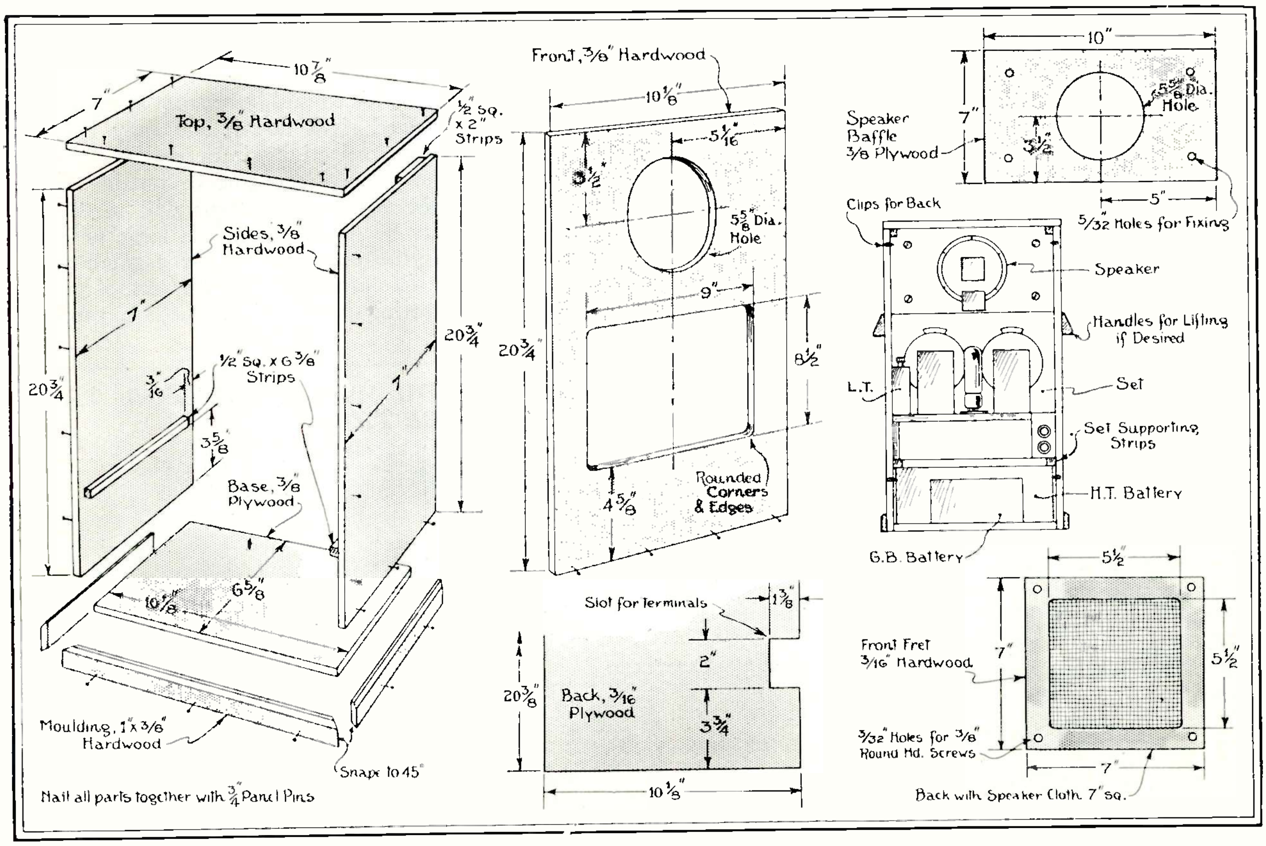
Naturally one must take due care to see that the insulating sleeving on any wires passing through these holes is perfectly sound; a short-circuit to the metallised surface of the baseboard would be apt to produce a very puzzling fault. The positions of the holes are not exactly critical, but I advise that the one for the lead running from the grid of the first valve (V_1) to the " F " (fixed) plates of one of the tuning condensers should be placed with a little care in the original position; this is the hole marked " 3 " on the wiring diagram.

The battery leads raise one or two special points. For instance, it is to be noted that they are attached direct to various convenient terminal points on components, etc., the only exception being the grid-bias positive lead; this is fixed to the earth terminal. It will be seen that no high-tension negative lead is shown on the wiring diagram, since it had been my intention to discuss certain alternative arrangements here.

However, space did not permit last month, and I'm afraid the same difficulty still persists. Accordingly I suggest that just the usual scheme be used without troubling about any special notions I may have had. That means that the constructor should just fit a continuation of the low-tension negative flex and fix the high-tension negative plug on the end thereof. The circuit diagram should be ignored in this connection, and all filament and general battery wiring done in strict accordance with the wiring diagram reproduced on page 186 of the last issue.



A view from this angle shows how the wooden chassis structure is put together, and this too is a task anyone handy with woodworking tools can undertake

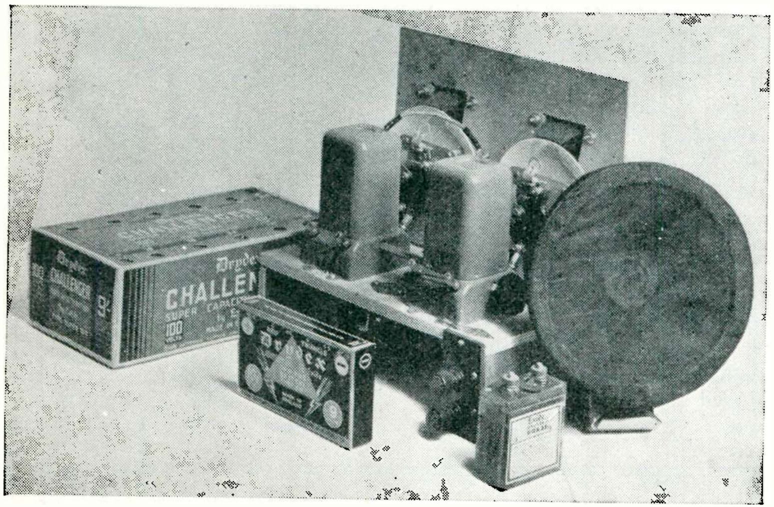


Here you have the cabinet design in fully detailed "dissected" form. If you do not wish to build it yourself any cabinet maker will be able to produce what is required with the aid of these drawings

I think that these additional notes if taken in conjunction with those of last month will be found to make all the constructional work quite simple and straightforward, so now we can go on and consider the question of a cabinet.

Question of Cabinet Size

The first point for decision is the *size* of the housing, for it is to be remembered that it would be quite easy to design a cabinet quite capable of holding set and batteries yet not large enough to baffle the loudspeaker satisfactorily. Instead of just asking one of the cabinet-making firms to design a suitable case and showing a photograph of the original set therein I have adopted a rather different course, upon which, incidentally, I should much appreciate readers' opinions.



The complete assembly of set chassis, loudspeaker and battery units ready for fitting into their cabinet. Note that both loudspeaker and accumulator are of special small sizes and hence do not give a fair comparison for size with the receiver: also a 4.5 volt bias battery will suffice

Included in this article will be found a set of simple drawings for the making of a suitable cabinet for the Minitube Three. These have been prepared by a draughtsman who happens to be himself a keen cabinet-making enthusiast, and I think readers will find that they form the basis for a cabinet of simple but pleasing appearance, and very easy construction.

These drawings should make it a simple matter for anyone with the slightest aptitude for woodworking to build his own, while those who do not wish to do this can take the drawings to a local cabinet-maker and have the case made up for them at a very moderate price (in consideration of the fact that the cabinet-maker will not have to work out his own dimensions).

Cabinet Finish

By the way, so far as I at least am concerned the great difficulty about making one's own cabinet is the question of a suitable finish, and I expect other people find the same thing. In order to overcome the difficulty as far as possible it has been arranged to include in this issue a short article on the making of an extension loudspeaker cabinet wherein will be found some practical notes on methods of wood finishing.

Battery Positions

It will be observed that the cabinet drawings to which I have referred give suggested positions for the various batteries, but it may be as well to point out that the actual placing of the low-tension and grid-bias units may be reversed if desired. So long as one of the special midget accumulators is used both these units can be placed in the vacant spaces on the set baseboard at either end, but either can be placed in the position shown for the bias unit if this proves more convenient in the case of a battery of some unusual shape. (By the way, the type number of the unit shown in the photograph is PRA3.)

Now it just remains to add one or two practical operating notes and then I can leave the reader to go ahead with the Minitube and, I hope, get the excellent results of which the set is capable. Really there are only two points in addition to those mentioned last month: the first is a reminder that good selectivity from any simple receiver of this type demands just a little care in applying reaction—there is nothing difficult about this, and excellent results can be obtained once the trick has been mastered.

Selectivity Adjustment

The other point concerns the use of the compression-type condenser in the aerial lead. This should be set first at maximum (screwed right down) and only reduced if more selectivity is needed.

In general when an average sort of outside aerial system is used the maximum setting will serve and reduction will only be necessary with a large or high-capacity one. In the opposite case of a small aerial it may be better to cut the condenser out of circuit altogether by shorting its terminals with a piece of wire.

LIST OF COMPONENTS YOU WILL NEED FOR THE MINITUBE THREE

		s.	d.
CHASSIS			
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 Compax .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			
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 ...			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 (see special note in text).			

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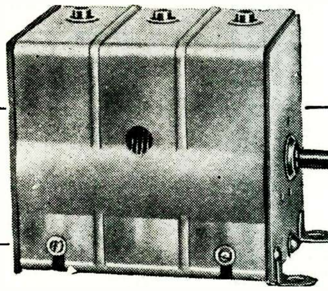

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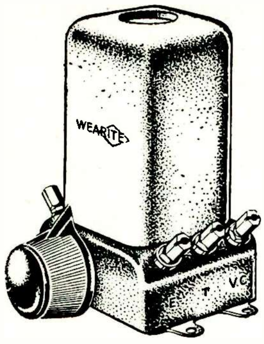

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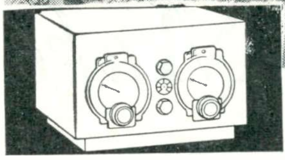
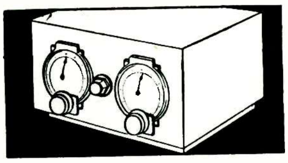
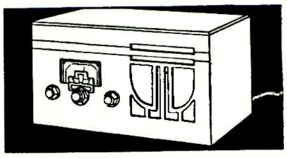


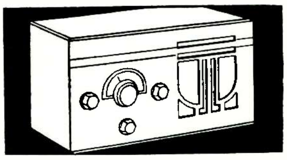
THE "DISCOVERY" SHORT WAVE THREE



THE "QUEST" SHORT WAVE TWO



THE "SENSITY SUPER" ALL-ELECTRIC A.C.3



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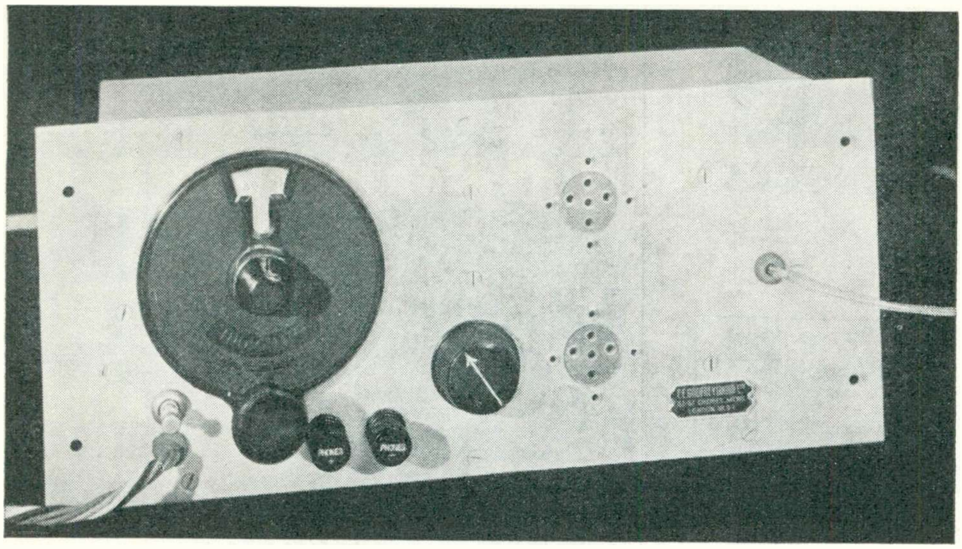

The author's instrument is made up in a neat metal case with just the valves, a pair of terminals and two controls visible on the outside

By

P. WILSON

M.A.

How to Make a Simple and Accurate Impedance Matcher

The modern receiver is dependent for its successful functioning upon the correct matching of coils, condensers and complete tuned circuits, an operation often regarded as beyond the powers of the amateur technician. In this interesting contribution Mr. Wilson shows that it is relatively easy to construct a piece of apparatus capable of rendering such matching a very simple process

EVERY serious experimenter, and certainly every serviceman who takes a pride in his work, must at some time or another have felt the need for an instrument for matching two tuning coils, two variable condensers or two tuned circuits accurately. The need has become more pressing since the advent of multi-H.F. receivers with ganged tuning and of superhets with intermediate-frequency transformers of adjustable frequency.

Badly Needed

Various means have been devised for obtaining more or less rough adjustments of the various components, but as one goes round and observes how far astray even well-informed people can get, one is driven to the conclusion that as a rule the adjustments are more, rather than less, rough.

It is, of course, possible to do all that is required if one has available a cathode-ray oscillograph and knows how to use it for the purpose. But cathode-ray oscillographs happen to be rather expensive ; and it occurred to me that a simple instrument which I had adapted from a design I saw in an American publication some years ago would be welcome to a number of readers.

The instrument is very easy to make and the components in the main are standard which everyone has lying by. The only components peculiar to the circuit are the coils and these any handy-man can readily construct.

Essentially the circuit consists of two oscillating valves. The first one has a fixed frequency of the order of 800 kilocycles, the tuning being accomplished by coils and condensers of fixed values. It is important to notice, however, that harmonics of 1,600, 2,400, etc., kilocycles are also produced by this oscillator.

The second valve is a short-wave oscillator the range being variable from about 30 to 60 metres (10,000 to 5,000 kilocycles). This oscillator beats with a harmonic of the first oscillator and produces an audible note in a pair of headphones. As the frequency of the second oscillator is adjusted by means of the variable condenser, the beat note goes lower in the scale until eventually the position of "zero beat" is found when the second oscillator is tuned to the exact frequency of a harmonic of the first.

How it Works

Now if any impedance, whether an inductance, a capacitance, a resistance, or any combination of these (e.g. a tuned circuit) is connected across one of the coils of the first oscillator its frequency of oscillation will be shifted by an amount which depends on the impedance of the external circuit.

The adjustment of the second oscillator would in these circumstances have to be altered to arrive at a position of zero beat.

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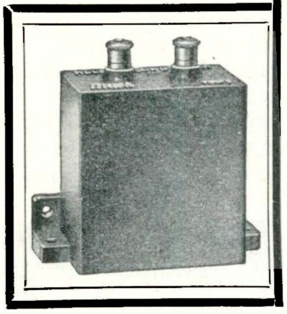

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This second adjustment, then, is a measure of the impedance connected across the tuned circuit of the first oscillator. Two exactly matched components when connected in this way should give zero beat at exactly the same setting of tuning condenser of the second oscillator.

It is obviously important for the accuracy of the test that the leads connecting the component to the first oscillator should have the same self-capacity in each case and should be screened so that no other component can affect the oscillator frequency.

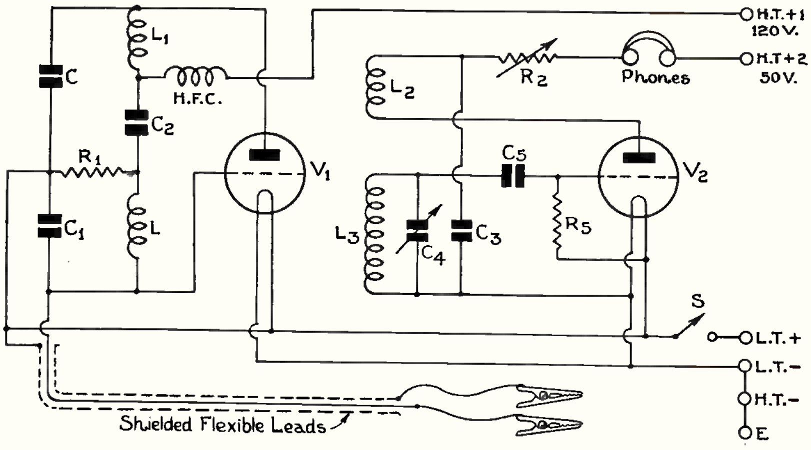
Use of Harmonics

It should also be noticed that since the instrument works on harmonics of the first oscillator frequency it can only be used to match up components very nearly alike to begin with.

External components of different frequency might just alter the first oscillator in such a way that harmonics of the same frequency would be produced in the two cases and zero beat would then be obtained in the 'phones when the second oscillator is tuned to that frequency.

Tuning Arrangements

The complete circuit is shown in Fig. 1. V_1 is the first oscillator tuned by coils L and L_1 and condensers C, C_1 and C_2, R_1 being a resistance common to both circuits. The external impedance is connected across the grid coil L by means of flexible leads about a yard long, the one at L.T.+ potential being used as a screen for the other. Crocodile clips are used to connect the leads to the external impedance.



The circuit employs a couple of valve oscillators in a very simple hook-up

V_2 is the second (short-wave) oscillator, the grid circuit being tuned by the variable condenser C_4. High-tension is fed to it through a variable resistance R_2, by-passed by C_3. The function of this variable resistance is to stop howling in the 'phones which occurs at some settings of C_4, completely obscuring the beat.

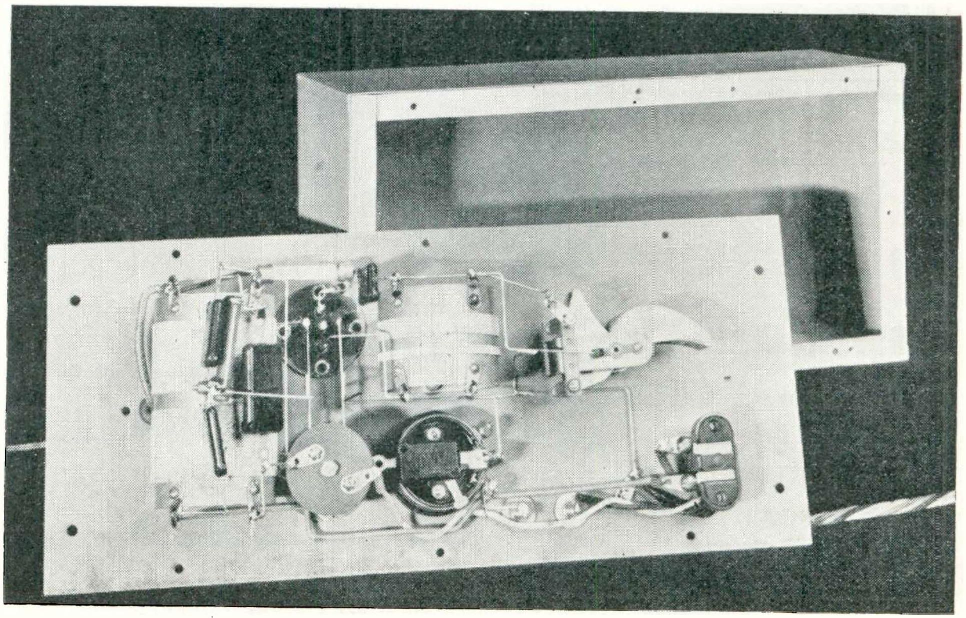
All the components are mounted on a metal panel which forms the lid of a metal screening box. The shielded flexible leads are taken through a rubber grummet in this panel since in the circuit, as made up, the shield is connected to L.T.+ and the box to L.T.— and earth.

The coils are wound on two paxolin tubes each 2 in. in diameter. L and L_1 are wound on one tube and have 32 turns each with $\frac{1}{4}$ in. space between the coils ; L_2 and L_3 are wound on the second tube spaced $\frac{3}{16}$ in. from each other. L_2 has 4 turns and L_3 9 turns. For the wire 9-strand Litz was actually used, though probably solid double-silk-covered wire of about No. 20 gauge would serve equally well.

The instrument I use was specially made for me by Godfrey Radio, Ltd. using one of their special short-wave condensers for C_4. This has a very low H.F. resistance and gives a dial range of 270° instead of the usual 180°.

Operating Notes

The method of operation is quite straightforward. When the connections to phones, H.T. and L.T. batteries have been made as indicated in the circuit diagram, beat notes will be heard between the 360-metre oscillator and the short-wave oscillator at every 10 degrees or so of the



Standard parts are used throughout the construction except in the case of the tuning coils ; these can easily be wound by the constructor for himself

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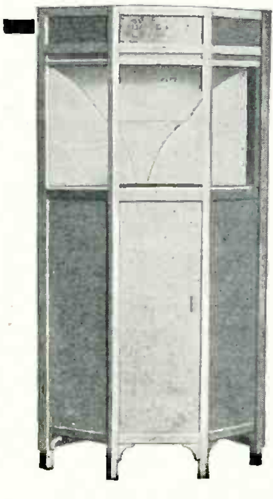

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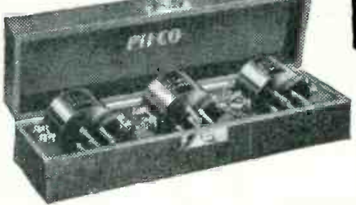

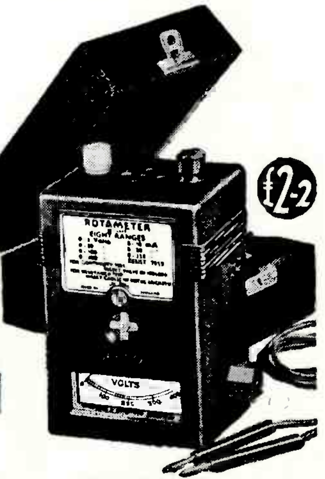

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C_1 : Do. do. 0.0005-mfd. (Dubilier)
C_2 : Do. do. 0.01-mfd. (Dubilier)
C_3 : Do. do. 0.0003-mfd. (Dubilier)
C_4 : Variable air condenser 0.00015-mfd. (Godfrey Radio)
L and L_1 : 32 turns spaced ¼ in. apart on 2 in. paxolin former.
L_2 : 4 turns on 2 in. former.
L_3 : 9 turns on same former as L2 with $\frac{3}{16}$ in. space between.
All coils 9/47 Litz wire.
H.F.C. : 200 turns, 30 D.S.C. on 1¼ in. spool.
R_1 : Grid leak 10,000 ohms (Dubilier).
R_2 : Variable resistor 50,000 ohms (Colverstat)
R_3 : Grid leak 8 megohms (Dubilier)
S : On-off switch.
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2 Valve holders : (Clix 5-pin).
2 Phone terminals : 4-way battery cord (Belling Lee).
Shielded flexible lead.
2 rubber grummets.
Metal box : 12 in. by 6 in. by 4 in. deep (Peto Scott).

tuning condenser C_4. If the beat notes are not heard or if howling occurs R_2 requires adjustment. Possibly also H.T.+2 should be reduced to some lower value (say 40 volts).

When the beat notes become audible the instrument is ready for use.

Suppose, for example, it is to be used for ganging the tuning condensers of a receiver.

The crocodile clips are connected across the first tuning condenser, the shield being taken to the shaft of the condenser (i.e. the moving vanes) and the inner lead to the fixed vanes.

Set the receiver dial at the point to be checked. Adjust C_4 to a beat note in the 'phones and rotate slowly until the position of zero beat is found, that is when no signal is heard in the 'phones.

Correct Indication

Now remove the clips from the first tuned circuit in the receiver and clip on to the second. Zero beat should be obtained at exactly the same dial reading for C_4 as before and the trimmer of the second tuning condenser in the receiver can be adjusted until this occurs.

Repeating the Check

Proceed in the same way for other tuned circuits in the receiver. The receiver will then be accurately ganged *for that particular setting of the tuning dial.* Go through the same test for different settings of the tuning dial.

If the tuned circuits in the receiver are properly matched no further adjustment of the trimmers should be needed to obtain zero beat at the same setting of C_4 for all the tuned circuits in the receiver. The dial reading for C_4 will be different at each stage of the test, i.e. at different settings of the receiver dial, but it should be the same for each of the receiver circuits at each stage.

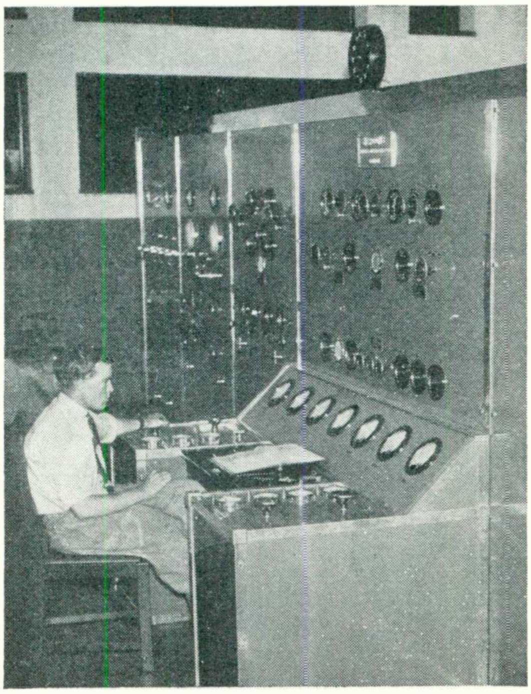
If this does not occur it is possible to determine whether it is the condensers or the coils in the receiver that are at fault. To do this it will be necessary to disconnect the coils in the receiver from their respective tuning condensers and other associated components.

The clips of the impedance matcher are connected across each coil in succession and the dial reading for C_4 should be noted. If the coils are properly matched the reading should be the same for each of the coils. If it is not the same, wire should be added or taken away from the coils until exact match is obtained.

Similarly the tuning condensers of the receiver can be tested at different settings of their common dial.

Not the Oscillator!

It should be noted that the ganging of the oscillator circuit in a superhet *cannot* be checked in this way ; for the resonant frequency of the oscillator circuit is necessarily different from that of the other circuits.



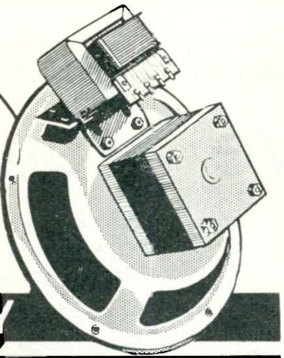
The neat and business-like appearance of the new Marconi 10-kilowatt transmitter at Grahamstown, South Africa, is apparent from this picture of the control desk

The tuning of the intermediate-frequency transformers, however, can be checked up in precisely the same way as that of the H.F. circuits.

These examples, though the most usual, are not the only uses to which the instrument may be put. In experimental work it is not unusual to have to match similar components accurately and obviously unless one has available some rapid method of measuring capacities or inductances, an instrument such as this which will serve to match any two impedances of the same character has a special value.

It occurs to me to add a final word of explanation about my suggestion that coil matching can be accomplished by adding or removing turns, for I do not want to lead anyone into unexpected difficulties.

Some of the very compact iron-core types are so designed that nothing can be done to the windings without taking down the whole assembly and removing the core, and that is not an operation to be undertaken lightly unless one has had much experience of the work.



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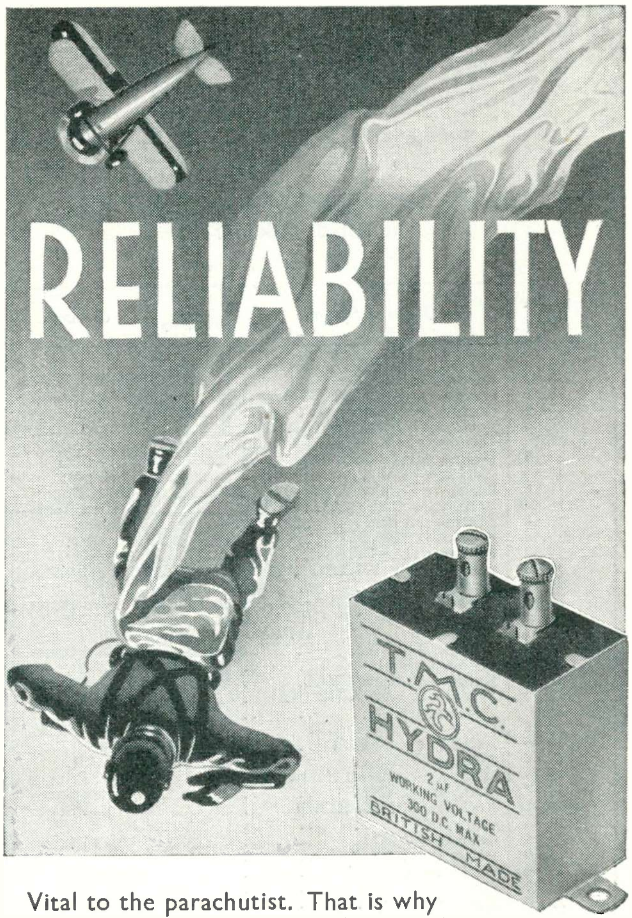

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Wavelengths of the Principal Short-wave Broadcasters

Stations best Received in the British Isles are Indicated in Bold Type

Names in Brackets are those of the Main Stations from which the greater part of the Programmes are Relayed

Wave-length	*Name of Station*	*Dial Readings*	*Country*
13.92	Pittsburgh W8XK		United States
13.97	**Daventry (Empire) GSH**		Great Britain
14.49	Buenos Aires LSY		Argentine
16.36	Lawrenceville (N.J.) WLA		United States
16.5	Drummondville (CFA8)		Canada
16.56	Buenos Aires LSY3		Argentine
16.85	Kootwijk PCV		Holland
16.86	Daventry Empire GSG		Great Britain
16.878	**Boundbrook W3XAL (WJZ)**		United States
16.88	**Eindhoven PHI**		Holland
19.47	Riobamba PRADO		Ecuador
19.52	Budapest HAS3		Hungary
19.56	**Schenectady W2XAD** (WGY)		United States
19.61	La Paz CP4		Bolivia
19.64	New York W2XE (WABC)		United States
19.66	**Daventry (Empire) GSI**		Great Britain
19.67	Coytesville N.J. WIXAL (WEEI)		United States
19.67	Tashkent (Rim)		U.S.S.R.
19.68	**Radio Coloniale FYA**		France
19.72	Saxonburg W8XK (KDKA)		United States
19.74	**Zeesen DJB**		Germany
19.82	Daventry (Empire) GSF		Great Britain
19.84	Rome (Vatican) HVJ		Italy
19.88	Moscow (RKI)		U.S.S.R.
19.93	W8XK, Saxonburg (KDKA)		United States
20.27	Rocky Point WQV		United States
20.31	Rocky Point N.Y. (WEB)		United States
21.43	Cairo SUV		Egypt
21.53	Rocky Point WIK		United States
21.58	Rocky Point WQP		United States
21.605	Rocky Point WQT		United States
21.83	Drummondville CJA8		Canada
22.26	Rocky Point WAJ		United States
22.48	Santa Rita YVQ		Venezuela
22.684	**Zeesen (DHB)**		Germany
23.39	Radio Maroc (Rabat) CNR		Morocco
24.41	Rugby GBU		Great Britain
24.9	Kootwijk PDV		Holland
25	Moscow RNE		U.S.S.R.
25.25	Radio Coloniale, Paris (FYA)		France
25.27	**Saxonburg (Pa.) W8XK (KDKA)**		United States
25.28	**Daventry (Empire) GSE**		Great Britain
25.34	Wayne W2XE (WABC)		United States
25.4	**Rome 2RO**		Italy
25.45	Boston WIXAL (WEEI)		United States
25.49	**Zeesen DJD**		Germany
25.532	**Daventry (Empire) GSD**		Great Britain
25.63	Radio Coloniale FYA		France
26.83	Funchal CT3AQ		Madeira
27.65	Nauen DFL		Germany
27.86	Rugby GBP		Great Britain
27.88	Marapicu PSG		Brazil
28.28	Rocky Point (N.J.) WEA		United States
28.5	Sydney VLK		N.S. Wales
28.98	Buenos Aires LSX		Argentine
29.03	Bermuda ZFD		West Indies
29.04	Ruysselede (ORK)		Belgium
29.35	Marapicu PSH		Brazil
29.59	Leopoldville OPM		Belgian Congo
29.64	Marapicu PSI		Brazil
29.84	Abu Zabel, Cairo SUV		Egypt
30	Radio Excelsior LR5		Argentine
30.1	Rome IRS		Italy
30.4	Lawrenceville WON		United States
30.4	Tokio JIAA		Japan
30.43	Madrid EAQ		Spain
30.77	Lawrenceville WOF		United States
30.9	**Rugby GCA**		Great Britain
31.23	Mexico City XETE		Mexico
31.25	**Lisbon CTIAA**		Portugal
31.26	Radio Nations HBL		Switzerland
31.28	**Philadelphia W3XAU (WCAU)**		United States
31.28	**Sydney VK2ME**		N.S. Wales
31.32	**Daventry (Empire) GSC**		Great Britain
31.34	Jelöy		Norway
31.35	**Millis W1XAZ (WBZ)**		United States
31.38	**Zeesen DJA**		Germany
31.45	**Zeesen (DJN)**		Germany
31.48	**Schenectady W2XAF (WGY)**		United States
31.55	**Daventry (Empire) GSB**		Great Britain
31.55	Melbourne VK3ME		Victoria
31.55	Caracas YV3BC		Venezuela
31.58	Rio de Janeiro PSA		Brazil
31.6	**Skamlebaek**		Denmark
31.7	Havana		Cuba
31.71	New Brunswick WKJ		United States
32.71	**Lawrenceville WNA**		United States
32.79	Maracay YVQ		Venezuela
32.88	Budapest HAT4		Hungary
33.26	Rugby GCS		Great Britain
33.59	Rocky Point (N.J.) WEC		United States
34.68	London VE9BY		Canada
36.65	Rio de Janeiro PSK (PRA3)		Brazil
37.04	Quito HCJB		Ecuador
37.33	Rabat (CNR)		Morocco
37.41	Suva VPD		Fiji Isles
38.07	Tokio JIAA		Japan
38.47	**Radio Nations HBP**		Switzerland
38.65	Kootwijk PDM		Holland
39.34	Tashkent RIM		U.S.S.R.
39.76	Moscow RKI		U.S.S.R.
39.82	Riobamba PRADO		Ecuador
40.3	Radio Nations HBQ		Switzerland
40.5	Bogota HJ3ABB		Colombia
40.54	Rocky Point WEN		U.S.A.
41.55	Bogota HKE		Colombia
41.6	Las Palmas EA8AB		Canary Isles
41.67	Singapore VSIAB		Sts. Settl'mts.
41.84	Grenada YN6RD		Nicaragua
41.9	Manizales HJ4ABB		Colombia
43	Madrid EA4AQ		Spain
43.86	Budapest HAT2		Hungary
44.61	Rocky Point WQO		United States
44.96	Maracay YVQ		Venezuela
45	Constantine FM8KR		Tunis
45	Guatemala City		S. America
45.02	Guayaquil HC2RL		Ecuador
45.38	Moscow RW72		U.S.S.R.
46.53	Barranquilla (HJIABB)		Colombia
46.69	Boundbrook W3XL (WJZ)		United States
46.7	Boston WIXAL		United States
47	Caracas		Venezuela
47.5	S. Domingo HIZ		Dominican R.
47.8	Domingo HIAA		Dominican R.
48.75	Winnipeg CJRO		Canada
48.78	Caracas YV3RC		Venezuela
48.86	**Saxonburg (Pa.) W8XK (KDKA)**		United States
	Moscow (RKK)		U.S.S.R.
48.94	Jelöy		Norway
49.02	Wayne W2XE (WABC)		United States
49.08	**Caracas YV2RC**		Venezuela
49.1	**Daventry (Empire) GSL**		Great Britain
49.18	**Boundbrook W3XAL (WJZ)**		United States
	Chicago W9XF (WENR)		United States
49.22	Bowmanville VE9GW (CRCT)		Canada
49.26	St. John VE9BJ (CFBL)		N. Brunswick
49.3	La Paz CP5		Bolivia
49.34	Chicago W9XAA (WCFL)		United States
49.35	**Zeesen (D9M)**		Germany
49.4	Vienna OER2		Austria
49.47	Nairobi VQ7LO		Kenya Colony
49.5	**Skamlebaek**		Denmark
49.5	**Philadelphia W4XAU (WCAU)**		United States
49.5	Cincinnati W8XAL (WLW)		United States
49.586	**Daventry (Empire) GSA**		Great Britain
49.67	Boston WIXAL (WEED)		United States
49.83	**Zeesen DJC**		Germany
49.96	**Drummondville VE9DN (CFCF)**		Canada
50	**Moscow RNE**		U.S.S.R.
50.8	Barcelona EA3AB		Spain
50.26	**Rome (Vatican) HV**		Italy
55.56	**Szehesfehevar**		Hungary
56.9	Königswusterhausen (DTG)		Germany
57.03	**Rocky Point WQN**		United States
58.31	**Prague**		Czechoslovakia
62.5	**Long Island (N.J.) W2X**		United States
68.18	Moscow (RFCK)		U.S.S.R.
69.44	Rugby GDB		Great Britain
73	Quito (HCJB)		Ecuador
84.5	Berlin D4AGE		Germany
85.9	Boston WIXAL		United States

"W.M." Book Reviews

"Noise," by N. W. McLachlan, D.Sc. (Engineering) London, M.I.E.E. (*Oxford University Press*, 160 *pages*, 71 *illustrations*, 6*s*.)

DR. McLACHLAN needs no introduction to readers of "W.M.," nor do they need any assurance as to his powers of clear and simple exposition of what might be a difficult subject in the hands of a less gifted author. They will therefore be prepared for the statement this reviewer is about to make that his recent book on noise is a really admirable survey of the whole ground involved in the study of one of the most acute problems of modern life, done with a conciseness and clarity only too rare in authoritative works of this kind.

The subject is, perhaps, a little off the usual lines in which our readers are interested, but the problems of noise measurement and analysis are so closely connected with matters of electrical sound reproduction and are so interesting in themselves that we make no apology for referring to the book. By way of indicating its wide scope, we quote the following list of chapter headings:

I. General Considerations : Behaviour of the Ear.
II. Measurement of Noise.
III. Frequency Analysis.
IV. Noise in Buildings.
V. Traffic Noise.
VI. Train Noise.
VII. Noise Due to Aeroplanes and Motor Vehicles.
VIII. Vibration Due to Machinery.
IX. Noise Due to Electrical Machines.
X. Physiological and Psychological Effects of Noise.

◆ ◆ ◆

"Television," by M. G. Scroggie, B.Sc., M.I.E.E. (*Blackie and Son*, 3*s*. 6*d*.)

THE wrapper of this book refers to it as "a simple explanation of how television systems work," and with that description we entirely agree—it *is* simple and it *does* really explain. Indeed, we regard it as a quite excellent piece of work and well worthy of the deservedly high repute of its author.

Mr. Scroggie has avoided the common pitfall of trying to write a book primarily for those who know little or nothing of elementary electricity and magnetism or even of radio, and at the same time making it readable for those who do possess such knowledge. His method is to assume a reasonable ground work of general knowledge yet to present his explanations with such care that they will be quite comprehensible without that knowledge. That he comes as near to complete success as is humanly possible is striking testimony to his unusual gifts as an author.

The book is deserving of special commendation in that it presents a truly up-to-date picture of television as it stands today, in particular in its treatments of such matters as disc systems of reception, cathode-tube methods, and so forth ; here the author is careful to deal with the disc and other low-definition systems only at such length as their importance as a means of familiarising oneself with basic ideas warrants. With the Farnsworth tube and the Iconoscope and high-definition apparatus and problems in general he deals very painstakingly. Altogether a very excellent little book !

News from the Radio Societies

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 announcement of forthcoming events, etc., and secretaries of short-wave societies, whether national or local, are asked to make the fullest use of this space

Radio Society of Great Britain

THE R.S.G.B. held the first London meeting of the new season on September 27, at the Institution of Electrical Engineers when Dr. C. G. Lemon gave an interesting lecture on "Micro-wave Transmission." This is a branch of radio that has not hitherto attracted much attention from the amateur transmitter, and doubtless the lecture will have stirred up considerable enthusiasm. Whether licences for micro-waves will be granted seems a doubtful point at the moment.

South London District held a successful "Conventionette" on September 29, proceedings commencing with a visit to Kenley R.A.F. aerodrome where much interesting radio equipment was shown to the party of twenty-five members who attended.

An important activity of the R.S.G.B. during the coming season will be the new "Commercial Activity Check." When the next International Conference opens at Cairo, the International Amateur Radio Union delegates are to be provided with much authentic information about the use made by commercial stations of the bands immediately adjacent to the amateur bands.

If there is to be any hope of securing a widening of the latter, the amateurs must obviously have definite information about the actual use being made of the surrounding ether-space. If it is negligible, they obviously have a very strong argument.

Individual members have been doing much good work on the 5- and 10-metre bands during the past month. Transmitters in North-west England have been securing reliable ranges of 50 miles or more on 5 metres, the longest two-way contact being over a distance of 73 miles, which is believed to be a British record.

Progress is becoming quite exciting as far as 10 metres is concerned. U.S.A. amateurs are at last being heard on this band and several British amateurs have made two-way contacts with South America. Just before going to press the news of a two-way contact between Great Britain and South Africa (G2HG and ZS1H) has been confirmed.

An interesting test in which R.S.G.B. members took part during September was the "Mountain Field Day" arranged by the Swiss amateur transmitters. All the Swiss stations were portable, and had to be operated from points more than 3,000 feet above sea level. The only restriction on the gear was that the total weight was not allowed to exceed 12 kilogrammes (about 30 lbs.).

Throughout this month the Australia-New Zealand International DX Contest has been in progress. This has come into being as a result of the tremendous popularity of the Melbourne Centenary Contest run last year.

Amateurs in all parts of the world try to make as many contacts as possible with the amateurs of Australia and New Zealand. Serial numbers of six figures have to be exchanged as proof of contact.

The times of the contest are from 17.00 G.M.T. on Saturday to 17.00 G.M.T. on Sunday, for the four week-ends in October.

Conducted by G6QB

International Short-wave Club

I understand that the I.S.W.C. DX Receiving Contest, also running this month, has attracted a huge entry. Special transmissions have been taking place from well-known short-wave stations nearly every day, although the awards are based on the total number of short-wave stations identified and verified, whether making special transmissions or not.

This contest is by way of celebrating the club's sixth birthday.

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Anglo-American Radio and Television Society

This Society continues to indulge in its pastime of dancing to music received direct from the U.S.A. Another successful event of the kind was recently held.

On October 30 the winter programme of the West Middlesex and East Bucks branch opens with a meeting arranged to herald the new season. Readers are welcomed, and should apply first to Mr. Leslie Orton, " Kingsthorpe," Willowbank, Uxbridge. A modern all-wave receiver will be demonstrated, and the member owning the set is confident that practically everything existent will be tuned in during the course of the evening !

Continued on page 316

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.

In Tune with the EXAMINER'S Review of the

FERRANTI CONSTRUCTIONAL AMPLIFIERS

FERRANTI has sent along a copy of a new publication dealing with amplifiers that can be built at home, for battery and mains operation. I was particularly interested in the description of a battery-operated Q.P.P. outfit, which can be built for an all-in cost of £5 19s. 4d.

The all-in cost includes the two valves and the grid-bias battery, but not the 2-volt accumulator and high-tension battery. The outfit is just the thing for those who are not blessed with electric light and who want good electrical reproduction of gramophone records.

The leaflet, which is free for the asking, contains a technical description of the amplifier, together with circuit and wiring diagrams. There is also a description of a 12-watt A.C. amplifier, which costs roughly £27 to build. To all those interested I strongly suggest that they should apply for their copy in the usual way, by asking for number **489**

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LESSONS IN RADIO SUBJECTS

I HAVE frequently received letters from ambitious young men who wish to enter the radio industry as a service engineer or a technical man, or on the salesmanship side. They tell me that they have a good knowledge of this and that, but in most cases their specialised knowledge amounts to very little.

To anyone who has thoughts of entering the industry—and there are particularly bright prospects for the right type of man—I would recommend the study of a booklet prepared by the International Correspondence Schools.

There are many different courses open to the student; there are courses for radio dealers, for salesmen, for service and general radio engineers, as well as advanced courses for men who already have a good knowledge of radio engineering. There are also courses for those who wish to obtain the Postmaster General's Certificates for positions as wireless operators aboard ships.

In whatever branch of the industry you wish to enter I feel sure that there is an I.C.S. course that will prove invaluable.

Copies of the 44-page I.C.S. brochure can be obtained free and without any obligation through this service. **490**

◆ ◆ ◆

ROLA EXTENSION LOUDSPEAKERS

FROM the British Rola Company comes a leaflet describing a complete range of moving-coil loudspeakers of every type—big and small, permanent-magnet and energised. Of particular interest to the ordinary set user are two extension loudspeakers, which between them cover the entire field. One is a high-impedance type costing 35s. and the other a low-impedance model costing 27s. 6d.

The former is for use on sets where the leads for the extension loudspeaker come from the primary of the output transformer, and the latter where the leads come from the secondary—the speech coil side.

The prices given above are for chassis only; cabinet models cost £3 2s. 6d. for the high-impedance and £2 15s. for the low-impedance models. Anyone who is contemplating the addition of an extension loudspeaker to their commercial receiver would be well advised to ask for a copy of this catalogue. **491**

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Here we review the newest booklets and folders issued by five manufacturers. If you want copies of any or all of them, just cut out this coupon and send it to us. We will see that you get all the literature you desire.

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Trade

Latest Catalogues

DUBILIER CONDENSERS AND RESISTANCES

for Constructors and Service Engineers

CATALOGUES are in two forms; those which list and price, and those which list and price and give useful technical information as well. The new Dubilier manual, which has just arrived, comes in the second category. It describes the complete range of Dubilier condensers and resistances of use to the ordinary radio man and also contains much valuable information concerning their use.

As a radio man and a motorist, I was particularly interested in the clear explanation of the cause of noise in car radio, and more interested still in the easy way it can be suppressed. Those who suffer from the bugbear of electrical interference should not hesitate to apply for one of these catalogues, for they contain valuable information on how this nuisance can be reduced if not completely cured. **492**

Engineers' Guide

containing the widest choice of engineering courses in the world

Outlines The T.I.G.B.'s up-to-date home study Courses in Wireless, Electrical and Mechanical Engineering, etc. Shows how to become A.M.I.E.E., A.M.I.W.T., A.Rad.A., etc., and how to qualify for a well-paid post. Training until Successful Guaranteed. WRITE NOW for Free Guide.

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MINITUBE THREE

4-pin - 7d.
5-pin - 8d.
With soldering slot

CLIX LOW-LOSS Valveholders
One of the principal rules in the design and construction of short-wave components is that masses should be reduced to a minimum and insulation be of the highest quality. Try these for your S/W Super.

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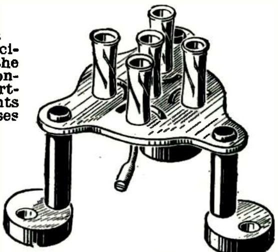

SEE FURTHER ADVT. ON PAGE 312

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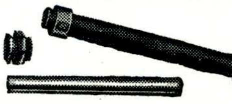

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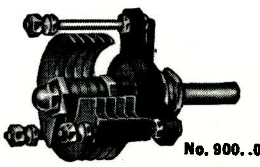

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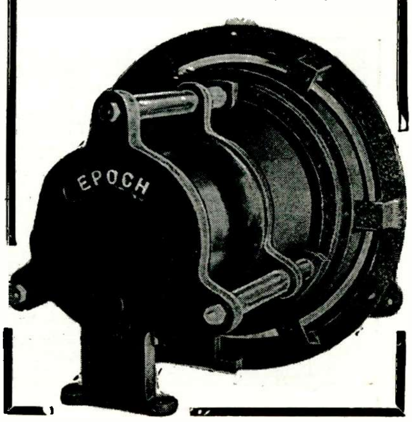


NEWS FROM THE RADIO SOCIETIES—Continued from page 313

Hastings and St. Leonards Radio Society

The above society has a strong leaning towards ultra-short-wave experimental work. It is fortunate in possessing its own headquarters station, G6HH, from which regular experimental work on 5 metres is carried out with G2AO at Eastbourne and other stations within workable range.

Readers in the Hastings district are invited to get into touch with the secretary, Mr. Sutherland (G5RO), 59 Old Harrow Road, Hastings.

◆ ◆ ◆

Tottenham Short-wave Club

The Tottenham Short-wave Club is opening up for winter activities, and the secretary would be glad to hear from prospective members at 57 Pembury Road, Bruce Grove, Tottenham, N.17. The object of the club is largely to give help and encouragement to newcomers to short-wave work.

◆ ◆ ◆

Loughborough Short-wave Radio Society

It is proposed to form a short-wave radio society in Loughborough and the organising secretary is Mr. P. Newton Nield of 5 Park Street, Loughborough, Leicestershire. Meetings will be held each Friday at the above address from 7.30 to 10 p.m., beginning on October 25. All who are interested are cordially invited to attend whether they are experienced or not.

There will be demonstrations of commercial and constructional receivers of the short-wave and all-wave types, and members are promised a very interesting time.

◆ ◆ ◆

Ealing Wireless Society (proposed)

Mr. H. A. Williamson, of 22 Camborne Avenue, Ealing, W.13, is forming a radio society and would like to hear from anyone interested.

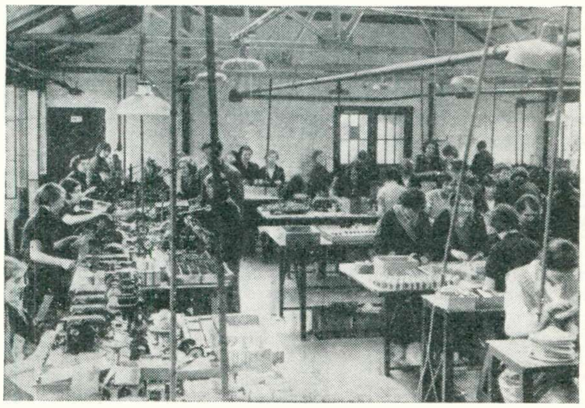
◆ ◆ ◆

Secretaries, Please Note!

May I appeal once more to secretaries of local societies however small, to send me particulars of their activities, past, present, and future.

There must be hundreds of flourishing local societies in the country of which the average reader of this magazine never hears anything at all.

Please remember that "It Pays to Advertise."



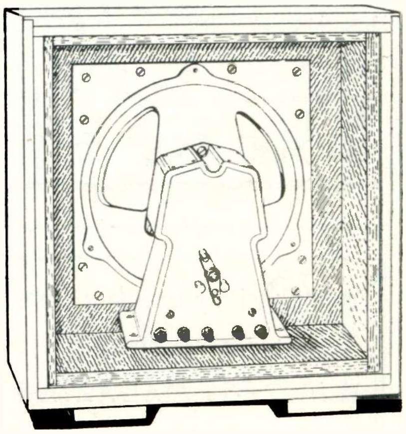
Just a part of the room at W.B.'s factory where the transformers for W.B. loudspeakers are wound.

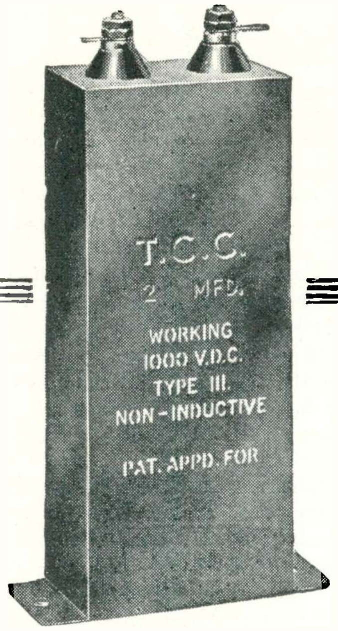
(Below) A drawing of the W.B. cabinet loudspeaker in which will be seen the special lining of non-resonant material.

W.B. CABINET LOUDSPEAKER ON TEST

"The speaker's performance was indeed particularly brilliant. Most outstanding was the effect of the new cabinet which seemed to give added life to the bass note response yet the top notes were in no way affected. The full output of the receiver was handled without any trace of rattle or overloading, and the loudspeaker must be regarded as an excellent proposition for both set buyers and constructors alike."

(*Preliminary report on the new "W.B." cabinet loudspeaker.*)





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Scanning Systems and Principles of the Television Receiver

Continued from page 279

ordinary electric lamp the *current* has to be quite high and the degree of amplification necessary would be impracticable, and secondly—really by far the more important of the two objections—there is a considerable "heat-lag" in the ordinary lamp filament.

Once the filament has been heated up it will retain its heat for quite an appreciable fraction of a second and rapid changes of voltage much above, say, two or three hundred a second will not affect it.

The Neon Lamp

There is, however, another form of electric light also occasionally used for domestic purposes, and considerably in a commercial way, i.e. the Neon lamp. It has been found that if we evacuate a lamp bulb and then introduce into it a small proportion of certain rare gases, such as Neon, and if we seal into this lamp bulb two electrodes, then when the voltage applied to these electrodes reaches a certain point the gas will start to glow with a peculiar and easily recognisable pinkish light.

In Neon lamps of the bulb type one of the electrodes is made to have a large surface (such as, for example, a close-wound coil of wire) and it is around this that the glow appears. Below a certain voltage there is no glow but when a critical point is reached the glow starts, after which it varies considerably with comparatively small changes of voltage. Furthermore there is no "heat-lag" or time lag of any kind in the change of glow with voltage.

Peculiar Properties

These useful and peculiar properties were quite early seized upon by television experimenters and in one form of television receiving lamp the larger of the two electrodes was made in the form of a flat plate. We now have a device which will vary its light with changes of voltage without the current being at all high.

In a simple television receiver, then, we connect a Neon lamp to the

Continued on page 320

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DETAILS OF MARCONI-E.M.I. TRANSMISSIONS

(Continued from page 248)

brightness. The radio frequency transmitter output is specified in what follows as a percentage of the peak output. This percentage is in terms of current (or voltage) and not in terms of power.

(8) Vision Modulation

The vision modulation is applied in such a direction that an increase in carrier represents an increase in picture brightness. Vision signals occupy values between 30 per cent and 100 per cent of peak carrier. The amount by which the transmitted carrier exceeds 30 per cent represents the brightness of the point being scanned.

(9) Synchronising Modulation

Signals below 30 per cent of peak carrier represent synchronising signals. All synchronising signals are rectangular in shape and extend downwards from 30 per cent. peak carrier to effective zero carrier.

(10) Line Synchronising Signals

The line synchronising signals are of one tenth of a line duration, and are followed by a minimum of one twentieth of a line of black (30 per cent peak) signal.

(11) Frame Synchronising Signals

The frame synchronising signals comprise a train of two pulses per line, each occupying four tenths of a line and having one tenth of a line interval of black (30 per cent peak) signal between them. At the end of even frames, the first frame pulse starts coincident with what would have been a line signal. At the end of odd frames the first frame pulse starts half a line after the preceding line signal. At least six frames will be transmitted at the end of each frame, but the number may be increased to any number up to 12 pulses (6 lines). During the remainder of the intervals between frames, normal line synchronising signals will be transmitted with black (30 per cent peak) signals during the remaining nine tenths of the line.

It will be noted that throughout the interval between frames (as during the whole transmission), the carrier falls from 30 per cent to zero regularly at line frequency and in phase with the beginning of the normal line synchronising pulses.

(12) Variations in Transmitted Waveform

The 15 per cent. interval between vision signals of successive lines, and the 10 lines interval between successive frames are minimum intervals used at the transmitter. During the initial development of the transmitter, certain transmissions may have longer intervals between lines and between frames, which lengthened intervals correspond to the transmission of a black border round the picture.

The 30 per cent carrier is the "black level" below which no vision signals exist and above which no synchronising signals extend. The mean black level of any transmission will be 30 per cent + or — 3 per cent of peak carrier. The black level during any one transmission will not vary by more than 3 per cent of peak carrier from the mean value of that transmission.

The residual carrier during the transmission of a synchronising pulse will be less than 5 per cent of the peak carrier.

The line frequency and the frame frequency will be locked to the 50 cycle supply mains, and therefore will be subject to the frequency variations of the mains.

Explanation of Method of Interlacing

The method of interlacing is demonstrated on Fig. 2. (see p. 248) which represents the top and bottom portions on the scanned area with the distance between the lines very much enlarged. The lines show the track of the scanning spot, which moves under the influence of a regular downward motion (frame scan) with quick return and a regular left to right motion (line scan) with very quick return (not shown on drawing). The combination of these motions produce the slightly sloping scanning lines.

Starting at A, not necessarily at the beginning of a line the spot completes the line A B, returns to the left and traverses line C D, then E F, and so on down the "dotted" lines on the drawing. At the bottom of the frame the spot travels along line G H and then starts at J and travels to K. At this point the return stroke of the frame motion begins and returns the spot to L at the top of the frame. A complete frame scan has now been made since leaving A, so that 202½ lines have been completed, and the point L is half a line away from A.

The downward frame motion now starts again causing the spot to travel along L M, completing a single line motion J K L M. The spot then returns to the left and traces

(Continued on page 320)

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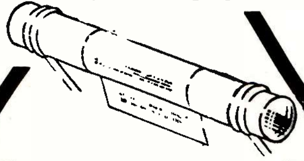

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in this Issue for

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- "Listener's Amplifier Radio Unit."
- "W.M. Simplified Short Wave Super."
- "Varsity Four."

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Kolster Brandes 425 Transportable

(Continued from page 289)

At night-time almost any station could be received on the built-in frame aerial, and without worrying about the directional properties of the frame. Every station came in true to its calibration on the scale.

Selectivity can be indicated very briefly by the fact that provided stations were keeping to their alloted channel they were received quite free of any whistle or sideband splash.

Long-wave Sensitivity

On the long waves sensitivity was particularly good. Luxembourg was heard well. We are pleased to note that this station's "whistle" was well in evidence when the variable tone control was set for maximum top; we could cut the whistle down to almost nothing by turning the control about half-way down.

In fact we regard quality as one of the strong features of the receiver. No rattle, no boom, and a well-balanced frequency range. We can sincerely recommend this receiver to any reader who wants quality and sensitivity coupled with ease of transport.

Graham Farish 333 Battery Three-valver

(Continued from page 290)

a battery set is "how much juice does it take from the high-tension battery?" There is no need to worry on this score. The total consumption from the high-tension battery is only 9 milliamperes; a figure which translated into practice means that the H.T. battery should last four or five months with the set in use four or five hours a day.

Altogether we compliment Graham Farish on producing a set at an extremely low price and which gives such excellent results. The highest compliment we can pay is that we know the purchaser is getting his money's worth.

Erratum.—In the list of parts for the "W.M. Simplified Short-wave Super" (page 265), the Eddystone variable condensers should be given as 3 .0001 microfarad microdensers, type 900; 15/-.

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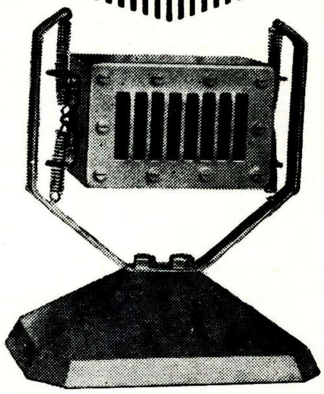

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This coupon is valid for one blueprint only at the price indicated:—

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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

SCANNING SYSTEMS

Continued from page 317

end of the amplifier in such a way that a certain voltage is permanently applied between the lamp electrodes, and the signal voltage is made to raise this voltage above the critical point. It thus starts to glow with signals, but remember when this television lamp is connected to the end of the television receiver the *whole* of the plate surface is varying in light intensity with the variation of signal. Looking at this plate as it is we shall see nothing at all resembling a picture form, but if now we *scan* the plate we can re-constitute the picture.

Reproducing Systems

Let us imagine by some device or other (suitable methods will be explained later) we arrange a rotating disc in front of the plate of the Neon lamp, the disc having a hole in it. Then if the hole in our receiving disc is in front of the top left-hand portion of the plate exactly at the same time as the scanning spot in the transmitter is at the top left hand corner of the picture, and if now the receiving disc aperture passes down the left side of the picture at exactly the same speed as the scanning spot of the transmitter, any variations of light of the transmitter will be faithfully reproduced as variations of light behind the receiving aperture in perfect synchronism.

We must arrange for our scanning spot and our receiving aperture to keep in perfect step so that the time taken to scan the whole surface of the receiving plate is exactly the same as that taken to scan the whole of the transmitted picture.

Persistence of Vision

Owing to persistence of vision in the eye the receiving aperture or scanning spot will appear to cover the whole of the receiving plate simultaneously and thus we shall have, if our transmitter and receiver are in synchronism, a reproduction in pinkish Neon light of the transmitted picture.

The *size* of our picture will be that of the plate in the Neon bulb and as it is not easy to build very large Neon tubes at a reasonable price the early television receivers had to show very small pictures.

INDEX TO ADVERTISERS

Details of Marconi-E.M.I. Transmission

Continued from page 318

out line N O, which due to L being half a line ahead of A, will lie between lines A B and C D. Similarly the next line P Q will lie half way between C D and E F. The spot now traces down the chain dotted lines to R S and finally traces out T U, at which latter point the frame return causes the spot to rise again to the top.

When the spot reaches the top it will have completed 2 frames, since leaving A, and, as two frames occupy the time of exactly 405 complete lines, the spot will return exactly to A, after which the cycle begins again.

From the foregoing, it will be seen that the complete picture is scanned in two frames, but as each frame contains an integer number of lines, plus a half, the two frames will interlace.

The system does not require the short return times shown for the line and frame scans, nor need the lines begin in the positions shown. Provided the line and frame traversals are regularly recurrent and have the correct frequency ratio (two frames = odd number of lines), an interlaced picture will be obtained.

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. November, 1935.

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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. 6a. each.

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
"HK" Four (2HF, D, LF) ...	*Mar. '35*	WM384
Varsity Four (Superhet) ...	*Oct. '35*	WM395
"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

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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

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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

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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

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One-valvers: Blueprints, 1s. each.

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Roma Short-waver	*10.11.34*	AW452

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Home-made Coil Two (D, Pen)	*14.7.34*	AW440

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Experimenter's Short-waver ...	*19.1.35*	AW463

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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

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Short-wave Converter-Adapter	23.2.35	PW48A
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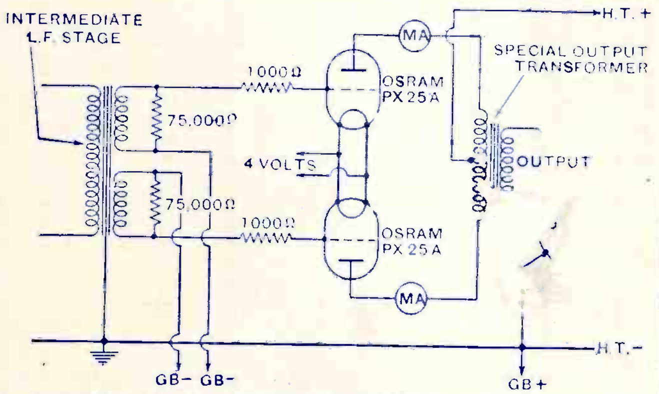

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