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EDITORIAL COMMENT

Interference Forms

Make Them Readily Available

THE Post Office is to be congratulated on the tactful and efficient manner in which they are endeavouring to bring about the suppression of electrical interference. Pending legislation on the lines proposed by *The Wireless World* to ensure that the suppression of interference is fairly administered, the Post Office continues its good work and is ready to investigate any complaints received from individuals, provided that the Post Office official interference form is filled up as a guide to the engineers in trying to locate the trouble. It is, perhaps, not sufficiently widely known that these forms are available for this purpose and can be obtained on application either to the General Post Office direct, or to the local resident Post Office engineer of the district. Unfortunately, the addresses of local engineers are not readily available to the public and we would, therefore, urge, as a part of the service which the Post Office is carrying out on behalf of listeners, that these forms should be made available to the public on application at any head Post Office. They would then be handed in to a Post Office after completion for transmission to the proper authority,

Forms relating to other services of the Post Office are available in this way, and there seems to us to be no reason why this procedure should not be adopted in the case of the interference forms. It would save bother and inconvenience to the public and to the Post Office alike.

It should be remembered that these forms should only be completed and forwarded to the Post Office after the listener has fully satisfied himself that the interference with wireless reception is due to some trouble apart from his set or his own premises and is of such a nature as to be beyond his own control. Sufferers from interference should not take upon themselves the task of complaining direct at the source of the trouble, even if they succeed in identifying it, as such action often prejudices any effort which the Post Office may make subsequently.

Replacements

Reputation of the Industry

THE wireless industry has gained for itself a high reputation for readiness to replace faulty articles with the minimum of inconvenience to the purchaser. It is well known that valve manufacturers do not hesitate to replace a valve if the purchaser satisfies them that it is faulty and, similarly, throughout the industry we find the same kind of readiness to accept responsibility without question when any component or set is shown by the purchaser to be defective.

This is a very commendable attitude, but we sometimes wonder whether there are not two sides to this question, and whether the manufacturer would not create a still better feeling if the necessity for these replacements occurred less often. We believe that a large proportion of the replacements which are made would never have been necessary if the articles had received a little more care in testing before going out.

These remarks are prompted as a result of many instances of defective articles which have come to our notice, but it must not be thought that our criticism applies to all manufacturers, some of whom, to our knowledge, go to infinite pains to see that every article is as free from defects as skill and ingenuity in testing are able to ensure.

Corrected A.V.C.

ALTHOUGH highly satisfactory results can be obtained by ordinary A.V.C. systems in which the H.F. valves are controlled, theoretical perfection is impossible, for the controlling bias is dependent on the detector input. In the new double-diode pentode (D.D.Pen) embodying a variable-mu pentode as an L.F. stage the A.V.C. control is taken both forwards and backwards to the L.F. and H.F. stages respectively. As a result it is possible to obtain almost perfect A.V.C. since both pre- and post-detector volume control is obtained.

THE subject of automatic volume control has been discussed from a number of different angles in recent articles in these pages. A brief discussion of the circuit of Fig. 1, which shows a double-diode V1 used for delayed A.V.C., followed by a triode V2 used as pure L.F. amplifier, will serve as a kind of informal summary of previous articles from other pens, and will serve to remind the reader of the principles involved.

The new Cossor double-diode pentode with which practically perfect A.V.C. can be obtained.

The tuned circuit with which the story begins is meant to represent the last tuned circuit of a complete set. It is connected, by way of the grid-leak and condenser, R1, C1, to one of the anodes of the double-diode V1. The second anode is joined to the first by a condenser, so that both are effectively at the same signal potential, and this second anode is connected to cathode by the leak-resistance R4 of about 0·5 megohm.

This second anode behaves exactly like the grid of a power grid detector; since some small "grid"-current is flowing through R4, even when no signal is supplied, rectification begins as soon as any signal reaches it. The rectified signal is passed on, by way of the coupling condenser, to the grid of the amplifying valve V2, the grid-leak R3 of which may or may not take the form of a potentiometer volume control as suggested in the diagram. The bias of V2 is derived from the voltage-drop caused by the passage of its anode current (and screen current, too, if a tetrode or pentode should be chosen) through the cathode bias resistor R2. If a suitable filter (not shown) is interposed between V1 and the grid of V2 the two valves together make up, in effect, a power grid detector in which, by separating the function of rectification and low-frequency amplification, the usual irritating tendency of the grid detector to overload has been avoided.

*Communicated from the Research Laboratories of A. C. Cossor, Ltd.

How to Use the New Double-diode Pentode*

Delayed A.V.C.

It would be quite possible to derive automatic bias for the earlier valves in the set from the anode which carries out the function of signal rectification, but only at the cost of biasing back these valves, and so reducing amplification, before the signal had reached full loud speaker strength. To avoid this, the other anode is used for providing automatic bias, its "grid-leak" R1 being taken to a point which is negative with respect to its cathode. Such negative voltage is most simply obtained by connecting the cathode of V1 to that of V2, so that the bias of V2 is also available for V1. R1 may then be returned either to earth, as shown, or to a tapping on R2 if the full voltage across this resistor is not required.

Since the grid detector, which is actually a diode valve, does not begin to rectify until grid-current flows, this negative bias has the result of allowing rectification on this anode to begin only when the peak voltage of the signal exceeds the bias applied. By suitable choice of bias voltage the commencement of rectification can be made to coincide with the attainment of an output of normal loud speaker volume from the set. If the rectified voltage across R1 is now used to supply bias to earlier valves, their amplification will remain at maximum until the set is delivering full volume to the loud speaker, after which the rising bias voltage will give an automatic control of volume. This scheme, in one form or another, is known as "delayed A.V.C."

No matter whether V2 is a triode, a tetrode, or a pentode, or even a composite valve including the two diode anodes within it, the results given by the circuit of Fig. 1 will be the same.

For controlling the onset of automatic control the circuit of Fig. 1 is, as we have seen, as perfect an arrangement as could be desired. Let us jump to the other end of the scale of signal voltages and consider the reception of the local station. We may assume, purely as an illustrative figure, that a bias of 20 volts is required on earlier valves to keep the amplification of the set low enough for the necessarily large signal received at the aerial. This bias can only be derived from the rectified voltage across R1; to provide this the peak signal voltage across the tuned circuit must be greater than 20 volts by at least the delay voltage. The whole of this large signal is applied to the second (signal-rectifying) anode of V1, with the result that V2, and with it the output valve, will be outrageously overloaded unless hasty use is made of the manual volume control R2.

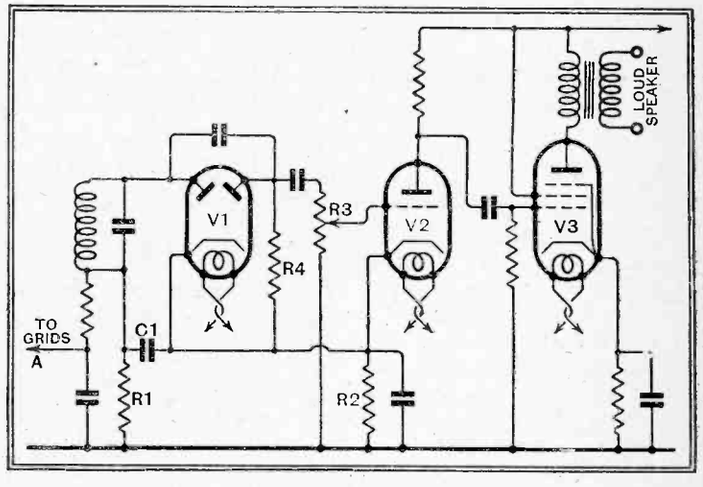

Fig. 1.—Circuit for a double-diode valve V1 used for delayed A.V.C. The valve V2 is a straightforward triode L.F. amplifier coupled in the usual way to an output pentode.

In effect, the automatic volume control serves to keep the signal comfortably

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within the range of control which R3 can provide, and smoothes out to a very marked extent the effects of fading, but it does not prevent the output level of the set from rising and falling over a range of perhaps 10 to 1 if the carrier voltage at the aerial should vary over a range of several thousands to one.

Since the A.V.C. bias can only be obtained by rectification, and since a large bias can only arise from a large signal, nothing can be done on the pre-detector side to prevent this residual variation of output volume with input signal. We therefore require an audio-frequency amplifier which can have its gain controlled by the automatic bias voltage, the relation of gain to bias voltage being such that as the signal at the detector rises the L.F. magnification falls away in such a manner as to provide exact compensation. This will maintain the signal-strength at the grid of the output valve at a constant level for any given depth of modulation no matter whether the station tuned in is the local or the most distant within the receiver's range.

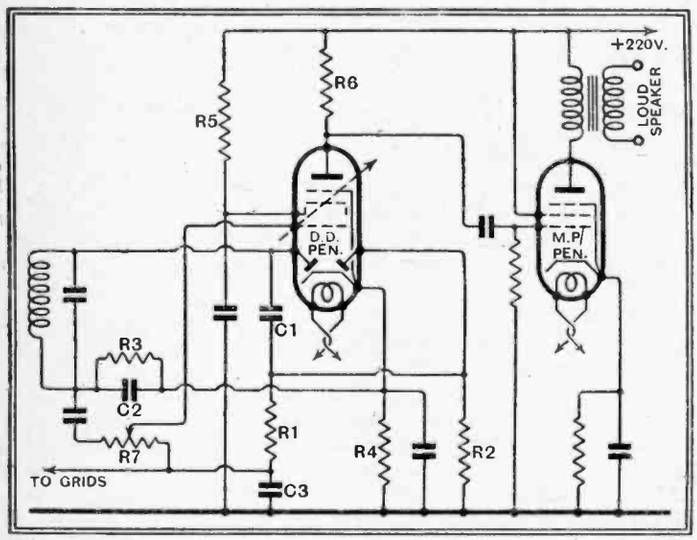

Fig. 2.—Suggested circuit for use with the new double-diode pentode. The variable-mu pentode contained within the same bulb as the double diode takes the place of the triode V2 in Fig. 1.

Variable-mu Pentode

The Cossor D.D. Pen, or double-diode pentode, is a valve specially designed to provide this corrected A.V.C. It consists of two tiny diode anodes facing one end of a cathode which serves also as the source of electrons for a variable-mu pentode of exponential characteristics. The circuit in which it is intended to be used is given in Fig. 2. So many electrodes have found their way into one bulb that this circuit is perhaps not too easy to grasp at a glance; in reality, it differs from Fig. 1 in only two respects. R3 of Fig. 1 (R7 in Fig. 2) is now returned to the A.V.C. line, so that V2 partakes of the automatic bias, and in place of a simple triode a screened pentode of suitably calculated variable-mu characteristics is used for V2. In addition the functions of the two diode anodes have been interchanged for convenience in drawing. With these hints the obscurities of Fig. 2 should be readily penetrated.

The diode portion of the valve need not be discussed in detail; like any other diode, it provides a close approximation to linear rectification, and damps the circuit to which it is connected to an extent equivalent to a resistance of about half the value of the grid-leak (R1+R2+R3, all in parallel) actually used. Since several milliamperes are available at each anode, the signal would have to rise to several hundred volts before overloading could occur. The exact values of the "grid-leaks" R2 and R3 and of the filter-resistance R1 will naturally be chosen by individual users of the valve; if each is made one megohm a very satisfactory compromise between sensitivity and retention of high notes is obtained when C1 and C2 are each 0.0001 mfd.

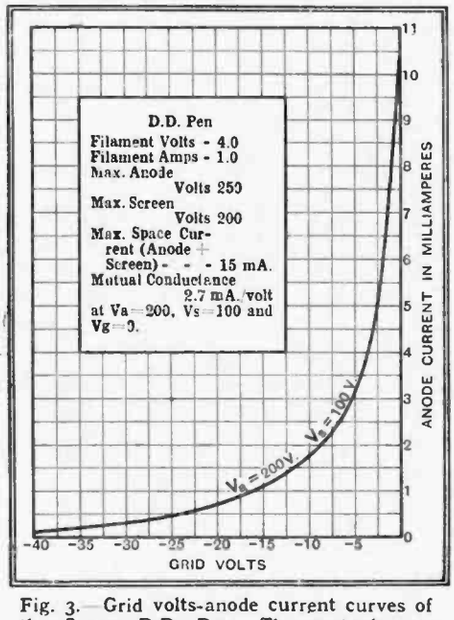

Fig. 3.—Grid volts-anode current curves of the Cossor D.D. Pen. The mutual conductance reaches the high figure of 2.7 mA.-volt.

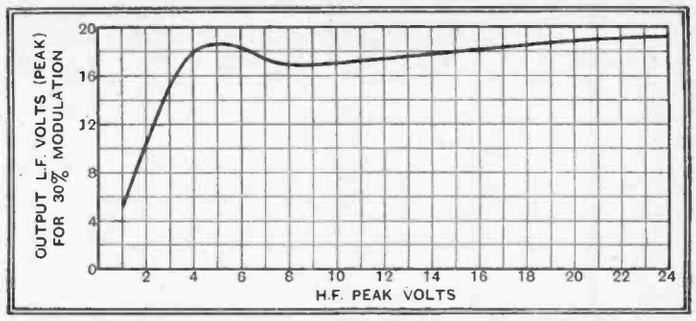

Fig. 4.—The output curve of a controlled D.D. Pen valve, showing H.F. input plotted against L.F. output. The anode voltage is 220 and the grid voltage 3.8 or peak H.F. voltage, whichever be the greater. This represents a delay voltage of 3.8.

A grid-volts/anode-current curve of the pentode portion of the valve is given in Fig. 3, in which the variable-mu characteristic is very evident. Since this static curve does not in the least convey its behaviour in practical use, where anode, screen, and grid voltages are all controlled by the carrier amplitude of the received signal, Fig. 4 will be found more informative. This was derived from a "dynamic-characteristic" taken with resistances (each 20,000 ohms) in both screen and anode leads, the external H.T. supply being 220 volts. The assumption made is that a slowly rising high-frequency signal, modulated to a depth of 30 per cent., is applied to the diodes, one of which, in common with the amplifying grid, is biased to −3.8 volts. Until the signal reaches a peak value of 3.8 volts, the bias of the valve, and therefore its gain, is held constant; the audio-voltage across the anode resistance (R6 in Fig. 2) is, therefore, proportional to the signal input. At an amplitude of 3.8 volts, the delayed diode begins to rectify, and the resulting bias voltage is added to the steady bias of the amplifying grid as in the circuit of Fig. 2. The L.F. amplification consequently begins to drop, and as the signal output, and with it the bias, continues to increase, the signal passed on to the output valve that follows the D.D. Pen remains approximately constant at about 17½ volts peak.

Modulation Depth

It will be appreciated that as the signal applied to the amplifying grid rises, the bias will automatically rise, too, so that, even with 100 per cent. modulation, the peak L.F. signal can never exceed the bias voltage. With a signal large enough to operate the A.V.C. system, modulation of this depth would, however, swing the amplifying grid over so wide a range that distortion would be introduced owing to the curvature of the characteristic if no volume control were used.

In practice it is found that, even if some transmitters modulate deeply, many others do not, and the gain of the amplifying stage as a whole has therefore been made high enough to load fully the MP/Pen which follows it even when receiving transmitters modulating to a depth no greater than 25 per cent. at their moments of loudest transmission. In these

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circumstances the distortion introduced is completely negligible at all points of the curve. When receiving a more deeply modulated carrier the volume control R7 interposed between diode and the grid of the pentode has to be adjusted to a suitably lower position to prevent serious overload of the output pentode, with the result that the relationship between L.F. and bias voltages at the grid of the D.D.Pen becomes exactly that which would arise from the reception of a station of lower modulation-depth with the volume control set at maximum. Total distortion does not rise to 5 per cent. until the effective depth of modulation, as determined by the setting of R7, which controls the relative amplitude of bias and of L.F. signal, exceeds 40 per cent., but, since this value of effective modulation gives rise to a signal voltage about double that which the MP/Pen output pentode will accept, and so leads to an immediate readjustment of the volume control, distortion never can arise in practice.

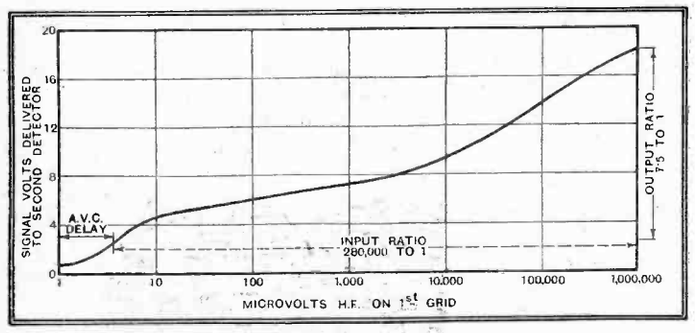


Fig. 5.—(Above) Response of a superheterodyne receiver with uncorrected delayed A.V.C. The A.V.C. is supplied in this case to the H.F. stage, the 1st detector and one I.F. stage.

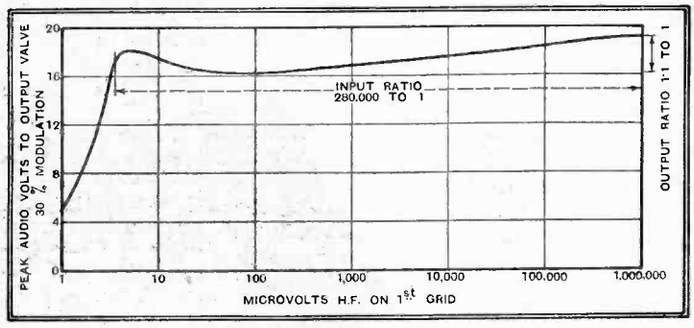


Fig. 6.—(Right) The response of the superheterodyne receiver of Fig. 5 with corrected delayed A.V.C. using the D.D.Pen.

By-passing H.F. Currents

This inter-relation of output, gain, and modulation-depth really means no more than that the D.D.Pen has been designed to yield an undistorted output of about 20v peak, which is more than sufficient to load up an MP/Pen. So long as no attempt is made to develop in its anode circuit a voltage greater than this, no audible distortion can arise, whatever may be the amplitude of the received signal or its depth of modulation. Further, the gain of the pentode stage is high enough to provide this output from any carrier whose maximum modulation is not less than about 25 per cent., providing that the carrier voltage applied to the diodes is about 3 to 4 volts peak. With deeper modulation lower carrier voltages will suffice.

If a larger peak output than 20 volts is required to drive a high-power output valve, a step-up transformer of suitable ratio should be interposed between it and the D.D.Pen. Since any serious change in the D.C. resistances in anode or screen circuits will entirely upset the audio-correction curve of Fig. 4, this transformer must necessarily be connected for shunt-feed, R6 being retained unaltered.

In the circuit of Fig. 2 no means of preventing H.F. currents from reaching the amplifying grid is shown. A choke with a small by-pass condenser in the grid-lead of the pentode is suggested, while a further filter in the anode circuit may be needed if feedback to earlier valves shows signs of being troublesome.

For an H.T. line voltage of 220, R5 and R6 should each be 20,000 ohms for the most perfect audio-correction; if higher voltages are used, R5 should be raised to keep the total current steady at about 8-9 mA. The anode resistance R6 may be raised to 25,000 ohms if the line voltage is as high as 280 volts, but for lower voltages is best left unchanged. The bias resistor R4 should be 450 ohms, giving an A.V.C. delay of $3\frac{1}{2}$ to 4 volts.

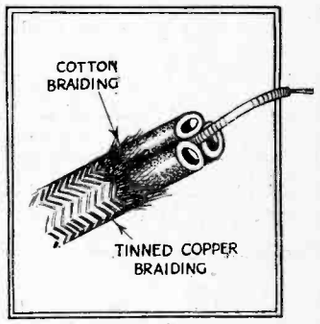
For the volume control R7 a potentiometer of quarter to half a megohm is suggested; since it is effectively in parallel with the "gridleak" R3, a resistance much lower than this will lead to some loss of signal strength.

The fact that this volume control need never be touched at all, even in passing from the local station to the most distant that the set can receive, is well thought out by the curve of Fig. 6, which shows the performance of an experimental receiver using the D.D.Pen for corrected A.V.C. A change in input covering a range of over a quarter of a million to one results in changes in output-voltage of only 10 per cent., as compared with the 750 per cent. change (Fig. 5) given by the same set when using the D.D.Pen for ordinary uncorrected A.V.C. by using fixed bias on the amplifying grid.

The use of the volume control is thus restricted to setting the output of the set, once and for all, at the level that the listener desires.

"Receptru" Screened Cable

THE uses of screened aerial down-leads in reducing electrical interference are already known to most of our readers, who will appreciate the fact that, if these benefits are to be obtained without serious loss of signal strength, the shielded cable used as a connecting lead between the horizontal part of the aerial and the receiver must have low capacity between conductor and external metal covering. Ordinary metal-braided wire is quite unsuitable.



New Radiophone down-lead: the conductor is centred by rubber tubes.

Those who suffer from electrical interference will be interested to learn that a new type of shielded down-lead has just been introduced by British Radiophone, Ltd., Aldwych House, Aldwych, London, W.C.2.

A most convincing demonstration of the benefits conferred by this method of screening was staged at the Radiophone factory for the edification of a *Wireless World* representative. For purposes of the test, man-made interference, normally radiated from the electrical wiring, was supplemented by an "unsilenced" vacuum cleaner and other devices. With an unshielded aerial, reception of even the local station was almost unintelligible, but on switching in a screened down-lead, background noises disappeared almost entirely, with the result that the programme could be appreciated as well as under ideal "country" conditions. Judging aurally, signals seemed to suffer hardly any reduction in strength.

A specimen down-lead submitted by the makers for test was found to have a capacity (between conductor and screen) of 26.05 micromicrofarads per foot. The external diameter of the cable is a shade under $\frac{1}{8}$in.

Cables of three different lengths are produced, the prices being (complete with fittings): 15ft. 10s., 20ft. 15s., 25ft. £1.

MORE SOLID-CORED COILS

AS was predicted when iron-powder-cored H.F. coils were first described in *The Wireless World* of September 16th last year, this type of tuning inductance now seems likely, for many purposes, to supplant all others.

Several British manufacturers have been working steadily on the problem of producing a satisfactory core material, and also of overcoming the various practical problems that arise in winding and in matching the finished products. It is now announced that Wright and Weaire are producing two distinct types, one with an open-core and the other with a closed magnetic circuit. The first is intended for the aerial tuner of single-circuit sets, while the other is matched for use in ganged multi-circuit receivers.

Under the well-known name of Nicore, the Varley firm has introduced a series of matched coils, including a double-wound H.F. transformer, which should be suitable for most modern circuit arrangements.

MINIATURE TALKIES

A 16mm. Sound-on-Film Equipment

By B. R. DAVIES, B.Sc. and E. A. BUCKLAND, B.Sc.

Projector cabinet, loud speaker box and self-erecting screen can all be carried by one person.

THAT the moving picture could be used for instructional purposes was realised before the talking picture came into being, but now that it is possible to accompany the moving picture with sound the instructional value of this instrument has been immensely improved. Primarily for this reason a portable sound-on-film equipment has been developed. The film used is the 16 mm. film as used in home movies, with the difference that one row of sprocket holes has been omitted to allow room for the sound track. This means that the projector can be quite small, allowing the whole apparatus to be sufficiently portable for carrying from one lecture room to another.

It can be seen that this apparatus may well be the forerunner of a home sound-on-film equipment.

The range of frequencies to be covered should go up to about 10,000 cycles per second for really good reproduction, but for reasons shown later, it is only feasible to get about 5,000 cycles on 16 mm. film. This would give sound of the same quality as the average cinema of about a year ago.

Let us consider some dimensions of a sound track on 35 mm. film. The film travels at 24 frames per second or 90 feet per minute. If we have to reproduce a sine wave at 5,000 cycles the wavelength of one cycle will be minute. Thus:—

90ft. per min. = $1\frac{1}{2}$ft. per second,

so that there will be 5,000 peaks in $1\frac{1}{2}$ft. of film, i.e., the wavelength will be:—

$$\frac{1.5 \times 12}{5{,}000} = .0036\text{in.}$$

Now, since the height of the picture on 16 mm. film is only two-fifths of the height of the picture on 35 mm. film and the number of frames per second must necessarily be the same, the wavelength of a 5,000-cycle note will be two-fifths of the wavelength of a note of the same frequency on standard film, i.e.,

wavelength = $2/5 \times .0036 = .00148$in.

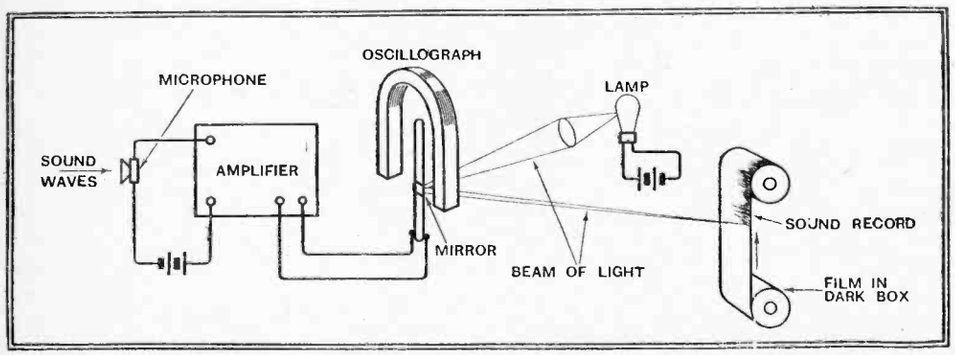
In order to reproduce this frequency satisfactorily, and 5,000 cycles is necessary for the faithful reproduction of all instruments, the slit of light which is focused on to the film must be small compared with one wavelength. It is easy to realise that this must be so by thinking of a slit the same width as one wavelength, then the amount of light falling on to the cell would be constant, and no change of current would occur through the cell.

Therefore, the width of the slit to reproduce 5,000 cycles on 16mm. film must be small compared with .00148in. In this 16 mm. sound reproducer the width of the slit is .0004in., and the very fact that the slit has finite width causes a loss which increases with rise of frequency, or which increases as the width of the slit becomes comparable with the wavelength. This, in fact, is the main cause of loss at high frequencies on 16 mm. film. It has been suggested that a 5,000-cycle note on this film is comparable with the grain size of the emulsion, but this is not the case; this limit is not approached until about 10,000 cycles is reached.

The equipment developed to reproduce sub-standard film is illustrated herewith. The amplifier occupies the space at the bottom of the cabinet, the valves being situated behind the projector mechanism, and access can easily be obtained to them by opening a door at the back of the cabinet. The amplifier consists of three stages, an AC/SG followed by an AC/HL, with a PP.5/400 in the power stage. The overall characteristic is approximately flat from 100 cycles to 5,000 cycles, and the amplification is of the order of 2,000 times.

The whole mechanism is driven by a belt from a universal motor running on an A.C. supply and suitably governed. When operating, the projector cabinet can be completely enclosed to eliminate noise, the volume control being brought out. The bracket carrying the feed and take-up spools also forms a rewinder, and can be accommodated inside the cabinet for transport.

The projector operates 24 frames a second. The cabinet houses the amplifier in the base.



The principle of the "variable area" system of sound recording explained in diagrammatic form.

TRANSMITTERS' NOTES.

Mr. L. H. Shersby, G2GZ, 41, Reverdy Road, London, S.E.1, is carrying out low-power tests on 7,164 and 14,328 kc/s each Sunday between 10.00 and 12.00, and will welcome reports.

International DXers Alliance

The object of the I.D.A. is to encourage listeners who specialise in long-distant reception on the ordinary broadcast bands as apart from short waves, the necessary qualification for joining the club being two or more verifications from broadcasting stations at least 2,000 miles away. The headquarters of the Alliance are in America. Mr. F. Wiseman, 90, Brighton Grove, Newcastle-on-Tyne, has been recently appointed European representative, and will be pleased to give further information to those who contemplate joining.

How the Superhet Works. 2.

The H.F. Stage and the Oscillator

Importance of the Choice of Valves

By W. T. COCKING

THE importance of the H.F. valve being able to handle the maximum signal likely to be applied without distortion is stressed. The use of a dual purpose or a separate valve to function as the oscillator is discussed, with particular reference to precautions which have to be taken.

The oscillator coil of "The Wireless World" Monodial A.C. Superhet with screening cover removed.

At the conclusion of Part I[1], we left the discussion of the superheterodyne at the point where the signal voltages are applied between the grid and cathode of the H.F. valve. It should be understood, however, that not only the potentials due to the wanted signals are applied to this valve, but also potentials due to other stations, since the aerial tuning circuit is not very selective.

The H.F. valve acts as an amplifier, and it must be distortionless in the sense that it must operate upon the linear portion of its characteristic. This is often forgotten, for a much larger amount of distortion can be permitted in an H.F. stage than in an L.F. without the quality of reproduction being affected to an audible extent. Even when the best quality is desired a certain amount of distortion can be allowed at this point, for the distortion is chiefly to the H.F. waveform, and not to the modulation. If the valve be worked upon the non-linear portion of its characteristic, however, rectification will occur, and as a result the carrier may become modulated by interference. Should this occur, no amount of selectivity in succeeding stages will remove it, and audible interference will result. This effect is known as cross-modulation, and it must be avoided by the choice of a suitable type of H.F. valve and by operating it correctly.

The first requirement is a valve that will handle the largest input that is ever likely to be applied. This will be from the local station, and at some ten miles from a 50 kW. station, a potential of about 5 volts R.M.S. will be obtained across C1 (see Fig. 1, p. 378, May 26th issue) with a good aerial and a normal type screened tuning coil. This is equivalent to 7 volts peak with an unmodulated carrier, and 14 volts peak when the carrier is modulated 100 per cent. The grid bias on the H.F. valve, therefore, should not be less than 15 volts for local reception.

In the ideal theoretical case, this value of bias should always be applied to the H.F. valve; there is, however, no valve which will handle such a large input and yet give more than a very moderate degree of amplification. An ordinary screen-grid valve is quite out of the question, since the linear portion of its characteristic is unlikely to extend over a range of more than 2 volts, and the anode current will be completely cut off if it is biased to more than some 10 volts. The variable-mu type appears to be the only practical solution, for in this the working range is greatly extended. At a low value of grid bias, the valve is similar to an ordinary screen-grid type, but the bias can be extended up to 30 volts or more before the current cut-off point is reached. In general, the characteristics are non-linear over the whole of the working range, but if the valve be properly used the departure from linearity is quite small, and no trouble is experienced in practice from audible distortion or cross-modulation.

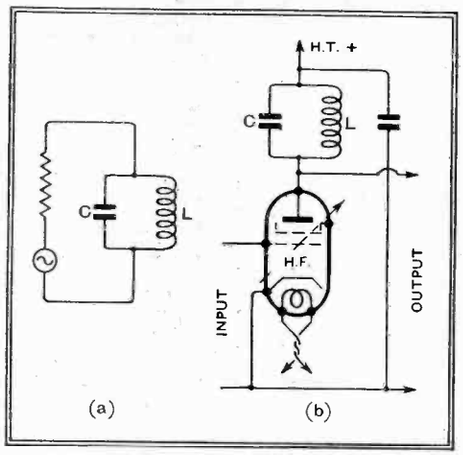


Fig. 1.—(a) The equivalent circuit of a tuned-anode H.F. amplifier. The generator represents the voltages appearing in the anode circuit, and the resistance the anode A.C. valve resistance. (b) The equivalent practical tuned anode circuit.

The amplification obtainable from the valve, when used under the proper conditions, is directly proportional to the mutual conductance, and this latter is a function of the bias voltage. When the bias is made high for the reception of a local station, therefore, the amplification is at its lowest; this is just what we require, for it is obvious that less amplification is needed for a strong signal than for a weak. As a result, the bias potentiometer R6 is actually the volume control, and the optimum bias for the signal is automatically obtained when adjusting the volume. In spite of this, it is sometimes advisable to limit the maximum input from a local station, and for this purpose a switch is sometimes fitted to connect a low value resistance R1 in parallel with the aerial coupling coil. Such a resistance damps the tuned circuit greatly and lowers its efficiency, so that a much lower voltage is set up across C1. The selectivity of this circuit is also lowered, but as high selectivity is rarely needed on a local station this is usually unimportant.

An Equivalent Circuit

We have now to consider the amplifying action of the valve. The simplest way of doing this is to regard the valve as an A.C. generator in series with a resistance; the generated voltage is equal to the input grid voltage multiplied by the valve amplification factor, and the resistance is equal to the valve anode A.C. resistance. This arrangement is sketched in Fig. 1(a) with a tuned anode circuit. and

[1] "How the Superhet Works," pp. 378-380, May 26th, 1933.

How the Superhet Works—

the more familiar equivalent in Fig. 1(b). The impedance of the tuned anode circuit LC varies with frequency, and is highest at the resonance frequency. The circuit, therefore, is selective. The output voltage from the amplifier is tapped off across the coil, and it is easy to see that it must always be less than the grid voltage multiplied by the amplification factor of the valve.

The impedance of the tuned circuit at the resonance frequency is usually known as the dynamic resistance, and it can rarely exceed a value of some 200,000 ohms; more usually it is about 50,000 ohms to 100,000 ohms. If the maximum amplification is to be secured, it must be high compared with the valve resistance, for then the amplification will closely approach the valve amplification factor. With a triode valve this is easily secured, for the valve resistance may be only 10,000 ohms or so; moreover, a high load impedance is the optimum condition for linearity of characteristic with a triode.

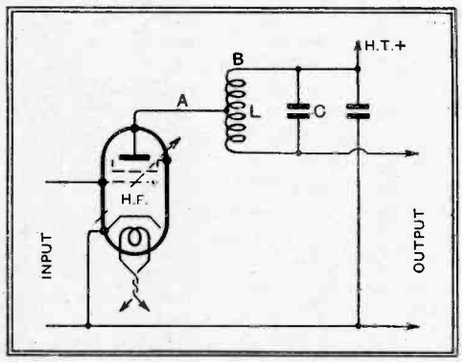


Fig. 2.—The tapped tuned-anode circuit is derived from the simpler arrangement. It has the merit of reducing the load impedance on the valve and of increasing the selectivity.

We are not using a triode, however, but a variable-mu valve, and the conditions are then quite different. Maximum amplification is still obtained with a high load impedance, but the most linear valve dynamic characteristics are obtained when the load impedance is very small. The two conditions are thus mutually opposing. The A.C. resistance of a variable-mu valve, however, is rarely less than 200,000 ohms, and is usually over 500,000 ohms; we cannot, therefore, hope to make the dynamic resistance of the tuned circuit large compared with the valve resistance, and we must be content with a degree of amplification much lower than the theoretical maximum.

A Simple Formula

When the load impedance is low compared with the valve resistance the amplification becomes equal to the mutual conductance of the valve multiplied by the dynamic resistance expressed in thousands of ohms, and the valve dynamic characteristics are almost identical with the static curves, so that the maximum degree of linearity is found. The mutual conductance of most variable-mu valves is about 2 mA/v., so that with a dynamic resistance of 100,000 ohms for the tuned circuit we should obtain a stage gain of 200 times at resonance for the circuit of Fig. 1.

A load impedance of 100,000 ohms on the valve, however, although small, is not entirely negligible, and for the maximum linearity of valve characteristic we should like it to be lower. If we lower the dynamic resistance, however, by increasing the coil resistance, we shall not only lower the amplification proportionately, but we shall also lower the selectivity. Suppose, therefore, that we connect the valve anode to a tapping on the tuned circuit, as in Fig. 2. Only that portion of the coil between A and B is now in the anode circuit of the valve, and the impedance between these points is equal to the impedance of the whole circuit divided by the square of the ratio of the total turns in the coil to the turns between A and B. Thus, if the total resistance is 100,000 ohms, as before, and the anode connection A is at the centre of the coil, the impedance between points A and B is only 25,000 ohms. The amplification to these points is now 50 times. We take our output voltage still from the whole coil, however, so that it is stepped up by the turns ratio; as this is 2-1, the total stage gain is 100 times.

It will be seen, therefore, that by tapping down the coil we lose amplification, but we reduce the load impedance on the valve more rapidly than we reduce the amplification. It is very important in this stage that the valve characteristics be as linear as possible, so that it will pay us to lose some amplification in order to ensure this. There is a further point, however, for although the valve resistance is high it is in parallel with the tuned circuit, and reduces its selectivity. With the tuned anode connection of Fig. 1 the valve resistance is in parallel with the whole tuned circuit, but with the tapped circuit of Fig. 2 the effective resistance in parallel with the tuned circuit is equal to the valve resistance multiplied by the square of the step-up ratio. When this is 2-1 the effective shunt resistance is four times the valve resistance; there is, therefore, a gain in selectivity when the valve anode is connected to a tapping on the coil.

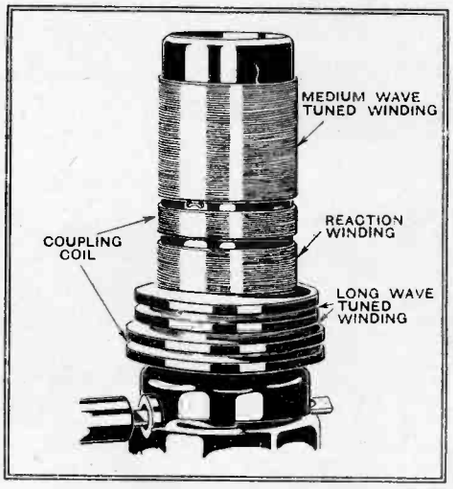
In a practical circuit, an actual tapping on the coil may prove inconvenient, since it will necessitate additional components to isolate the grid of the succeeding valve from the H.T. supply, and these components may themselves introduce losses. It is often better, therefore, to use a transformer, as shown in the complete circuit diagram in last week's instalment.* Here the primary is a completely separate winding coupled very tightly to the tuned secondary, and if the coupling be 100 per cent. it is in all respects identical with the circuit of Fig. 2. Actually, complete identity cannot be obtained, but the difference is quite small in a properly designed transformer.

The First Detector

It will thus be seen that we obtain amplified potentials across C2, and these are applied to the grid of the first detector. This intervalve circuit also provides additional selectivity, so that the ratio of wanted to unwanted signals at the first detector grid is greater than that at the H.F. valve grid; so far as stations immediately adjacent in wavelength are concerned, however, it is still far from sufficient.

The first detector grid is biased negatively by the usual expedient of biasing its cathode positively, this being arranged by the insertion of the resistance R2 in its cathode lead. In order that the impedance of this circuit may be low- to high-frequency currents the resistance is shunted by a large capacity condenser C7. It will be observed that the cathode lead of this valve is returned to earth through a coil coupled to the oscillator circuit, and it is now necessary to consider this valve.

The oscillator and first detector together form the frequency changer, and their functions are sometimes combined in a single valve. In general, however, better results are to be secured through the use of separate valves.



The disposition of the different windings for the oscillator coil are shown in this illustration. A switching arrangement is included for wave-range changing.

The oscillator is required only to generate oscillations of the required frequency, and there are many entirely satisfactory circuits which could be used. The particular arrangement shown in the full circuit,* however, has the merit of combining simplicity with reliability. The tuned circuit is connected between the valve grid and the earth line, and the cathode connection is completed to H.F. currents through the condenser C9, the valve being biased by the voltage drop along R4. The reaction coil is between the points 1 and 2 of the coil assembly, and it is shunt-fed from the

*See circuit diagram on page 378 of last week's issue.

How the Superhet Works—

anode circuit through a condenser C10, the H.T. supply to the valve being taken through a resistance R3.

If the correct values are assigned to the circuit constants, the valve will oscillate if the coupling between the reaction coil and the tuned coil be tight enough. For the best operation, however, the coupling should, in general, be only just sufficient for the maintenance of oscillations. The output of the valve will be chiefly at a single frequency, determined principally by the constants of the tuned circuit, but since it is almost impossible to work the valve solely upon the linear portion of its characteristic, the output will usually contain harmonics.

Due to this, the anode current will change when the valve is oscillating, and with the particular circuit under discussion it will be greater in the oscillating condition than in the non-oscillating. The amount of the increase is determined very largely by the D.C. resistance of the anode circuit, and by whether the grid bias is fixed or automatic. With fixed grid bias and a low D.C. resistance anode circuit the current in the non-oscillating condition may be 3 mA., but it may easily rise to 40 mA. or more when the valve is generating oscillations. With automatic bias and a high resistance anode circuit, however, the rise in current may be to no more than 5 mA.

The choice of a suitable oscillator valve is by no means difficult, for almost any valve will oscillate in a suitable circuit. It is necessary, however, that the output should exceed a certain figure, and it is usually found that a valve of moderate A.C. resistance and moderate mutual conductance is the best. In general, the resistance should lie between 5,000 ohms and 10,000 ohms, and the mutual conductance be between 1.5 mA/v. and 2 mA/v. for the most stable and consistent operation.

DISTANT RECEPTION NOTES

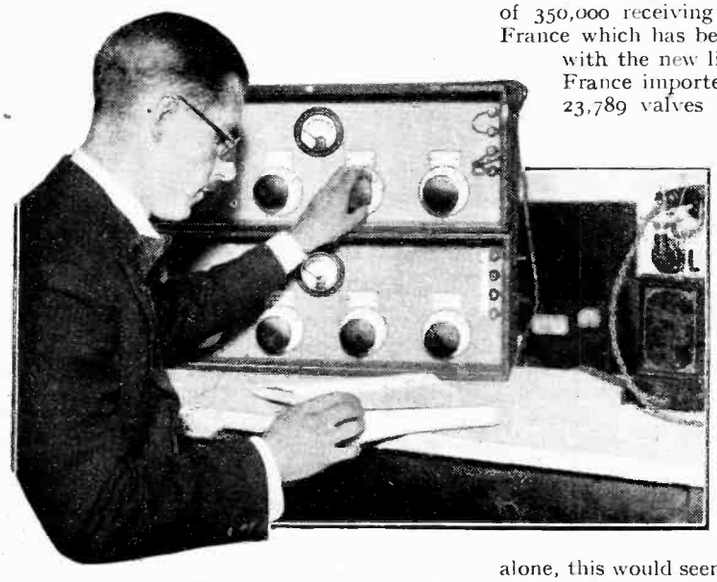
Summer Conditions : A.V.C. to the Rescue

IT is interesting to notice that the vertical radiator type of aerial used by the Bisamberg station is also being employed by the 500-kilowatt WLW in America. Under this system there are no suspended wires; the lattice metal mast itself is the aerial. American wireless engineers are most enthusiastic about this kind of radiator, which, they maintain, adds at least twenty-five per cent. to the service area radius of a station. WLW is calculating on a regular range of at least 1,000 miles in each direction, and 5,000 miles are spoken of under favourable conditions.

Toulouse Midi remains silent. I hear that permission to use the St. Aguan station has been definitely refused by the Government on the ground that it was erected without authority. The old station is being rebuilt as quickly as possible. I should not be surprised if the St. Agnan plant were eventually acquired by the Government, for under the Ferrié Scheme Toulouse is booked for a high-power PTT transmitter.

More and more use is being made of the intermediate wavelengths between the medium- and the long-wave bands. Unfortunately, there are not nowadays many sets that will tune up to (or down to) the waveband between 550 and 1,000 metres. Already the second Budapest station (18.5 kilowatts) is at work on 840 metres, and Monte Ceneri, the 15-kilowatt Italian-Swiss station on 678.7 metres. Grenoble (568.1 m.) is at present rated at 2 kilowatts, and, even so, is quite well heard. Within a short time the power is to be increased to about 20 kilowatts.

I was amazed to read the official estimate of 350,000 receiving sets for the whole of France which has been made in connection with the new licensing scheme. Since France imported from us no less than 23,789 valves in the month of April alone, this would seem to be, to say the least of it, a slight underestimate, particularly as France has herself a considerable valve-manufacturing industry. Either the official figures are wrong, or every Frenchman must have the habit of renewing his entire outfit of valves two or three times a year!



CONTROLLING GRAND OPERA. Mr. Stanton Jefferies, who directs the musical side of the B.B.C.'s Balance and Control Section, photographed at Covent Garden during the broadcasting of an opera. The entire work has to be followed from the full score in order that the graduations in volume can be proportioned to the decibel range of the transmitter.

Bari, the Italian station which works nominally on a wavelength of 269.8 metres, has been very well heard on many recent occasions. This is rather a crowded part of the medium waveband, but such is the strength of the Italian station that it successfully drowns interference. By the time that these notes appear in print Bisamberg should be in full swing. A good many long-distance enthusiasts will have had a previous sample of its strength and quality, for the new transmitter has been in use on the last few Saturday nights.

A certain amount of fading is manifesting itself at present on the medium-wave band. It is not of the violent kind accompanied by periods of complete silence or horrible distortion; stations simply swing quite slowly from full strength to moderate strength and back again. Such conditions bring out to the full the advantages of automatic volume control. It is an eye-opener to use on a typical evening at the present time first of all a "plain" receiving set and then one with A.V.C., or A.G.C., as the sticklers for strict technical accuracy prefer to call it.

It is the stations above 500 metres that are chiefly affected just now by fading, and some of these, I fear, will be out of season until there is an "R" in the month once more! Budapest is now barely receivable, and Munich is seldom a good signal.

Outstanding stations on the medium waves are Prague, Langenberg, Lyons Doua, Rome, Katowice, Leipzig, Hamburg (unless heterodyned), Strasbourg, Brussels No. 2, the Poste Parisien, Breslau, Hilversum, Heilsberg, Turin, Trieste, Nürnberg, and Hörby. On the long waves reception is particularly good, except in the case of Kalundborg and Oslo, both of which are unreliable at the moment.

D. EXER.

CATHODE RAY TELEVISION

Special Tubes Introduced

UP to the present time most amateur constructors have been deterred from embarking on the reception of television by purely mechanical difficulties. Rotating mirror drums and similar devices, which must be run accurately in step, can hardly be set up in the home workshop.

The cathode ray system of reception has the advantage that there are absolutely no mechanical moving parts; the images are formed by controlling electrically the movements of a ray directed from the cathode on to the flattened end of the tube which forms a fluorescent screen. Synchronism is similarly ensured by electrical means.

Many technical workers consider that the perfected television apparatus of the future will employ a cathode ray tube; indeed, this opinion was expressed by the late Campbell Swinton as long ago as 1908.

A practical system was described in *The Wireless World* for March 18th, 1931, and interesting developments introduced in Germany by von Ardenne were discussed in the issue of May 25th, 1932.

It will be good news for British amateurs who are interested in this most promising method of reception to hear that the Ediswan Company have now introduced a special tube for television purposes. Apart from this tube, practically no components other than those used in ordinary radio practice are needed for setting up a practical television receiver, which, as it requires a very small input, may be fed from any ordinary set.

News of the Week

Events of the Week in Brief Review

Bisamberg Begins

BISAMBERG, the new high-power station near Vienna which opened on Sunday last, May 28th, has as its interval signal the first bar of the Blue Danube watlz.

Cutting Out the Crackle

DERBY trolley buses have been causing interference with wireless reception, and in consequence of complaints the Corporation has fitted choke gear to each omnibus at a cost of about £20 per omnibus.

Voices from the Past

THE Eiffel Tower station has just celebrated the anniversary of "radio reportage" or running commentaries. Among the interesting items was the broadcasting of an old gramophone record giving a speech by Ernest Renan and by the great French chemist Berthelot.

How Holland Listens

MORE listeners in Holland now subscribe to the broadcast relay systems than to direct wireless broadcasting. According to latest statistics Holland has 280,610 wireless licence holders, and no fewer than 291,628 subscribers to the radio distribution service.

Norway's "Three-Year Plan"

A TOTAL of forty-three broadcasting stations is provided for in Norway's new three-year plan which has been started with the construction of the 20 kW station at Bergen and ½ kW relays by Kirkenes, Kristiansund, Stavenger and Tromso. The existing Trondheim station is to be increased in power from 1.2 to 25 kW. The entire scheme should be completed before the end of 1935, by which time, presumably, the Lucerne Plan will require an extensive overhaul.

A 2,000-feet Aerial Mast

ONE of the hitherto unrevealed projects for the "Century of Progress Exposition" which opened in Chicago on Saturday last was a 2,000-feet steel tower, double the height of the Eiffel Tower. This great landmark (writes our Washington correspondent) was to have been an ideal transmission point for television and accompanying sound on the ultra-short waves. Unhappily, financial support was not forthcoming.

The Exposition will have no broadcasting station of its own though arrangements are being made to link up a studio with the major networks. In addition a group of amateurs have erected a short-wave station in the Travel and Transport Building, visitors being invited to send messages far and wide *via* the "ham" wavelengths at no cost to themselves. The call letters of the amateur stations are W9USA and W9USB.

"Pirates" in Spain

SPAIN is suffering from an epidemic of secret transmitters, the principal plague spot being Saragossa, where the police claim to have captured five of the culprits, all of whom were transmitting seditious propaganda.

Australian Station for New Zealand

THE New Zealand State Broadcasting has accepted a tender of Amalgamated Wireless (Australasia), Ltd., for a 2½ kW broadcast transmitter for 3YA, Christchurch, to be erected at Banks Peninsular, near the city. The station, which will be capable of increasing its power to 10 kW, will work on a wavelength of 570 kc/s.

The Big Show

THIS year's National Radio Exhibition, which will be held at Olympia from August 15th to 24th, promises to offer more novelties than any of its predecessors. Not only will the new receivers bristle with multiple valves; the indications show that iron cored coils will be the general rule in receivers intended for long distance reception. In addition to Ferrocart use will be made of British coil inventions which hold great possibilities as regards selectivity and sensitivity.

Amateur Signals from Stratosphere

M. MAX COSYNS, the well-known Belgian amateur, will transmit on wavelengths of 41.1 and 21.4 metres, from the balloon which is making the third ascent into the stratosphere from Belgium during July.

Preliminary tests are being carried out with the apparatus on a Puss-Moth Gypsy plane piloted by M. Jacques Mahieu, with the call letters XXON4AU. Transmissions are being made every Thursday and Sunday between 3 and 6 p.m. (B.S.T.).

Medium Waves Cross Atlantic

"RADIO EXCELSIOR" at Buenos Aires has just been completed by the Marconi Company, and reception has been reported at the Marconi Works at Chelmsford, Essex. The wavelength of the station is 361 metres, and the power 200 kW. "Radio Excelsior" has one of the highest broadcasting aerials in the world, the horizontal aerial being suspended between two towers 700ft. high.

I.F.S. Committee in Distress

A COMMITTEE which decides upon the composition of broadcasting programmes is bound to be the target of public criticism. The Broadcasting Advisory Committee of the Irish Free State is no exception to this rule, and Mr. Gerald Boland, the Minister for Posts and Telegraphs, is considering its abolition or reconstitution. This statutory body is appointed under the Wireless Telegraphy Act, 1926, to "advise and assist" the Minister controlling broadcasting. It consists of about ten members representative of educational and general interests.

In defence of their efforts the Committee have protested that their powers have been too loosely defined and that their advice has not been acted upon.

YOUNG ITALY LISTENS. Children in elementary schools all over Italy recently heard a simultaneous broadcast specially organised for their benefit by the Board of Education. The photograph shows a typical assembly listening to an address on the history of Rome.

Listeners as Censors

THE first law of its kind has been formulated by the Czechoslovakian postal authorities in forbidding listeners to "disseminate" broadcast programmes from abroad which might be contrary to public order or damaging to the Czechoslovak Republic. If such a programme be received, the listener must not make it audible to any persons outside the family circle. Problems which occur are: What constitutes a damaging programme and how is the listener to discriminate in advance?

Problems at Lucerne

TWO major problems appear to be holding up the great Wavelength Conference at Lucerne. The main difficulty is the question of the Russian wavelengths. Russia was not invited to the Washington Conference in 1927, and in consequence has utilised wavelengths very freely without reference to other European States; many Russian transmitters are between 600 and 1,000 metres. The Russians have, however, expressed their willingness to make certain alterations, but have no intention of discarding all their wavelengths outside the ordinary broadcasting band.

Another problem (writes our Lucerne representative) is concerned with the £.s.d. of wavelength alterations. For instance, a station like Luxembourg, designed for long wave working, would have to be almost completely scrapped and rebuilt if required to work on the medium waveband. A change of a score or two of kilocycles requires much expenditure; for instance, new crystals will have to be bought for every German station, and these alone cost £50 at par! This serves to explain why the proposed wavelength changes are planned to be the smallest possible.

It is expected that the Conference will continue until after Whitsun.

General interest has been aroused by the proposed "Plan de Lucerne," which was exclusively revealed in last week's *Wireless World*.

A Canadian Reshuffle

THE elimination of "phantom" stations, i.e., those which have used more than one set of call letters for the same transmitter, has led to an apparent reduction in the number of Canadian broadcasting stations, the official list now standing at fifty-six. Most of the stations have been given new wavelengths based on the U.S. Canadian Agreement of May, 1932, which aims at preventing interference between transmitters in the two countries.

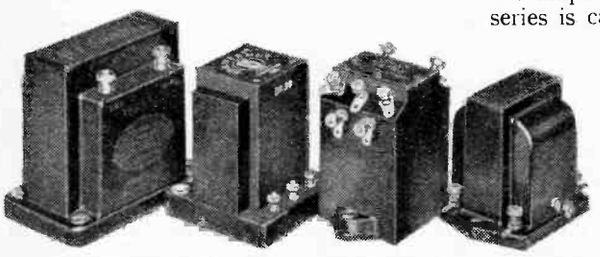
Toulouse Mystery : New Theory

IN his 70-page report on the disastrous fire at the Toulouse broadcasting station six weeks ago, M. Gleises, a local magistrate who presided over the enquiry, establishes that the cause was a short circuit in the wire lighting the indicator signals between the control room and the big studio.

Meanwhile the officials wait in vain for Post Office sanction to open the 60 kW transmitter at St. Agnan, and listeners, both in France and abroad, are wondering whether the French Post Office intends to suppress this energetic organisation until the completion of the projected Regional Scheme. If so, Toulouse might remain virtually silent for several years.

Components for CLASS "B" AMPLIFICATION

JUST as the variable-mu valve has superseded the screen-grid valve in high-frequency amplification, so it would appear that the class "B" valve is about to replace the single battery output valve in all but the simplest receivers. The reason is not far to seek; a class "B" receiver will give as much volume and as pleasing quality of reproduction as the type of mains set which is so popular to-day, and thus the favourite grouse of the battery set user—that he must content himself with only mediocre power output—is disposed of once and for all.

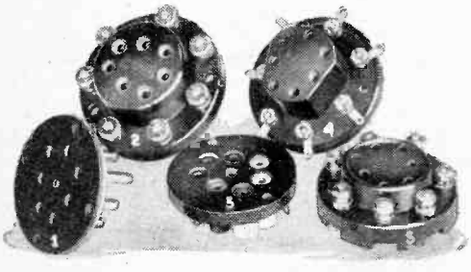


Driver transformers. From left to right: Ferranti AF17C, R.I. Driver-mu DY39, Varley DP40 and British Radiophone.

In economy of H.T. consumption the new valve can claim considerable advantage over earlier types, as practically the whole of the power consumed is available for operating the speaker, and precious milliamperes are only consumed in proportion to the loudness of signals.

Sceptics have pointed out that although the *average* working anode consumption has been proved to be within certain limits, the H.T. battery of medium capacity could hardly be expected to withstand the momentary peaks of, say, 40 mA. which occur during full modulation. In this connection it is pleasing to note that, from reports on the behaviour of *The Wireless World* "Class 'B' Ferrocart" receiver, the life of the H.T. battery, rated for 12 mA. discharge, is quite normal.

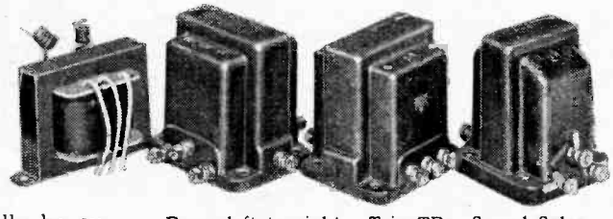
Class "B" amplification has undoubtedly established itself, and we find the leading valve manufacturers entering the market with various types. In addition to the 240B valve made by Cossor, who are pioneers in this field, there is now the Ferranti HP2, of similar characteristics to the 240B, and a Mazda class "B" valve styled the PD.220. This newcomer is not only valuable in the output stage of ordinary battery sets, but is also admirably suited to the needs of portable sets, as the filament consumption is but 0.2 amp. The Mullard member of this series is called the PM2B and also has a filament rated at 0.2 amp., whilst the Marconi and Osram valve, although not released at the time of writing these notes, is understood to have a similar filament consumption.



Five 7-pin valve holders suitable for Class "B" valves. (1) Clix, (2) Ferranti, (3) Dowbro, (4) Wearite, and (5) W.B.

Designing the Driver Stage

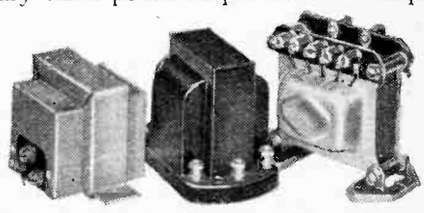
With so many types available, it has been thought that tables giving valve constants and driver transformer ratios would be helpful in arriving at a choice of the best combination of components for any given conditions. Readers probably have neither the time nor the inclination to exercise their mathematical faculties in working out the rather complicated relationship between driver valve, driver transformer, and class "B" valve, so that the classified list, which is not complete, but representative of the many arrangements possible, should form a short cut.



From left to right: Trix TB1, Sound Sales Type UB, Trix, and Lissen Hypernik.

In broad principle every class "B" valve (which consists of two triodes in one bulb) has a minimum input impedance—that is, when a large signal is received, each separate triode in turn runs into grid current, and the valve's grid circuit presents quite a low resistance—say, 2,500 ohms—across half the driver transformer secondary to which it is connected. Now if the driver transformer has an overall ratio of 1 to 1, its step-down ratio per half secondary will be 2 to 1, and the load transferred to the primary in the case just mentioned will be $2{,}500 \times 2^2$, or 10,000 ohms. Should the driver valve, which must be looked upon as a small power output valve delivering undistorted energy, require 10,000 ohms as its optimum load, all is well, and we can say that, for the class "B" valve concerned, the driver transformer and driver valve have been well chosen.

Unfortunately, this is not the whole story. Valve makers are finding that although it is accepted practice in ordinary small power output valve technique to choose a load impedance from 1.6 to 2 times that of the valve in order to give the greatest output free from harmonic distortion, in class "B" work the driver load must be perhaps three times or even five times the A.C. resistance of the driver valve. This being so, it will quickly be appreciated why there appear in Table B driver transformers having ratios per half secondary of 3 and 4 to 1.

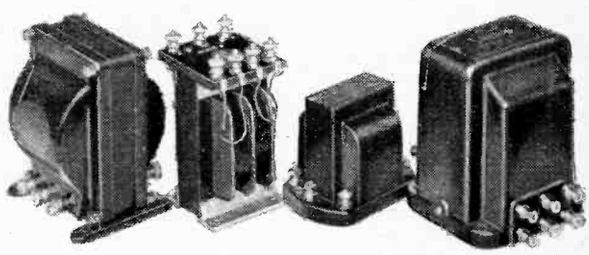


Three driver transformers. From left to right: Benjamin, Multitone BEPU, and multi-ratio Wearite model.

Small Leakage Inductance

Let us assume that in the interests of H.T. economy it has been decided to be content with rather less than one watt speech output, for which purpose quite a small driver valve will suffice—the type of L.F. valve which will pass very little anode current and thus will be of moderately high impedance, say, 13,000 ohms. Accordingly, a load of three times this value will be chosen—say, 40,000 ohms—and to transfer 2,500 ohms valve input impedance to this value, which is a ratio of sixteen times, the primary to half secondary ratio will have to be $\sqrt{16} = 4$ to 1.

It is not enough just to wind the correct number of turns on a "generous" core.



Output transformers and chokes. From left to right: Ferranti OPM.16C, multi-ratio R.I. output choke, Multitone Puchoke and Varley output choke.

The inductance of the primary must be high under working conditions, the D.C. resistance of the secondary really low, and, above all, there must be the very minimum leakage inductance and core

Components for Class "B" Amplification—

loss. Many of the transformers given in the table have been tested and found to conform to the required standard.

An example of how to use Table B may not be out of place. Suppose that a power output of one watt only is desired from a loud speaker working in a comparatively small room and that it is proposed to use an inexpensive 120-volt H.T. battery; a sound choice would be an R.I. DY38 driver transformer with a step-down ratio of 4 to 1 fed from a Mazda L2 driver valve and feeding into a PD.220 class "B" valve of the same make.

Of the matching of the output transformer to the speaker little need be said, as all the manufacturers who supply driver transformers also have tapped output chokes or multi-ratio transformers available. The correct ratio is obtained from the usual formula:

$$\sqrt{\text{Anode-to-anode load} \div \text{speech coil impedance}}.$$

If, as is usually the case, the speaker has a built-in matching transformer, we must substitute in the above formula for "speech coil impedance" the speech coil impedance as referred to the primary of the transformer—a figure which the makers will be able to supply.

Since the original articles on class "B" amplification appeared in *The Wireless World* considerable research has been carried out on causes of distortion, and in many cases it has been found to be due simply to battery coupling. If, therefore, suspicion arises as to the condition of the H.T. battery, borrow a new one to feed the class "B" valve only, and, should distortion disappear, it indicates that more extensive decoupling is required in all the other stages. A good example of comprehensive decoupling is to be found in the Ferranti class "B" Constructors' Set recently reviewed in these pages.[1]

[1] See issue dated May 19th, 1933, page 361.

Another cause of distortion is parasitic oscillation, which can be prevented by the use of 0.002 to 0.005 mfd. condensers between one or both anodes of the class "B" valve and the output transformer centre-point.

TABLE A.
CLASS "B" VALVES.

Type.	Filament. Volts.	Filament. Amps.	Total Quiescent Anode Current (mA.)	Min. Input Impedance (ohms).	Anode-to-anode Load (ohms).	Undistorted Output at 120v. H.T. (Milliwatts).
Cossor 240B.....	2.0	0.4	4.0	2,500	8,000	2,000
Ferranti HP2	2.0	0.4	3.0	2,500	8,000	2,000
Mazda PD220.....	2.0	0.2	2.0	4,000	17,000	1,000 (A)
" PD220.....	2.0	0.2	2.0	3,800	11,500	1,400 (B)
Mullard PM2B ...	2.0	0.2	3.0	4,000	14,000	1,250

(A) Using an L2 valve as driver. (B) P220 valve as driver.

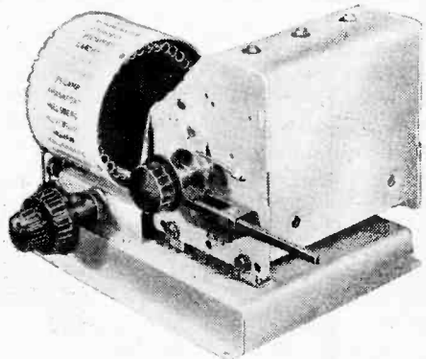
TABLE B. DRIVER TRANSFORMERS.

Type.	Maker.	Ratio per Half Sec.	Suitable Class "B" Valve.	Suitable Driver Valve.	Output. 120v. H.T.	Output. 150v. H.T.	Price.
							s. d.
Class "B" ...	Amplion	2 to 1	240B	215P	2 watts	—	9 6
		3 to 1	PD220	P220	1.4 "	2.4 watts	9 6
		3 to 1	PM2B	PM2DX	1.25 "	—	
		4 to 1	PD220	L2	1.0 watt	2.1 "	9 6
"B"	Benjamin	2 to 1	240B	215P	2 watts	—	10 6
		3 to 1	PD.220	P.220	1.4 "	2.4 watts	
		3 to 1	PM2B	PM2DX	1.25 "	—	
Class "B" ...	British Radiophone	2 to 1	240B	215P	2 watts	—	15 0
AF15C	Ferranti	2 to 1	240B	215P	2 watts	—	26 6
		2 to 1	HP2	215P	2 watts	2.7 watts	
AF17C	"	2 to 1	240B	215P	2 watts	—	15 0
		2 to 1	HP2	215P	2 watts	2.7 watts	
Hypernik	Lissen	2 to 1	240B	215P	2 watts	—	12 6
BEPU 1:1 ...	Multitone	2 to 1	240B	215P	2 watts	—	9 6
BEPU 1.5:1 ...	"	3 to 1	PD.220	P.220	1.4 watts	2.4 watts	
		3 to 1	PM2B	PM2DX	1.25 "	—	9 6
		2 to 1	240B	10,000 ohms	1.0 watt	—	
BEPU 2:1.....	"	4 to 1	PD.220	L2	1.0 "	2.1 watts	9 6
DY37.....	R.I.	2 to 1	240B	215P	2 watts	—	15 0
		3 to 1	240B	6,000 ohms	2 watts	—	
		3 to 1	PM2B	PM2DX	1.25 "	—	
		3 to 1	PD.220	P.220	1.3 "	2.1 watts	
DY38.....	"	4 to 1	240B	10,000 ohms	1.0 watt	—	15 0
		4 to 1	PM2B	20,000 "	0.7 "	—	
		4 to 1	PD.220	L2	1.0 "	2.1 watts	
DY39.....	"	2 to 1	240B	215P	2 watts	—	11 0
		4 to 1	240B	10,000 ohms	0.75 watt	—	
DY41.....	"	4 to 1	PM2B	20,000 "	0.7 "	—	11 0
		4 to 1	PD.220	L2	0.75 "	1.5 watts	
DY42.....	"	3 to 1	PM2B	PM2DX	1.25 watts	—	11 0
		3 to 1	PD.220	P.220	1.4 "	2.4 watts	
"UB"	Sound Sales	2 to 1	240B	215P	2 watts	—	10 0
		3 to 1	PD.220	P.220	1.4 "	2.4 watts	10 0
		3 to 1	PM2B	PM2DX	1.25 "	—	
		4 to 1	PD.220	L2	1.0 watt	2.1 watts	10 0
TB1	Trix	2 to 1	240B	215P	2 watts	—	9 0
TB2	"	4 to 1	PD.220	L2	1.0 watt	2.1 watts	9 0
TB3	"	3 to 1	PD.220	P.220	1.4 watts	2.4 "	9 0
		3 to 1	PM2B	PM2DX	1.25 "	—	
DP40	Varley	2 to 1	240B	215P	2 watts	—	15 0
		3 to 1	PD.220	P.220	1.4 "	2.4 watts	
		3 to 1	PM2B	PM2DX	1.25 "	—	
DP41	"	3 to 1	PD.220	P.220	1.4 "	2.4 watts	15 0
		3 to 1	PM2B	PM2DX	1.25 "	—	
		4 to 1	PD.220	L2	1.0 watt	2.1 watts	
"B"	Wearite	2 to 1	240B	215P	2 watts	—	8 6
		3 to 1	PD.220	P.220	1.4 "	2.4 watts	
		3 to 1	PM2B	PM2DX	1.25 "	—	
		4 to 1	PD.220	L2	1.0 watt	2.1 watts	

NEW TUNING DEVELOPMENT

A NOVEL device which is sponsored by the Invincible Trust, Ltd., 24, Throgmorton Street, London, E.C.2, will shortly make its appearance on the market. Unlike the majority of tuning dials now in use it does not take the form of a drive mechanism but is rather in the nature of a station selector. It consists of a drum mounted by the side of the gang condenser and engraved with the names, in alphabetical order, of the principal broadcast stations working on the medium and the long wavebands. On the condenser spindle is a small pinion, and immediately below and engaged with it is a rack sliding in a specially constructed cradle.

Round the periphery of the drum, and on the side adjacent to the condenser, is a series of holes corresponding in number to the stations engraved on the dial. Each is provided with an adjustable stop carrying a small electrical contact, and these can be set to permit the rack to travel to any desired depth into the drum.



New station selector dial attached to a three-gang condenser.

It thus follows that each stop can be fixed to arrest the travel of the rack when the condenser is adjusted to any desired station, and in practice this adjustment is made to coincide with that position of the drum which brings the name of the station in question opposite the escutcheon window. The function of the electrical contact is to interrupt either the loud speaker circuit or break any other suitable lead in the set, while making these adjustments, and the circuit is completed by the final movement of the rack.

The model illustrated here is fitted with a 3½in. drum engraved with the names of twenty-six medium-wave and long-wave stations. To avoid confusion black lettering is adopted for the former and red lettering for the latter. In addition, there is one position marked "Common" which enables the receiver to be tuned in the normal way. Drums of larger size could be employed, if necessary, thereby allowing many more station names to be accommodated. Provision is made for a limited movement of the drum should a final adjustment be necessary at any time.

Practical HINTS AND TIPS

AIDS TO BETTER RECEPTION

THERE seems to have been an epidemic lately of defective condensers of the solid dielectric type. At any rate, several failures have been traced to a lack of continuity between the terminals and the moving or fixed sets of vanes.

Open-circuited Condensers

This trouble seems to be confined to the cheaper type of condenser, in which the vanes are almost entirely concealed between plates of paxolin or similar material. Sometimes the fault does not manifest itself until the condenser is subjected to torsional stresses by being mounted rigidly on the panel. Tests for continuity should, of course, be made directly between the appropriate sets of vanes and the terminals.

IT is sometimes thought that none but specially designed L.F. transformers can be used as parallel-fed intervalve couplings. This is a mistake; any transformer, even if manufactured before resistance-feeding was thought of, may be employed in this manner, often with advantage. With the accompanying diagram as a guide, there should be no difficulty in making the connections correctly.

Parallel-fed Transformers

In Fig. 1 (a) is shown the normal system of connection, in which the primary winding is inserted directly in the anode circuit of the preceding valve; the four terminal points of the transformer are lettered in accordance with the prevailing practice, although the beginner may bear in mind the fact that A (anode) is often substituted for P (plate).

When changing over to the simplest form of parallel-fed circuit (diagram b), the secondary connections remain unchanged, but the primary is joined up in the manner indicated. Although the "P." and "H.T." terminals are no longer joined to the points indicated by their lettering, the input from the preceding valve is still applied to the original high-potential point.

In order to obtain a higher step-up ratio, and consequently greater amplification, primary and secondary are often connected together and thus converted into an auto-transformer, as in diagram c. Here the connections are not quite so straightforward, and, although the methods indicated will generally be correct, it cannot be guaranteed that the "sense" of the windings will be right in every case. Instead of joining "G.B." to "P" and "H.T." to the grid bias battery, as shown, it may be necessary to reverse the primary connections. This is done by joining "H.T." to "G.B." and "P" to the bias battery. In every case the lead from the feed condenser may be connected to the "G.B." terminal.

Although the subject is rather too involved for superficial treatment, the question of the values of the feed resistance and coupling condenser may be briefly touched upon. The first component may have a resistance of anything between 10,000 and 50,000 ohms; the latter value would generally be applicable only where a detector valve of high A.C. resistance is employed in conjunction with a relatively high H.T. voltage; 20,000 to 30,000 ohms is the average value.

A feed condenser of 1 mfd. is a fairly safe choice, although a lower value may help to introduce a desirable bass resonance, and thus improve the characteristics of the L.F. amplifier.

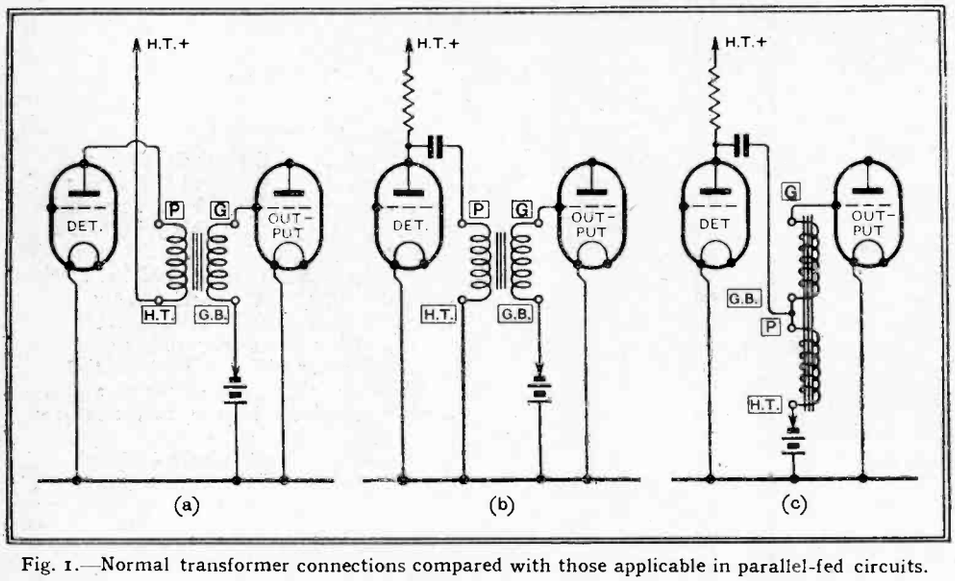


Fig. 1.—Normal transformer connections compared with those applicable in parallel-fed circuits.

Before closing this note attention might be drawn to the fact that the "extra step-up" circuit of diagram (c) is at present rather under a cloud, as decoupling of the grid circuit of the succeeding valve becomes more difficult when it is employed. This disadvantage applies only to mains-operated sets, and not to a circuit where bias voltage is derived from a battery.

IT is as well to cultivate the habit of making periodical tests of the insulation resistance of coupling condensers used in a resistance capacity amplifier. Quite a small leakage will seriously impair the working of the valves; when high-resistance grid leaks are employed so much positive voltage from the source of H.T. supply may reach the grids that the negative bias voltage normally applied may be entirely cancelled out.

Effects of Leakage

Although a direct measurement of the insulation resistance of the coupling condenser can seldom be made with the apparatus available, it may be remembered that we have a fairly certain indication that the condenser is leaking when the anode current of the associated valve is found to be unduly high.

More or less serious distortion will suggest that one or more of the condensers may be leaking. The symptoms are those of overloading, but if the grid condenser of the valve preceding the output stage is not at fault, the working of the output valve would not be affected. For instance, a meter connected in its anode circuit would show a steady reading.

PROSPECTIVE constructors of the short-wave converter described in *The Wireless World* of April 28th may be tempted to obtain anode current for the H.F. and detector-oscillator valves of the unit from the receiver with which it is to be used, instead of providing separate mains equipment in the manner described in the constructional article.

The "Universal Short-wave Converter"

This is an alteration that can hardly be recommended, especially when the existing set is of the superheterodyne type. In the first place, there is very little surplus power in the average set, and so its operation may be impaired by imposing an extra drain on the rectifying equipment. Even if the difficulty of current supply can be overcome, a separate source of supply for the converter is desirable, as it reduces the possibility of stray couplings between unit and set.

Broadcast Brevities

By Our Special Correspondent

Discords on a B.B.C. Music Committee

IT is a sad fact that the profession of music seems to involve its votaries in acrimonious disputes. Broadcast music, alas, is no exception, hence it is not surprising that differences of opinion should reach a critical stage even on the B.B.C.'s Musical Advisory Committee.

Two members of this very important body have recently tendered their resignations, which have, however, been declined in the hope that better counsels may prevail.

Should Artistes Hold Diplomas?

A great bone of contention, I understand, has been the proposal that no musical artiste should be permitted to broadcast unless he or she possesses a diploma or other suitable credentials from one of the established schools of music in this country.

Impossible Rule

It seems difficult in this year of Grace to conceive of such a regulation, and I believe that many musicians with diplomas would be among the first to protest against such an arbitrary ruling. It has been said that Johann Sebastian Bach would have been quite unable to secure a modern Mus. Bac. degree, and, of course, it is common knowledge that the great Verdi was turned down by one of the big academies of music, as "showing insufficient promise."

Banning the Great Masters

Surely it will be a bad day for broadcasting when the Bachs and the Verdis are denied access to the microphone.

The Men in Charge

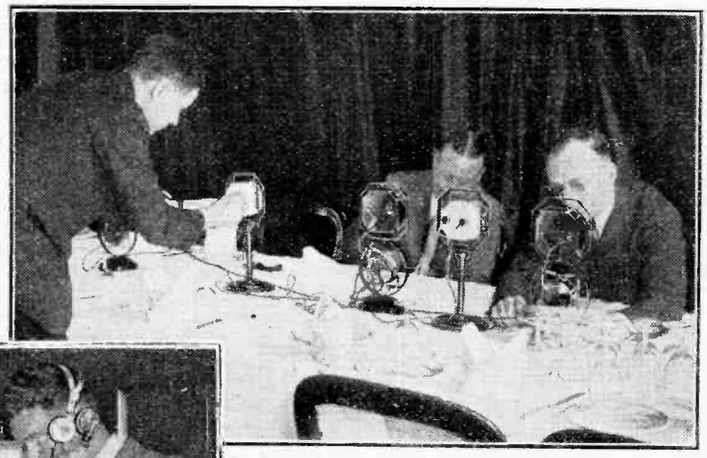
At the Junior Carlton Club on Empire Day I saw just how a broadcast of this kind is done. Two B.B.C. engineers handled the entire job, although the speeches of Lord Derby, the Archbishop of Canterbury, and the Rt. Hon. J. H. Thomas were broadcast to all parts of the Empire and a failure would have started a buzz of enquiry all over the globe.

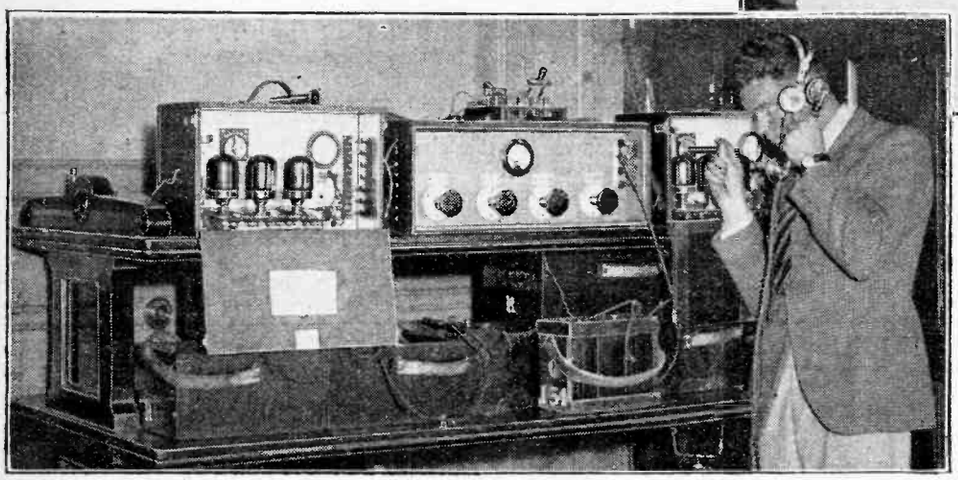
But there was no failure. One engineer took charge of the microphone, while his *confrère* hastily rigged up "control" on a dumb waiter concealed behind masses of foliage, plates, camouflaged Canadian salmon, and hors d'œuvres.

Nothing Missed

So slick are these "O.B." men that the whole affair was contrived within an hour. Speech was tested and found wholesome, the cables from the microphones were made foolproof to ensure that not even the most myopic of visitors could possibly trip over them, and, finally, before all was pronounced perfect, the engineers even tested the lighting system for interference clicks.

"WE ARE NOW TAKING YOU OVER. . . ." Engineers fitting microphones at the Junior Carlton Club for speeches by Lord Derby, Mr. J. H. Thomas, and the Archbishop of Canterbury on Empire Day. (Below) The B.B.C. "control," showing the "A" amplifier and emergency gear.





How to Broadcast an Empire Luncheon

HOW our great grandfathers would have blinked at the preparations for a ceremonial luncheon of to-day! They would have comprehended the gastronomic side of the business and would probably have deplored the asceticism of the present generation, which can begin a luncheon at 1 p.m. and be in a fit state for speech-making forty-five minutes later. But the mikes and the amplifiers, and the loud speakers . . . !

Sang Froid

Like all other items of B.B.C. routine, outside broadcasts are now a cut-and-dried procedure, and I have little doubt that the engineers would preserve the same *sang froid* whether they were relaying an egg-laying contest at Little Mugwump or a Delhi Durbar. Which is just as well, for few jobs call for more self-possession and a cooler head if anything goes wrong.

The R.A.F. Display

THAT splendid commentator, Squadron-Leader Helmore, will once more be in charge of the microphone at the Royal Air Force Display at Hendon on June 24th, when two running commentaries will be broadcast, the first from 3 to 3.30 p.m. and the second from 4.25 to 4.45 p.m.

Tied-together Flying

Perhaps the most thrilling of all the events to be described will be the demonstration by No. 25 Fighter Squadron of "tied-together" flying, in which the 'planes engaged will be linked by light cables to which streamers will be attached. Listeners will also hear a description of the take-off of a Day Bomber Wing, an aerial combat and inverted flying.

Mystery

WHAT is the mystery about the broadcasting of the World Economic Conference on June 12th? At the time of writing I am unable to obtain an official statement from the B.B.C., albeit the story of His Majesty's broadcast at the opening of the Conference at the Geological Museum, South Kensington, on June 12th has been heralded in several journals of importance.

Organised by the Post Office

This world-wide broadcast is being considered by the Post Office in conjunction with the foreign administrations concerned. His Majesty's speech will be relayed through the International Telephone Exchange at Faraday Building and thence to all the capitals of Europe, and by transatlantic 'phone to the United States.

Duke Ellington in the B.B.C. Studio

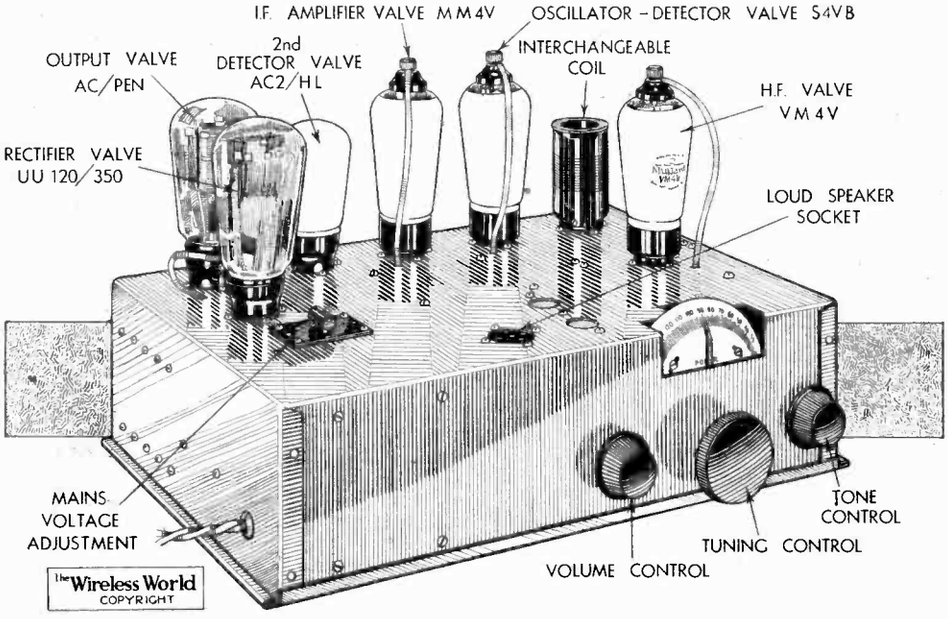
DUKE ELLINGTON and his orchestra, most renowned of "hot" musicians, are on their way to this country and will broadcast on the National wavelength, June 14th, from 8.0 to 9.0 p.m. Some who have no ear or stomach for "hot" music—an increasing host since Henry Hall soothed our jangled nerves with his soft rhythmic melodies—may not like "The Duke's" playing.

No Hot Cha-Cha or Base Emotions

Others will anticipate the coming visit with as much zest as the classical moderns view the arrival of Stravinsky or Schönberg at the Queen's Hall. To each and all, however, the visit will be an important event in the annals of broadcasting; for, to quote his publicity agent, "In Ellington we have not just another negro jazz-band leader full of hot-cha-cha and the baser emotions."

TRIX "Explora"

Short-wave Superheterodyne



FEATURES

Type: *Short-wave superheterodyne; six valves with rectifier; interchangeable coils (including medium waveband); provision for gramophone pick-up; moving-coil loud speaker.* ***Circuit:*** *Variable-mu H.F. amplifier—detector-oscillator—variable-mu I.F.—second detector—pentode output valve.* ***Controls:*** *(1) Tuning; (2) Volume and on-off switch; (3) Tone control.* ***Price:*** *(chassis only, including valves, coils and loud speaker) 21 gns.* ***Makers:*** *Eric J. Lever (Trix) Ltd., 8/9, Clerkenwell Green, London, E.C.1.*

For Reception Overseas

THIS receiver has been designed with special regard for the requirements of short-wave listeners overseas. It is sold in chassis form so that the purchaser may choose a material for his cabinet which he knows from experience will be best suited to local climatic conditions. Metal or special wood cabinets can be supplied to order. With the valves and plug-in coil removed the chassis is clear of excrescences which would add to the shipping space required. The moving-coil loud speaker is connected through a valve socket and four-pin plug, and is easily removed.

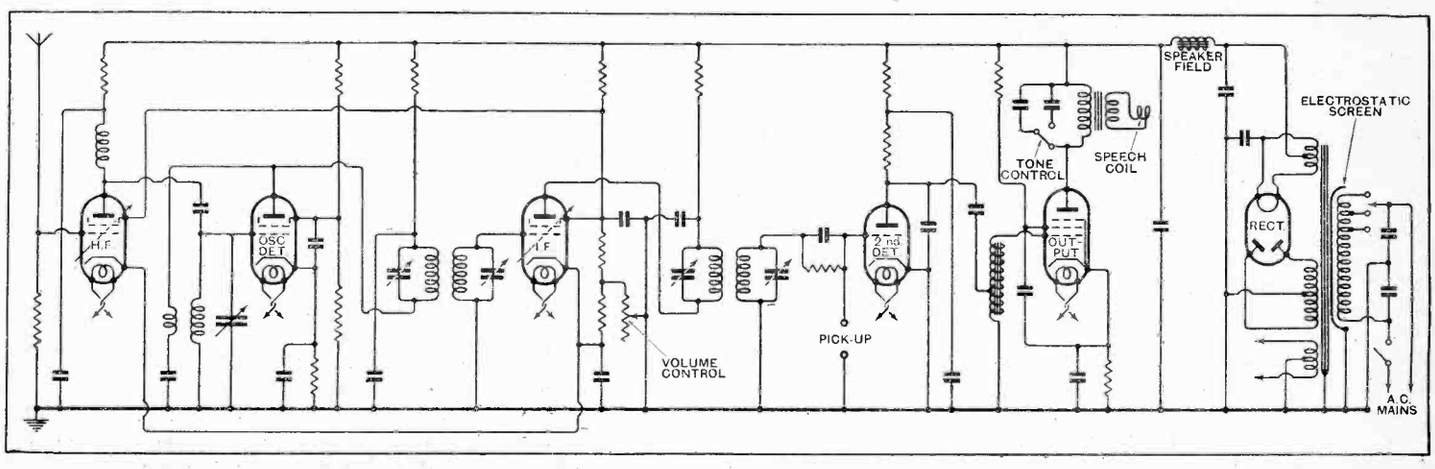
The short-wave range of 12 to 86 metres is divided into four overlapping sections covered by interchangeable coils. As a result, stations are well spread out, and with the well-chosen reduction in the slow-motion dial, tuning is far less critical than in the majority of short-wave receivers. The dial is illuminated and is calibrated in degrees. We understand that the approximate settings of the more important stations are given with each receiver, and that a full calibration can be supplied if required. The station settings are independent of the aerial capacity as a screen-grid valve has been interposed between the aperiodic aerial circuit and the detector-oscillator.

Silent Background

The overall magnification is most impressive, and in our opinion is sufficient to give loud speaker reception of any station whose signal strength is above the prevailing atmospheric noise level. In particular, the lowest range (12-24 metres) was much more lively than in the majority of short-wave sets. Three American stations (Schenectady, 31.48 metres; East Pittsburgh, 25.27 metres; and Bound Brook, 16.87 metres) were picked up in a random search between 11 p.m. and 1 a.m. In each case the loud speaker was well and truly overloaded with the volume control at maximum. Incidentally, the control is rather crowded at this end of its range, and the last fraction of a turn brings up the background noise considerably. Fortunately, the full magnification is seldom, if ever, required, but it is useful to know that a reserve exists if conditions are favourable. With the aerial removed the set is quite silent at maximum sensitivity, and mains hum is inaudible outside a six-inch radius from the loud speaker. Full brilliance of tone can be maintained on strong signals, but where the strength of the station is comparable with the background noise a tone control is provided which gives more mellow quality and considerably reduces background noise.

The intermediate stage operates at a frequency of 150 kilocycles, and an additional coil for the medium broadcast waveband is available. When changing coils it is advisable to turn the volume control to minimum or to switch off the set altogether, otherwise the loud speaker is apt to make distressing noises. The valves take two or three minutes to warm thoroughly to their work, so the coil change-over should be made quickly if the precaution is taken of switching off completely.

The set has obviously been designed with a thorough understanding of the special requirements of short-wave reception, and the use of tropical-type condensers and a cadmium-plated chassis should ensure reliability in warm and humid climates.



Circuit diagram of the Trix "Explora" chassis. The volume control resistance governs both the grid bias and screen potential of the I.F. amplifier valve.

UNBIASED
BY FREE GRID

Does Moral Rectitude Pay?

THE wave of dishonesty which seems to sweep over certain members of the female sex whenever they pay a visit to a large emporium is, as one of our stipendiaries recently remarked, a menace to all law-abiding citizens.

At no time has the truth of this statement been brought home to me more forcibly than on the occasion of a visit the other day to the wireless section of a well-known departmental stores.

Trouble arose from the fact that I am accustomed to carry valves and other odd bits of wireless gear about my person. In order to examine the innards of a set more closely I had removed the valves and had quite naturally dropped them into my coat pocket. At the conclusion of my examination I returned the valves and quitted the building, only to be accosted by what the Yanks call a "coupla house dicks," who informed me that I had been observed to take four valves from a receiver and that my presence was requested in the manager's room.

Being conscious of my own moral rectitude, I was at first inclined to beat them over the head with my umbrella, but realising that such an action would put me on the wrong side of the law, I controlled my indignation with difficulty and curtly refused their request. They seemed nonplussed for the moment, but, quickly recovering, summoned a "pavement

Conscious of moral rectitude.

pounder" who happened to be in the offing and poured out their tale of woe to him.

Not being unmindful of my legal position, I at once demanded that I be arrested and charged with some crime, and formally refused all requests to "make statements" or fall into any of those pitfalls whereby suspected persons, ignorant of their legal rights, may quite easily compromise themselves. After a hasty conference the two "sleuths" decided not to prefer any charge, and, after suitably rebuking them for wasting his time, the bobby put away his notebook in a disappointed manner and I was allowed to pass along my way in peace.

It was only when I was turning out my pockets, prior to retiring at night, that I came across four strange-looking valves marked "Dummy" among the miscellaneous collection which I had removed from my person. Hastily sorting over the other valves, I found that four brand-new valves, formerly numbered among my pocket possessions, were no longer there.

A New One

"ANOTHER important development," says one of the leading Midland journals, discussing the latest radio innovations, "is the introduction of the double-diode pentode valve . . . . Two types are available, one variable-mu and one non-variable-mu. The former is particularly suitable for the later amplifying stages of superheterodyne sets."

I am always interested to hear of the latest inventions, but this is a new one on me. I cannot help thinking that this is a case of Homer nodding, since the writer is obviously confusing the double-diode pentode with the H.F. or screened pentode.

Noises Off?

FROM a confidential source I hear that the B.B.C. are perturbed over a new menace which threatens them. My informant tells me that disturbing rumours are current of plots by certain people to cause deliberate interference with the performances which they attend. It is not merely the ejaculation of words of abuse by members of the audience, wearied with the fare provided, which the Corporation fear, but, what is far more serious, that bands of organised propagandists are plotting to chant their slogan in the middle of a programme, like the suffragettes in the House of Commons in pre-war days.

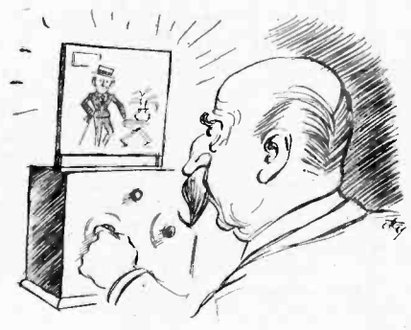
It has even been rumoured that certain big manufacturers are suspected of preparing a secret advertising campaign, and almost any day now the "packed" audience may suddenly burst out with "Buy Bloggs' Blankets."

Various suggestions have been made, such as putting the audience in a sound-proof room behind a plate-glass panel and feeding the "sound" part of the programme to them *via* loud speakers. Temperamental artists have objected, however, on the grounds that to get their "stuff" over properly they must have the "atmosphere" provided by an audience. A silent audience behind plate glass, they say, would be reminiscent of the Chamber of Horrors. If you were the B.B.C. what would you do about it?

Listening and Looking

EVER since broadcasting began, certain sections of listeners have railed against the B.B.C. talks, and even their most hardened advocates have sometimes found certain of these a little difficult to follow without diagrams or illustrations.

I have often felt that the talks would be vastly more popular if they could be



Still pictures on the "telereceptor," "teleceptor" or "visaceptor."

livened up, but I cannot for the life of me make any sense out of a suggestion sent me by a man who, very appropriately in my opinion, signs himself "Dum Spiro Spero."

His suggestion is that still-pictures and diagrams should be televised by the B.B.C. simultaneously with the talks, etc., which they are intended to illustrate. Actual lantern slides, he says, could be used at the transmitting end, and we should have something in the nature of an ordinary lantern projector coupled to a television receiver in our homes.

The whole affair would then be quite simple, he alleges, as one picture or diagram could be scanned continuously instead of there being the necessity to deal with umpteen pictures a second, as in the case of movies, and so the disadvantages of television would disappear. The arrangement would, he tells me, have all the simplicity of the ordinary projecting lantern as compared with the complexity of the modern cinema projector.

I quite realise, of course, that his plan is perfectly well-intentioned, but how on earth it could be any improvement on the ordinary "movie television" I fail to see, as the picture has got to be scanned no less rapidly, and so there can be no question of more detail being got in.

He is so confident, however, that he has even gone as far as discussing among his friends which of the three words, "telereceptor," "teleceptor," or "visaceptor," he should register for his proposed instrument. The last thing I wish to do is to throw cold water on inventive genius, but I must state that, in my opinion, my correspondent appears to be a likely candidate for the perpetual motion stakes.

Letters to the Editor

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

Automatic Volume Control

WHETHER or not the "experimenting constructor's" interest is limited to fields involving little more theory than a knowledge of Ohm's law, most listeners find fading extremely irritating. Admittedly A.V.C. does not correct the distortion which sometimes accompanies fading; but presumably one will only listen to such a programme if one has a special interest in its subject matter, so that it is preferable to hear the programme distorted at times rather than both distorted and inaudible.

The A.V.C. receiver has the desired characteristic of working at the maximum useful sensitiveness when receiving weak stations, and, in fact, the charge of insensitivity is based on a complete misrepresentation of the action of A.V.C. Sensitivity is reduced when necessary to prevent the input to the detector from exceeding a predetermined maximum value, but it does not reduce the amplified signal below this value, and it has no effect on signals which are so weak initially that they do not reach the desired value. If Mr. Haynes is thinking of the reduced sensitivity of the Q.A.V.C. system during searching, he should not have any reason to complain of excessive background noise. Personally, I favour the "noise suppressor" principle employed in the A.V.C. Monodial Super whereby the maximum sensitivity of the receiver may be adjusted to suit prevailing conditions; for a given sensitivity an A.V.C. set need not be any worse than an uncontrolled set.

I should feel more satisfied if Mr. Haynes would give some theoretical explanation of his statement that "in a superheterodyne the weak signal is represented at the second detector as one of very low modulation."

There is, however, one disadvantage of A.V.C. in connection with that valuable aid to selectivity—the "apparent demodulation" or "rectifier discrimination" effect. When the wanted signal fades the effective selectivity is reduced, owing to the change of the ratio of wanted to unwanted carrier strengths, so that adjacent channel interference is increased. This difficulty is avoided if the adjacent channel selectivity ratio of the receiver can be made large compared with the ratio in which signals are liable to vary through fading.

D. A. BELL.

Magdalen College, Oxford.

RE the correspondence appearing in *The Wireless World* of May 5th under the heading of "A Dissenting Voice," after reading the article to which the letter makes reference it appears that the remarks included were probably based principally on tests and data obtained from normally standard receivers, but where automatic volume control has been included as an extra.

I would like to emphasise that, in order to obtain the full benefits which A.V.C. undoubtedly offers to well-designed radio receivers, it is essential to have this in mind throughout when receivers are being designed, starting from the aerial terminal to the current flowing through the loud-speaker windings. It is really useless to expect to obtain full benefits unless the whole set is being designed with A.V.C. in mind from start to finish.

It is well known that A.V.C. of some sort can be added to standard receivers employing diode detection, or by the simple method of placing certain cold rectifiers capable of operating on R.F. across the I.F. transformer, or elsewhere in a superheterodyne receiver, but it is impossible, in my opinion, to obtain even reasonable A.V.C. in this manner.

In the first paragraph of the article referred to, where it mentions that A.V.C. employing diode detector functions only when using a set having more H.F. valves than desirable, I would like to know whether any limit or standard has been placed on receivers as to the number of H.F. valves which are desirable.

NOT A GRAMOPHONE RECORD. B.B.C. engineers in quest of the "amorous descant" at Pangbourne. The nightingales have proved excellent broadcasters this year.

Actually, in my opinion, it is rather desirable to include at least one or two H.F. valves in order to cut down valve noise which is present if great gain is attempted after the oscillator. Also one or two H.F. valves in a superheterodyne greatly assist in removing second channel interference, etc. It is, therefore, desirable to employ H.F. valves without wasting this desirable feature by omitting A.V.C.

In the article it is also implied that A.V.C. gives considerable mush between station settings. This is hardly correct, since the same amount of mush will always be constant in two receivers of equal sensitivity between stations if one receiver employs A.V.C. and the other is of the same type without A.V.C. A.V.C. cannot, in my opinion, introduce background noises.

Where, farther on, it is mentioned that A.V.C. in no way corrects the distortion which accompanies fading, this, of course, is true, but it only requires a few minutes' test with the receiver with A.V.C. included to prove to the ordinary listener that when a set fades, but is held at a constant volume with A.V.C., a lecture or other talk will invariably be followed without any words missed, whereas otherwise certain paragraphs would be entirely lost. Even if distortion is present to some extent it is better to put up with that rather than lose part of the programme.

In reference to the concluding paragraph of the article I would like to ask, is it not the case, even where A.V.C. is not applied to the receiver, that the set should work at its maximum sensitiveness, apart from the position of the audio volume control, when a set is tuned between stations? It would appear from the remarks printed that if a set tuned to a certain station, where input is such as to cut the apparent sensitivity down to, say, 10,000 microvolts absolute, the receiver has only this sensitivity until adjustments have been made. This, of course, is not the case. The set, from the H.F. point, would be working on maximum sensitivity until another carrier is tuned in.

I have made considerable tests and experiments on receivers which were designed originally with A.V.C., and can state that it is possible entirely to prevent overloading of a set where conditions have been made such that A.V.C. action starts at the exact point or one or two microvolts earlier than the point where the output valves commence to be overloaded. This will be obtained, for instance, in a set which has normal sensitivity as obtained from measurements with a standard signal generator of 20 to 30 microvolts at 50 milliwatts output, with an even sensitivity between 1,500 kcs. and 150 kcs. and where A.V.C. action takes place at 200 to 300 microvolts, at which point the set becomes fully loaded. Increasing the signal input, then, from this point up to even as great as one volt or two volts should not produce overload distortion in any manner. This is a very important adjunct to have in a receiver which would be used by an ordinary listener, since distortion due to overloading would not be reached.

It has also been noticed that articles have already appeared in various radio and motor journals to the effect that wireless receivers for motor cars are shortly to be attempted in this country. If this be the case, and the correct care and attention are paid to the design from the start, it is my opinion that A.V.C. will essentially have to be included in order to keep the volume level when the car is travelling through various screened areas, such as under tunnels or bridges, or down in low-lying parts of the country, where the microvolts per meter input will vary considerably every few yards.

It must also be appreciated that with well-designed sets using A.V.C. it is possible, when listening to the more powerful stations, that atmospherics or man-made statics will not be any louder than the volume produced by the station itself, since

the action of A.V.C. will also hold down static discharge as well. This is not so with sets without A.V.C., and often a programme, even from a fairly powerful station, can be entirely upset during bad etheteric conditions.

G. J. REDFERN.

Philco Laboratories, Hendon.

Pick-ups and Bass Response

I WAS interested to read the article in your issue of May 12th on "Increasing Bass Response," because of a point only referred to indirectly, namely, the practice of designing pick-ups to effect compensation for loss of bass in the record.

It is no uncommon thing for makers of pick-ups to publish response characteristics in which a considerable amount of bass appreciation is shown on the low frequencies, and it is gradually becoming an accepted principle that this is the right thing to do, and that, if the result of combining the loss of bass in recording with the bass gain of the pick-up is a flat response characteristic, all is well with reproduction. My opinion is, however, that this is a most dangerous practice and that no pick-up should be designed otherwise than for flat response, i.e., the translation of instantaneous velocities on the record into proportionate instantaneous e.m.fs in the electrical circuit.

If we refer to the case illustrated in Mr. Bloxam's first figure it will be observed that the pick-up illustrated has a gain of no less than 28 decibels at 100 c.p.s. in relation to its response at 250 c.p.s. There can only be two possible reasons for this gain, namely, mechanical resonance of the pick-up as a whole with the elasticity of the armature support and an increase in the electrical response at low frequencies due to curtailment of the air gap. The former effect will inevitably lead to the latter, owing to the increased swings of the armature relative to the pole pieces, and the latter definitely means acceptance of the principle that non-linear distortion is to be introduced to compensate for loss of bass.

It is seldom that we see this aspect of the matter mentioned in technical discussions, and I have a strong feeling that the time has come for efforts in the direction of improvement which take advantage of the greatly increased magnification of modern valves and the consequent possibility of simple but effective equalising circuits. The starting point should be the axiom that no pick-up is properly designed which gives anything but a constant output e.m.f. for a constant stylus velocity over the whole of the lower range of frequencies.

London, W.C.2. P. W. WILLANS.

REMOTE CONTROL

An Efficient and Reliable System Now in Use

A WIRELESS receiving set is now regarded as one of the essential services of any modern dwelling, and the time is not far distant when the architect will legislate in his plans for the wireless installation at the same time as he lays down the lighting and heating.

The recently introduced Annan-McKinlay "Telecontrol" brings this ideal a step nearer to practical realisation. Instead of taking up valuable space in the living room, the receiver—in chassis form—is installed out of sight in the loft or basement. The house is wired with multiple cable, and plugs are installed in all rooms where wireless is required. Through a system of relays a neat control panel performs all the normal adjustments of the set, including tuning, volume and waverange.

With the Telecontrol unit all the normal adjustments of the receiver can be made in comfort at the fireside.

The tuning condenser on the receiver chassis is driven by a small electric motor, which stops automatically when the condenser setting corresponds with the position of the pointer on the control panel. While the motor is in action the volume control is automatically reduced to zero, and the irritating noise usually produced in passing through intervening stations is eliminated.

The vertical scales on the control panel corresponding to long and short waves are illuminated internally by the push-buttons controlling the waverange. A push-button in the centre of the tuning knob switches the set on or off, and another control is provided for volume. For all intents and purposes the tuning control is continuously variable, for it is possible to ease the control forward in steps equivalent to one-fifth of a degree on the condenser dial.

The apparatus is made by Halford Radio, Ltd., 39, Sackville Street, London, W.1, and the price of the chassis control box and operating unit is twenty guineas. A complete installation, including the Gambrell and Halford 7/8-valve superheterodyne chassis and moving-coil loud speaker is available for 48 guineas.

VALVE VOLTMETER FOR AUDIO FREQUENCIES

IN the June number of *The Wireless Engineer* appears an article describing the design of a valve voltmeter for audio frequencies calibrated by direct current. This is a companion article to one which appeared in *The Wireless World*, October 14th, 1931, when a valve voltmeter for radio frequencies, also calibrated by direct current, was described constructionally.

Copies of this issue can be ordered through newsagents or direct from the publishers of *The Wireless World*.

A YEAR AT THE N.P.L.

Research in Radio and Acoustics

WAVELENGTHS of less than one metre are being actively studied by the National Physical Laboratory, and it has been found that several of the older types of three-electrode valve are suitable for the production of wavelengths of the order of 60 centimetres. Indeed, some of these valves have given wavelengths as short as 15 centimetres when the electrode voltages were suitably adjusted. These facts are recorded in the Annual Report of the National Physical Laboratory.*

One of the most interesting phases of research has been concerned with the electrical properties of soil. Samples of soil taken from a number of sites in different parts of the country have been examined in the Laboratories and the results obtained show that considerable variation in the earth's conductivity prevails in different places. While dry soil is a comparatively poor conductor, the conductivity increases more than 1,000 times when the soil contains the normal amount of moisture.

The excellent work of the Laboratory in connection with radio frequency standards is well known. Two standard vibrators of different types were continuously maintained day and night during 1932. The vibrators were a tuning fork producing a note of 1,000 vibrations per second and a ring cut from quartz crystal and vibrating somewhat like a bell at 20,000 vibrations per second. Comparisons of the two standards showed that the average rate of vibration of one with respect to the other over successive periods of twenty minutes remained constant to an accuracy of one part in a hundred million.

International comparisons of standards of radio frequency are carried out by broadcasting transmissions accurately controlled by these standards, a number of such transmissions having been made by the Laboratory during 1932.

A New Transmitter

The experimental station of the Laboratory has been fitted with a new transmitter tested and calibrated for use in researches on the ionisation of the upper atmosphere and also for the emission of waves of standard frequency. A cathode ray oscillograph is incorporated for visually observing the type of wave emitted. The whole station is provided with four aerials for wavelengths varying from 50 to 1,000 metres.

The new acoustical laboratories, begun in 1931, are nearing completion. The main experimental rooms are all isolated structures standing on cork pads inside the shell of the main building, and it is interesting to note that the plan of the rooms is irregular, the ceiling slanting at an angle to the floor so that sound impinging on one wall cannot be continually reflected between that wall and the opposite one.

The Report gives the impression that the National Physical Laboratory is pursuing its work with a zeal and energy which might well be emulated by many organisations which exist simply to make large and speedy profits.

*National Physical Laboratory, Report for the year 1932 (H.M. Stationery Office, price 14s. net, 277 pages and 52 illustrations).

READERS' PROBLEMS

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers.
Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Superheterodyne Oscillators

FROM remarks made in several recent letters, it would seem that the padding condenser of a superheterodyne oscillator circuit is often confused with the trimming condenser, with the result that adjustments of these two components are incorrectly made.

As shown in Fig. 1, the padding condenser (usually a semi-variable with a maximum capacity of about 0.002 mfd.) is connected in series with the main tuning condenser, and is totally inoperative when the switch across it is automatically closed for medium-wave reception. It comes into action only on the long-wave side, and accordingly should only be adjusted when reception is being carried out on that band. A semi-variable padding condenser will compensate to some extent for minor discrepancies in the coil or main tuning condenser.

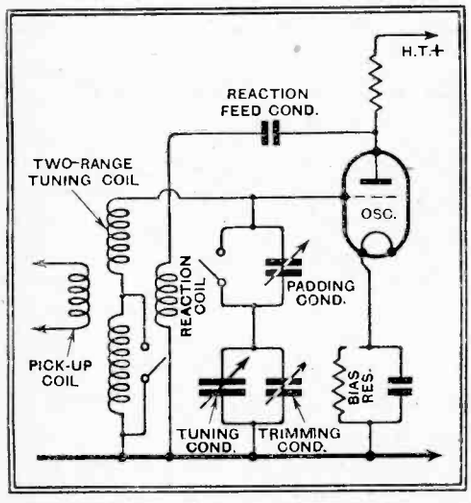


Fig. 1.—The oscillator of a typical modern superheterodyne. Energy is induced into the first detector circuit through the pick-up coil.

The trimming condenser, usually built in as part of the tuning condenser, must only be adjusted on the medium wave-band.

Multi-knob Tuning

ALTHOUGH the practice of tuning a receiver by means of ganged condensers has now become almost universal, requests are periodically received for information as to whether various receivers described in this journal could be modified by fitting individual tuning for each circuit.

Theoretically, it should always be possible to modify "single knob" receivers in this way, but in practice the plan is not likely to prove very satisfactory nowadays. In the first place, the operation of the receiver will become much more difficult. Further, it requires a great amount of skill to control the component circuits of band-pass filters by means of independent condensers.

Finally Adjusted

WHEN the intermediate-frequency circuits of a superheterodyne have once been set up properly there should be no need for subsequent adjustment; most certainly it should be unnecessary to "re-trim" when receiving a station on a wavelength other than that at which the original adjustment was carried out. The fact that our correspondent finds that a definite improvement in sensitivity and selectivity results from making adjustments to the I.F. amplifier at each wavelength would indicate that the behaviour of the set is distinctly abnormal. From his description we are inclined to suspect that the ganging of the signal-frequency and oscillator circuits is incorrect, particularly on the long-wave side.

An Improvised Microphone

ALTHOUGH a moving-coil loud speaker may be used quite satisfactorily as a microphone, the energised type is not recommended for this purpose, unless its field winding can be fed from a source of perfectly smooth D.C., such as an accumulator battery.

Even though the smoothing arrangements included are so generous that no hum would be produced when the speaker is used for the purpose for which it is intended, the slightest trace of ripple would give trouble if it were introduced into the input end of the set and magnified by the succeeding L.F. stages.

Electrolytic Condenser Polarity

A READER who is planning a "universal" set for use on both A.C. and D.C. supplies interchangeably seems to doubt whether it would be safe to use electrolytic condensers for smoothing purposes. He thinks that the condensers might be damaged by accidentally connecting the set to a D.C. supply without first making sure that the polarity is correct.

In all conventional arrangements for alternative A.C.-D.C. feed a rectifier is interposed in such a position that it protects the smoothing condensers in the event of polarity reversal. With incorrect polarity no current can flow through the rectifier, and so no voltage will be applied to the smoothing condensers; those of the electrolytic type may therefore be used with safety.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

Well-matched Condensers Needed

PROSPECTIVE constructors of the Ferrocart III.—and, for that matter, of the Class "B" Ferrocart receiver—should realise that the best and most accurately matched ganged condensers are none too good for tuning any set in which the new high-efficiency iron-cored tuning coils are employed. Minor discrepancies in alignment, which would probably pass unnoticed with coils of ordinary efficiency, are likely to become all too evident.

These remarks are prompted by letters from several querists, who propose to use tuning condensers which are not of the latest and most accurately matched design for tuning "iron-powder cored" coils. We would strongly dissuade them from doing so.

D.C. Class "B" Eliminator

IT is asked whether the Class "B" eliminator might be modified to work on 240-volt D.C. mains. It is intended to use it for feeding the Class "B" Ferrocart Receiver.

By omitting purely "A.C." components (mains transformer and rectifier), this eliminator would be suitable for D.C. supplies, and no special difficulties should arise in its operation.

Input-Output Reaction

WHEN a self-contained set (with built-in loud speaker) works satisfactorily so long as the chassis and loud speaker are separated, it may generally be assumed that H.F. energy is getting through to the output valve circuits if uncontrollable self-oscillation takes place when the set is inserted in the cabinet. We are confident that a reader who describes this effect will be able to put matters right by attending to H.F. filtering.

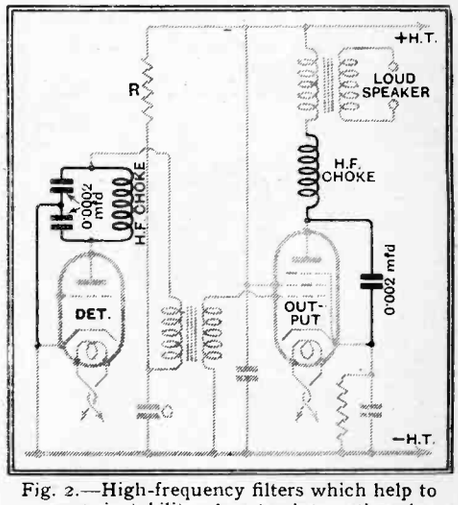


Fig. 2.—High-frequency filters which help to prevent instability due to interaction between the loud speaker leads and the input end of a receiver.

The usual steps to be taken are illustrated diagrammatically in Fig. 2. If not already fitted, a conventional filter circuit, as illustrated, should be inserted in the detector anode circuit; if necessary, the capacities of the by-pass condensers may often be increased without appreciable high-note loss.

A somewhat similar type of filter may also be interposed in the output anode circuit, in order to deflect H.F. impulses from the loud speaker and its leads to earth.

The Wireless World

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EDITORIAL COMMENT

Lucerne Wavelengths

Effect on Receiver Design

THE important Conference now being held at Lucerne is expected to announce the result of its deliberations in the course of a week or so, and already *The Wireless World* has been able to publish exclusively, in our issue of May 26th, a list of the proposed allocations of wavelengths for stations in Europe which, though not final, is likely to go through with comparatively little alteration, as it has already, we understand, had the tentative approval of the broadcasting organisations concerned.

This re-allocation of wavelengths, associated as it will be with adjustments of power, is of extreme interest to listeners for several reasons; in particular it will be noticed that the bounds of what has come to be regarded as the medium broadcast band have been extended and a number of stations of first-class importance have been moved up to higher wavelengths, at present occupied only by a few scattered stations of Eastern Europe.

No date is yet fixed for the new plan, when finally approved, to come into operation but it seems almost certain that it cannot be a gradual process but that at a given time all these changes will have to take place more or less simultaneously, as otherwise a chaotic state of affairs would result and the changes, instead of reducing mutual interference, would increase it. It would seem likely that the change over will be timed to take place about the end of the present year or very early in 1934.

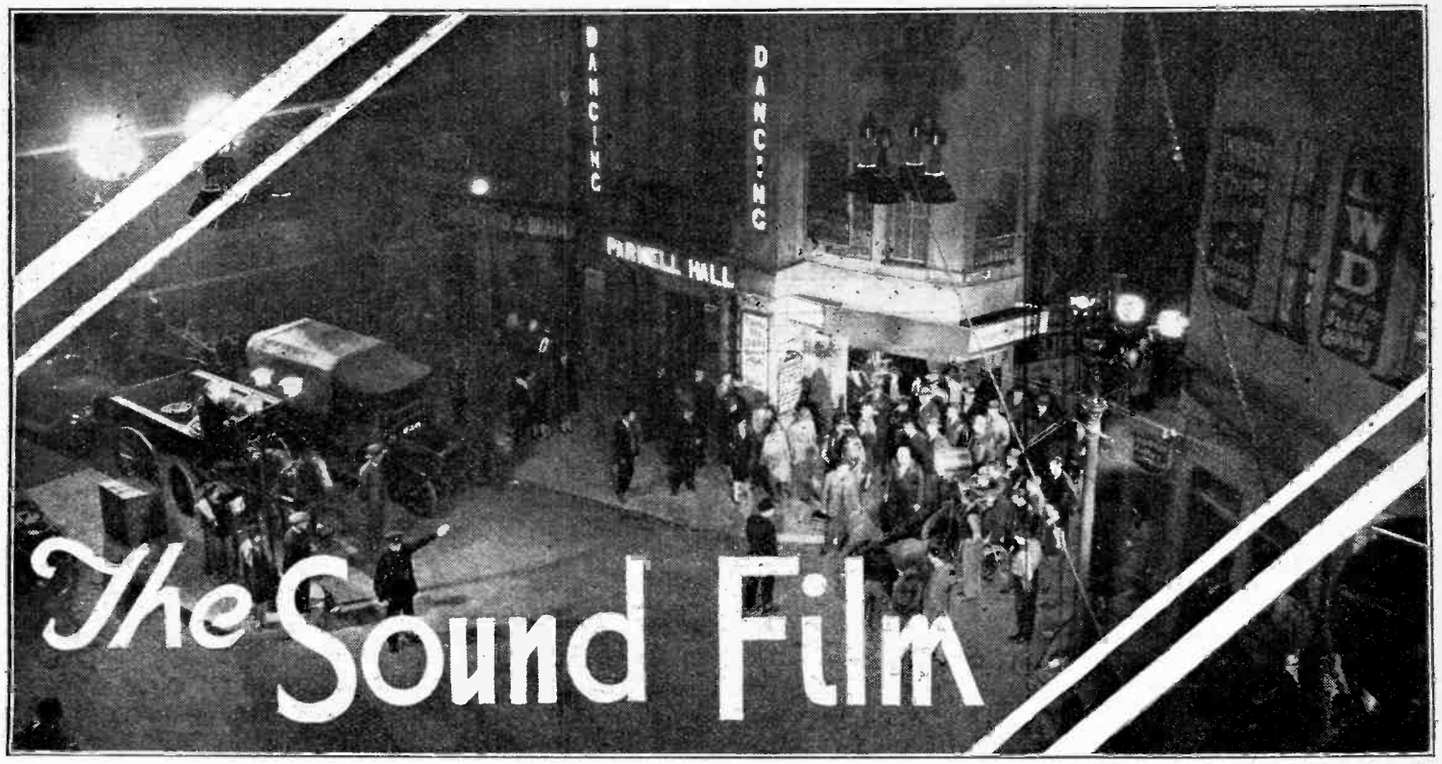
The change in distribution of wavelengths is likely to have a somewhat disturbing effect upon the design of receivers, for the tendency to-day, especially with commercial sets, is to include station names in order of wavelength on the tuning scale.

Again, sets which at present ignore the range of frequencies between the long waveband and the medium band, will be incapable of receiving quite a number of important stations in Europe. For this reason modifications in the design of sets, in some cases of a very radical character, will eventually be necessary. However, the compilers of the plan appear to have borne carefully in mind the desirability of keeping stations as far as possible within the wavebands covered by present standard sets in use in Europe, but the fact that the intermediate band has been encroached upon to a greater extent does suggest that *new* stations which may start up in Europe are likely to be given accommodation in this intermediate band rather than in the congested medium range.

A Technical Experiment

The decisions of the Conference will be awaited with the utmost interest, and if the plan goes through with no drastic changes from the provisional proposals, one of the most interesting technical developments to look forward to will be the allocation of a common wavelength to many pairs of high-powered stations of Europe which are widely separated geographically.

One of the first experiments of this kind which will most intimately concern listeners in this country will be the linking of the National transmitters of West Regional and Brookman's Park, which is about to be tried out. Here, however, the problem is not quite so complicated as in the case of some of the common wavelength allocations in Europe, since the same programme will emanate from West Regional and Brookman's Park National transmitters, whereas many of the common wavelength allocations proposed in the Lucerne plan will concern transmitters putting out independent programmes.



A typical street scene built up in an Elstree studio.

1. How the First Talkies Were Made

By DALLAS BOWER

THE sound-film and broadcasting being so intimately allied technically, it is interesting to observe that in sound-film the *deus ex machina* is far ahead of its development as an art, whereas in broadcasting the art of programme presentation has progressed more or less in parallel with technical achievement in transmission and reception. The rapidity with which production equipment has advanced is also largely accounted for by the extraordinary retrogression caused in mute-film production by the advent of sound. The screen had finally emerged from its penny arcade state, already a considerable literature had arisen discussing its æsthetic aspects, and its possibilities as a medium for the serious artists were becoming quite widely accepted. Sound seemingly destroyed those very qualities which enabled the mute-film to lay claim to being unlike any art that had previously been known.

Sound *versus* Movement

Movement over vast stretches of countryside as the "cowboy westerns" used to show, film movement, achieved by the juxtaposition of shots and physical freedom or the will to roam where it pleased, are two basic constituents of the cinema art. Dialogue (the only terms in which film directors could think when sound was first given them), restricted movement, decreased *tempo* of action—all these cramped physical freedom. It seemed that the talking film could never be more than a bad imitation of a stage play. Sound had put the cinema back so far that it would surely have to start all over again. More and more, however, during the last seven years, has it become realised that sound is not antipathetic to the technique of the mute-film, that really it is highly augmentative to it if used with imagination, that the matter explains itself by the early sound apparatus being technically inadequate to fulfil the wide requirements demanded by what is probably the most popular art the world has ever known.

HERE is the first of a series of short articles which will describe the development of sound-film production since its inauguration as a commercial undertaking some seven years ago. Possibly in no other branch of technology has progress been so rapid. The process has undoubtedly been accelerated by the almost complete extinction of the silent film.

In 1876 Edison invented the phonograph, and in 1894 he invented the cinematograph. At an establishment called a Kinetoscope Parlour he exhibited in 1895 the "Kinetophone"—a system for synchronising a cinematograph with phonograph records. A United States patent was granted in 1897 for the synchronisation of motion pictures with phonograph records, while in 1901 the first Gaumont patent was granted for the same purpose.

No system with features fully in common with the modern sound-film is found until 1906, when British Patent 18057, granted to Haines, Pletts and Lauste, specified the "Photocinematophone." Eugene Augustin Lauste is unquestionably the father of the sound-on-film processes used exclusively to-day. His system was amazingly advanced for its time, using variable density recording by means of a magnetically controlled mechanical light shutter, reproduction being achieved by a selenium cell. The aural record was on the same film as the visual record both in the negative and positive condition, as it is to-day in the Movietone system. Lauste used no valves, of course, and it was not until 1923 that Lee de Forest demonstrated a sound-film for which valves were employed in recording and reproduction.

An "All-talking" Film

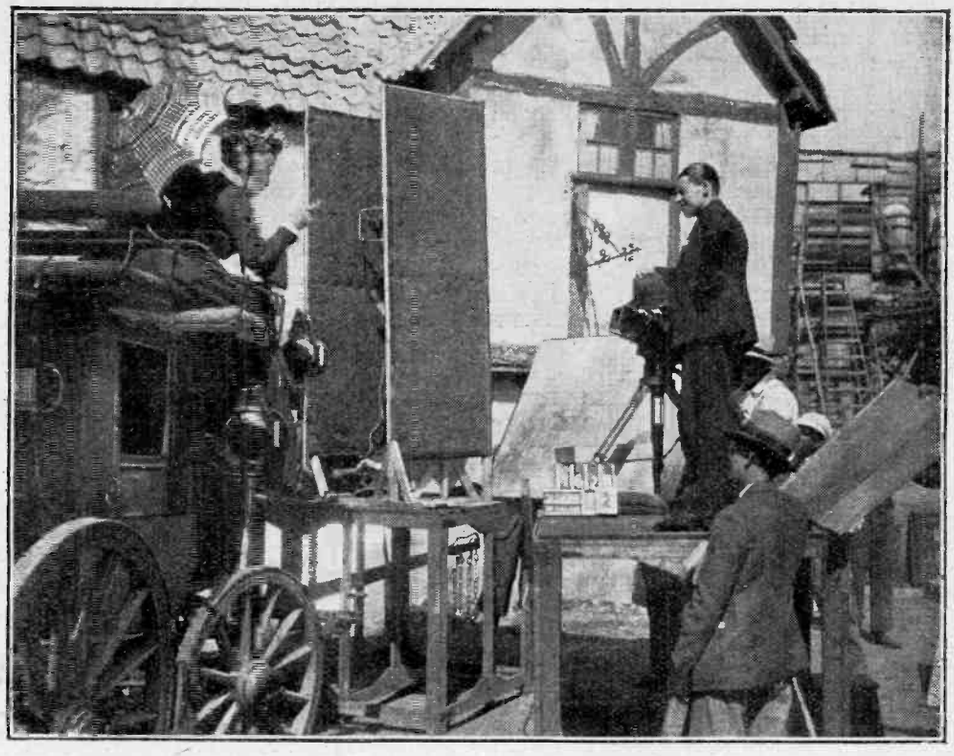
Simultaneously with de Forest's demonstration Theodore Case was developing the Movietone system for William Fox, and disc recording—now obsolete—was being developed under the trade name of Vitaphone. In 1926 Warner Brothers produced some short films using the Vitaphone system, and the de Forest Phono-Film Company produced a melodrama called *Retribution* which ran for approximately thirty minutes, using sound-on-film recording. There seems little doubt this must have been the first "all talking" entertainment film ever made. The turning point in the history of the sound-film as a commercial speculation came with *The Singing Fool*. Mr. Al Jolson, who played the leading part, caused a sensa-

The Sound Film—

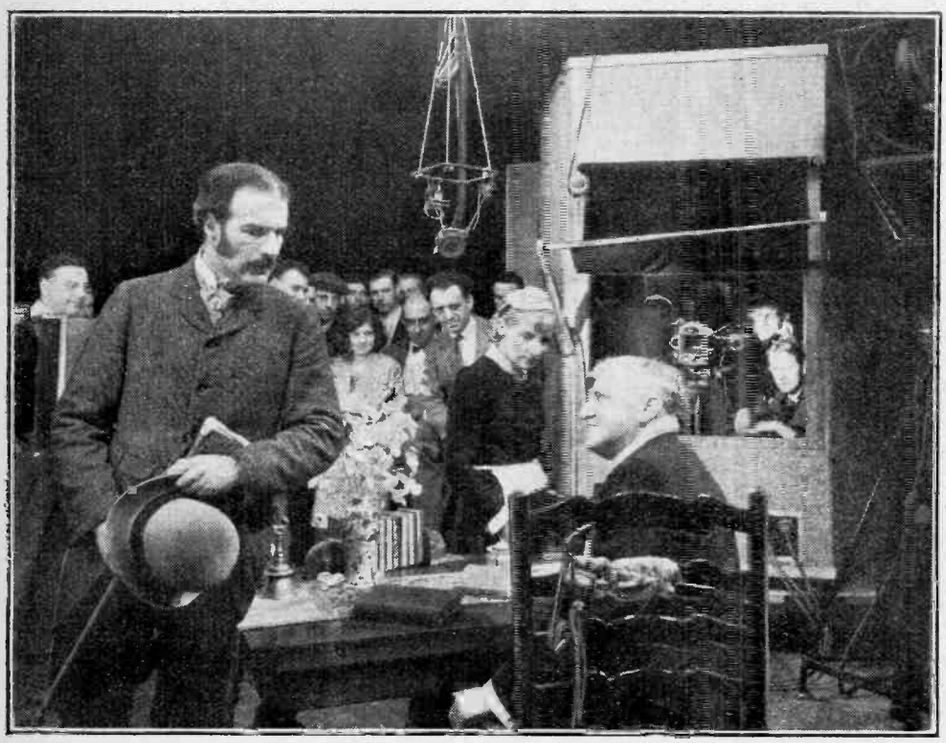
tion wherever the film was shown. The film was produced by Warner Brothers, and for some months that company had been making shorts using sound-on-disc recording, but not until *The Singing Fool* could the sound-film be said to have arrived.

Early Production Difficulties

The greatest problem experienced by directors of the first sound-films was camera and microphone immobility. Previously the director had been subject to regard the ciné-camera like a human eye—it could observe what it pleased, in minute detail or panoramic view. The ciné-camera could show just what a man sees when he walks down a street, by its unique capacity for photographing movement while moving itself. After the public had tired of the scientific wonder of seeing a man on the screen and hearing him speak at the same time, there arose the problem of using the camera as it had been used in the days of the mute-film, but retaining the enormous attraction of sound in so doing. The primary cause of camera immobility was due to the noise produced when a camera is in action. Microphones being sensitive to sound other than those it is specifically desired they should pick up, record camera noise quite as effectively as dialogue. A dialogue record with camera noise sounds much like a broadcast transmission with a bad hum from the H.T. supply at the transmitter. Consequently, cameras had to be placed in sound-proof booths where they could operate without being heard. These booths were exceedingly cumbersome, being rather like small chicken-houses. They necessitated the camera photographing through glass (which, of course, had to be optically flat), and, being sound-proof, they were partially airtight, with the result that the camera-man and his assistants, closeted within, would become nearly asphyxiated if a scene were of any duration. In order to move these booths a gang of some half-dozen stage-hands would be required, as they were quite heavy, due to the sound-absorbing material with which they were constructed and the lead lining of the joins. It will be understood, therefore, that a moving camera shot (other than a small "pan" or movement in the horizontal plane) was an impossible proposition with such a device, the difficulty of moving it for different "set-ups" (close-up, medium view, long view) being complicated enough, without any attempt to move it while the camera was in action. This crippling of camera freedom led to a great many films being produced in which the characters would simply stand still and talk, the dialogue being punctuated occasionally by a change of view. Concurrent also with camera immobility due to booths, there was the extreme difficulty of moving the microphone after it had been adjusted for any particular shot. The ideal position for a microphone is directly in front of the person speaking into it.



The first exterior recording in England. Note the microphone surrounded by sound-damping boards known as "goboos." The camera is unsilenced.



An early microphone (R.C.A.) set-up, showing the camera in its sound-proof booth. Two microphones are in use.

Placing the Microphone

Naturally this is impossible, as the microphone would be seen in the picture. The next most favourable position is above and slightly ahead of the speaker, and this is the position that has to be generally procured. The distance, vertically, of the microphone from the actor or actors is determined by the distance of the view the camera is photographing. Obviously, in a long view, the microphone will be farther away than in a close view, as in the former a greater area of the scene fills the screen, which means that more of the scene is seen in a vertical direction, thereby necessitating the microphone being at a greater distance from the actors than would be the case in a nearer view. The first microphones were very difficult to manipulate, inasmuch as they had to be suspended by tackle from the studio ceil-

The Sound Film—

ing and brailed into the requisite positions as the sets-up of the camera were changed. Adjustment by so broad a method was really quite inadequate for any nicety in setting, and, of course, once a microphone had been set it could not be moved. In the R.C.A. system the difficulties were further complicated by the fact that a two-stage amplifier in a box about the size of a portmanteau had to be hauled into position with the microphone over the actors' heads, this being occasioned by the insensitiveness of the capacity type microphone and the consequent need for preliminary amplification before transmission over the cables to the recording amplifier proper. The lower photograph on page 405 shows a suspended microphone, unfortunately with the amplifier above the cable not visible, but nevertheless giving a clear enough indication of what such a position entailed. The assembly of string, paper clips and rubber bands is not, as might be supposed, an invention of Mr. Heath Robinson, but is representative of some of the difficulties in the early production days of setting microphones at all. It was the only means by which any nicety of angle adjustment could be made; the microphone and amplifier were intended, as was thought would be best at that time, for operation on a stand. The two camera assistants can be seen, one listening on the chief camera-man's monitor headphones (obsolete nowadays), and the other with a microphone and earpiece for communication with the recording booth in another part of the studio.

DISTANT RECEPTION NOTES

Dissecting the "Plan de Lucerne"

SOON after these notes appear in print we should be hearing something of the fate of the U.I.R. wavelength plan put forward at the Lucerne Conference. Will it become the Lucerne Plan? Certain alterations, I expect, will have to be made before everyone can be induced to accept it. One only hopes that they will not be so extensive as to rob it of half its value. The plan itself strikes one as being both well thought out and skilfully contrived. Particularly interesting is the adoption of a 9-kilocycle separation throughout, except in one or two places where large stations not more than moderately far apart geographically occupy adjacent channels. Here the separation has been made 10 kilocycles. Set manufacturers must have had a shock when they first saw that there were virtually three wavebands instead of two, but at present stations of importance are not assigned wavelengths between 685 and 950 metres.

The basis of the plan is eminently sound, for full attention has been paid to the geographical position of transmitting stations. This has made it possible to assign common wavelengths to two, and in some cases three stations of fairly high power operating in different countries. Thus, the Scottish National will have Smyrna as a wavelength partner, the North National, Dnepropetrovsk (I am thankful that I have only to write that name and not to pronounce it!). So far as one can see there should be no interference, at any rate within the service areas of the stations which are grouped in this way in pairs and trios.

Another strong point of the plan is that for the first time not only Russia but also North Africa, Egypt and Asia Minor are included in the European scheme. One's atlas readily proves that these countries are not in Europe, but wireless unfortunately takes no heed of national boundaries and past experience has shown that stations such as Rabat or Algiers can be very much in Europe when it comes to broadcasting.

There will no doubt be some heart-burning over the allocation of the higher wavelengths, for nearly everybody wants one of these. The scheme, though, goes a very long way towards satisfying all needs. By suppressing the Eiffel Tower and relegating Luxembourg to the medium band (let us hope that Luxembourg will suffer itself to be so relegated!) room is made for a surprising number of countries. England, France, Germany, Norway, Sweden, Denmark, Holland, Finland, Spain, Iceland, Roumania, Turkey, Switzerland and Poland have each one wavelength, whilst Russia has four, three of which are shared.

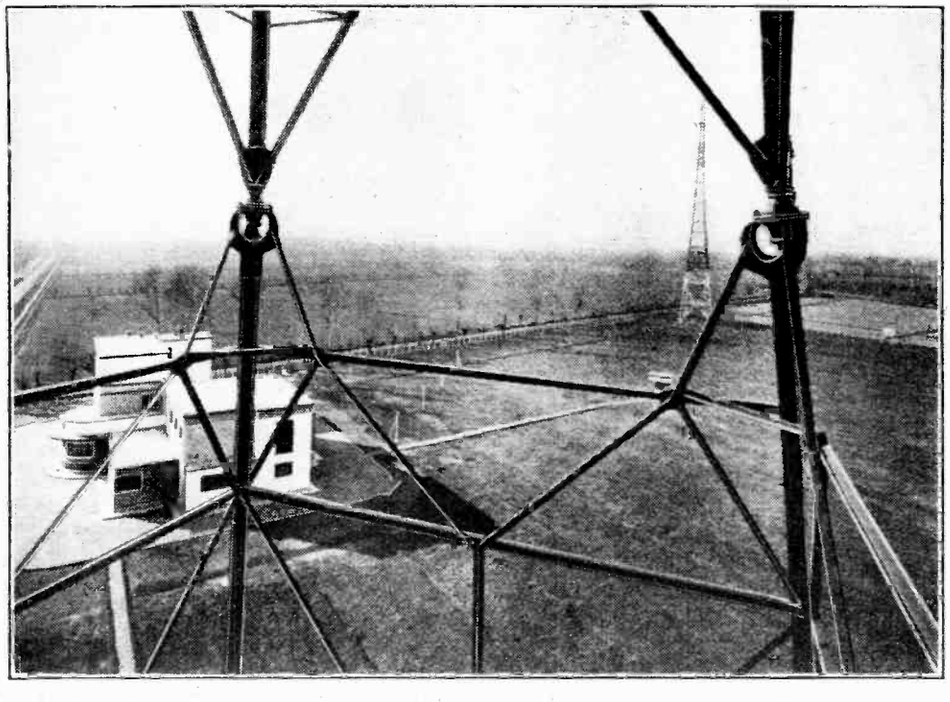
If it is adopted, as it is nearly certain to be, the plan should provide a good working basis for broadcasting in Europe and the neighbouring countries. Its success, though, will depend very largely upon international willingness to obey not only the spirit but the letter of the new law. With a universal 9-kilocycle separation it is essential that all stations should abide by their allotted wavelengths exactly. Deviations such as those which occur at present will wreck the whole scheme.

Atmospherics and Thunderstorms

For some little time now atmospherics have been distressingly bad—I was rash enough to suggest a fortnight ago that they might be on the wane. Even atmospherics, though, can be interesting at times. It is curious to notice that though atmospherics are believed to be produced by thunderstorms, their effects being noticeable sometimes at immense distances, by no means all thunderstorms appear to give rise to them. On a recent evening, for instance, great damage was done by lightning in a village within fifteen miles of my abode; yet I listened to numerous foreign stations and made a note in my log that atmospherics were completely absent.

On the long waves Radio-Paris, Zeesen, Motala and Luxembourg are the most reliable transmissions. Huizen is always receivable but heterodynes sometimes occur and signal strength at the moment is not quite up to the mark. Amongst medium-wave stations I would select Bisemberg, Prague, Langenberg, Lyons Doua, Beromünster, Rome, Stockholm, Hamburg, Strasbourg, Brussels No. 2, Breslau, Göteborg, Hilversum, Heilsberg, Frankfurt, Gleiwitz and Trieste.

D. EXER.



SEEN FROM THE MAST. A novel view of the famous 50 kW. station at Milan. The station, which usually relays Turin, works on 331.5 metres and is easily heard in this country after dark.

BOOKS RECEIVED

Les Construction Radio-électriques de l'Amateur, by L. Favre, giving details of the construction of a moving-coil loud speaker, pick-up, transformers, and other components, and of a complete all-wave receiver. Pp. 70 with eleven plates of diagrams and dimensional drawings. Printed by l'Imprimerie Arts et Sports, Paris.

Wireless Weather Messages (M.O. 252, Ninth Edition).—Particulars of meteorological reports issued by wireless telegraphy and telephony in Great Britain, Gibraltar, Malta, Middle East and Iraq, including the forecasts and gale warnings broadcast by the B.B.C. Issued by the Meteorological Office of the Air Ministry, and published by H.M. Stationery Office. Price 1s. 6d

New Valves

How They Will Improve Receiver Performance

By W. I. G. PAGE, B.Sc.

NEVER before has the amateur been afforded so large a choice of valves. Every type of receiver and every stage in the receiver is now provided with a specialised type; in a word, this is the era of valve specialisation and the "all-purpose" valve becomes the exception rather than the rule. In order to conserve space in the receiver many manufacturers are adopting the expedient of putting the elements of two valves into one bulb—a practice which, if not carried too far, makes for economy and greater efficiency.

It is the purpose of this article to explain why the new valves have been introduced and to give a brief account of the improvement in performance which may be expected when they are made to replace earlier types. The first series to be dealt with are the H.F. pentodes.

In the ordinary three-electrode valve, in which the anode is held at a comparatively high positive potential, electrons are shot off at high speed from the hot filament, and those which bombard the anode at the highest velocity are capable of dislodging other electrons known as "secondary" electrons. These eventually find their way back to the anode and the functioning of the valve suffers no detriment. When, however, a second electrode at a high positive potential is added, as is the case in the ordinary screen-grid valve and the variable-mu tetrode, it is just possible that some of these electrons may be attracted to the extra electrode or screening grid, as it is called, especially if the latter happens to be at a more positive potential than the anode. Thus there occurs the peculiar phenomenon that at certain anode voltages the screening grid may rob the anode of current and for a short distance along the characteristic curve an increase of anode volts is accompanied by a decrease of anode current.

This rather startling effect is just the opposite to that produced by a resistance, and so is called "negative" resistance; the effect of it is to cause a receiver in which the valve is included to oscillate uncontrollably.

Every effort is made to prevent this state of affairs by applying to all screen-grid valves a screen voltage which is roughly half that of the anode voltage, but it must be remembered that as far as signal potentials are concerned the screening grid is tied down to earth and so has a fixed potential, whilst for the process of amplification the anode voltage must rise and fall in sympathy with the signal above and below the fixed voltage. Until recently the screen-grid and variable-mu valves available gave ample margin of safety, but with the advent of automatic volume control and diode detection demanding, as they do, very large signal voltages, the negative resistance portion of the curve is often encroached upon, momentarily causing H.F. distortion.

Typical new valves: (A) Mullard VP4, a variable-mu screened H.F. pentode; (B) Marconi double-diode triode, MHD4; (C) Mullard PM2B, twin Class "B" output valve; (D) Tungsram PX46 single Class "B" valve, two of which will give 21 watts speech output; (E) Sylvania 6A7 Pentagrid; (F) Marconi Catkin pentode MPT4; (G) Tungsram SE2018 variable-mu A.C.-D.C. valve.

H.F. Pentodes

The obvious remedy is to remove, if possible, the negative resistance effect of the S.G. valve. Fortunately, this can be done fairly easily by adding an electrode between the screening grid and anode and attaching it to the cathode—in other words, by making the tetrode into a pentode. The secondary electrons now find a barrier which prevents access to the screening grid and larger signal potentials can be handled with impunity.

The screened H.F. pentode with both "ordinary" and variable-mu characteristics is likely to be marketed by all the leading valve manufacturers before the Olympia Exhibition, and it is fairly safe to prophesy that it will supersede the S.G. valve and variable-mu tetrode. At present there are on the market one Ferranti and two Mullard models, shown in the tables which accompany this article. Apart from the advantage already described, namely, the capacity to handle very large signals without distortion, it is found that the screening-grid voltage is not nearly so critical as it is with the ordinary S.G. valve and less complicated resistance networks are needed. It is anticipated that H.F. pentodes will appear with screening grids capable of carrying the full anode voltage so that the feed network may be omitted altogether. This would lead to considerable economy of components in the H.F. stages.

High-frequency pentodes are at present marketed with 5-pin bases (the anode connection being at the top of the bulb) so that any variable-mu or ordinary S.G. valve can be readily replaced without alteration of wiring, but as soon as the standard 7-pin base is used it is hoped

New Valves—

that the "suppressor" grid now taken internally to the cathode will be brought out to one of the idle pins. We should then have a ready means of injecting volts from the oscillator valve into the H.F. pentode first detector. Also it has been found that when negative bias is applied to the suppressor grid the valve's A.C. resistance drops, thus causing damping of the associated tuned circuit and providing a method of reducing sideband cutting with the local station. The second idle pin could be connected to the metal covering of the bulb, since a cathode-connected screen in a single-valve frequency changer for instance—for which purpose the H.F. pentode can be used—is not desirable, as it is well above earth potential. The Mullard SP4 has been tried as a power grid detector in a straight set, and it was found to be more sensitive in this position than any S.G. valve.

H.F. PENTODES.

Type.	Filament. Volts.	Filament. Amps.	Max. Anode Volts.	Max. Screen Voltage.	Grid Base (Volts).	Average Anode Current Min. Bias.	Average Screen Current Min. Bias.	Mutual Conductance at Min. Bias.	Price.
Ferranti .. VPT 4* ..	4.0	1.0	200	100	24	5.5	2.0	2.0	19/-
Mullard .. SP 4 ..	4.0	1.0	200	100	5.0	4.0	1.4	3.0	19/-
VP 4* ..	4.0	1.0	200	100	40	6.0	2.0	2.5	19/-

* Variable-mu characteristic.

CLASS "B" VALVES.

Type.	Filament. Volts.	Filament. Amps.	Working Anode Voltage.	Grid Bias.	Total Quiescent Anode Current.	Total Working Anode Current.*	Minimum Input Impedance (Ohms).	Anode-to-Anode Load (Ohms).	Max. Undistorted Output (Milliwatts).	Price.
Cossor .. 240 B ..	2.0	0.4	120	Zero	4.0	8.5	2,500	8,000	2,200	14/-
Ferranti .. HP 2 ..	2.0	0.4	120	Zero	3.0	8.5	2,500	8,000	2,000	14/-
HP 2 ..	2.0	0.4	150	Zero	3.0	—	2,500	8,000	2,700	
Mazda .. PD 220 ..	2.0	0.2	120	Zero	2.0	6.0	4,000	17,000	1,000 (A)	14/-
PD 220 ..	2.0	0.2	120	Zero	2.0	7.0	3,800	11,500	1,400 (B)	
PD 220 ..	2.0	0.2	150	0.5	2.0	8.0	4,000	14,000	2,100 (A)	
PD 220 ..	2.0	0.2	150	0.5	2.0	8.5	3,800	12,500	2,350 (B)	
Mullard .. PM 2 B ..	2.0	0.2	120	Zero	3.0	5.0	4,000	14,000	1,250	14/-
Tungsram .. PX46† ..	2.0	3.0	400	Zero	14.0	108	900	5,800	21,000	30/-

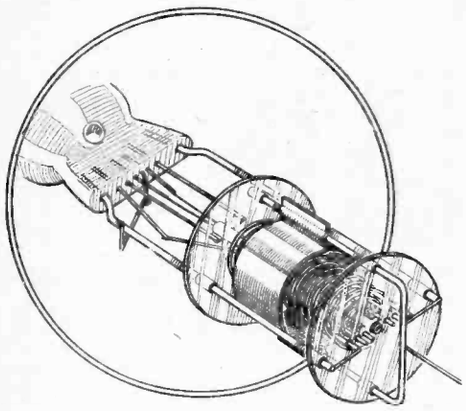
* Taken with a silver voltameter during a typical broadcast programme. (A) Using an L2 valve as driver. (B) P 220 valve as driver. † Characteristics given for a pair of valves.

DOUBLE-DIODE TRIODES, DOUBLE-DIODE PENTODES AND SINGLE-DIODE TETRODES.

Type.	Filament. Volts.	Filament. Amps.	Mutual Conductance.	Max. Anode Volts.	Max. Screen Volts.	Grid Bias.	Average Anode Current.	Average Screen Current.	Price.
Cossor .. DD Pen ..	4.0	1.0	2.7	250	200	−1.5 to −40	Max. space current 15 mA.		20/-
Ferranti .. HD 4† ..	4.0	1.0	2.7	200	—	3.0	4.5	—	15/6
Marconi & Osram. MHD 4† ..	4.0	1.0	2.2	200	—	3.0	2.5	—	15/6
Mullard .. TDD 4† ..	4.0	1.2	1.8	200	—	4.0	3.5	—	15/6
SD 4* ..	4.0	1.0	4.5	200	100	3.0	6.5	1.0	20/-

* Single-diode tetrode. † Double-diode triodes.

The next series of valves to be discussed is the multiple type, including a single or double diode. Every constructor must have experienced the overloading of a grid detector in a set with reaction control. As reaction is increased the signal strength grows to a maximum and then drops quite a lot before oscillation starts. The effect is due to detector overload, and can be ascribed to the fact that in a grid detector the signal is rectified in the grid circuit and then amplified in the anode circuit, the latter having to accept the H.F. *plus* the L.F. component. Anode bend rectification in opposite phase to grid rectification readily occurs with large inputs, and the output is not only restricted but distorted. Now that A.V.C. has come to stay in this country, the death of the power grid detector for superhets. and straight sets with 2 H.F. stages embodying this system is a foregone conclusion. Large control voltages for the early valves in the receiver are required and can best be supplied by a diode which will rectify a signal of 50 volts or more without any signs of overloading. Furthermore, the diode detector for reasonably large signals is nearly 100 per cent. efficient and distortionless.



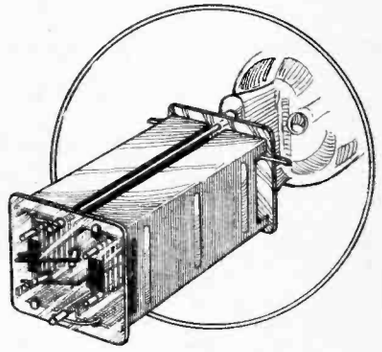
The electrode construction of a multiple diode valve for corrected A.V.C.—the Cossor D.D. Pen.

The Double-diode Series

By mounting a triode in the same bulb as the diode, economy of space is effected, and if an H.F. filter is interposed so that the triode grid receives only L.F. impulses, the output is considerably greater than it would be were the same valve to be fully loaded as a grid detector. In fact, the Marconi and Osram MHD4 will fully load a PX4 output valve using resistance coupling. There is another great advantage in using a diode detector; the damping of the preceding tuned circuit is very small indeed, and may be five or six times less than with the conventional grid detector.

Of the multiple valves of this type the most popular is the double-diode triode now introduced by Marconi and Osram, Ferranti and Mullard. The first diode anode is used for half-wave detection, while the second is arranged to give delayed A.V.C. The single-diode tetrode (the Mullard SD4) cannot, of course, be used for delayed A.V.C., but it is a good detector followed by a highly sensitive tetrode for true L.F. amplification. Using resistance coupling, a large output valve can be satisfactorily loaded. In the Cossor double-diode pentode (D.D.Pen) the automatic volume control voltage is not only taken back to the H.F. and I.F. valves, but also forwards to the variable-mu grid of the pentode forming part of the multiple valve. By this means almost perfect A.V.C. is obtained. For a change of input over a quarter of a million to one the output only alters by 10 per cent.—a performance which is much in advance of other methods.

Class "B" valves have had so much space devoted to them lately that little need be said here. The battery set user can now obtain about seven times the watts output that he could extract from his single triode output valve for an H.T. battery consumption which is hardly increased. It is confidently expected that nearly all the coming season's battery sets will be



The double-triode assembly of the Ferranti Class "B" valve—the H.P.2.

New Valves—

equipped with Class "B" output. An obvious development in this field is Class "B" valves for D.C. mains where there is perforce a limited anode voltage. For very large volume with A.C. mains sets class "B" output can show considerable economy. Two Tungsram PX46 valves (see table) used in positive drive will give the enormous output of 21 watts speech.

PENTAGRIDS.

Type.	Filament. Volts.	Filament. Amps.	Max. Anode Volts.	Max. Screen Voltage.	Grid Base (Volts).	Average Anode Current Min. Bias.	Average Screen Current Min. Bias.	Conversion Conductance (Micromhos) ‡	Price.
Sylvania* .. 2 A7 ..	2.5	0.8	250	100	50	4.0	2.0	475	17/6
6 A7† ..	6.3	0.3	250	100	50	4.0	2.0	475	17/6

* Marketed by Claude Lyons, Ltd. † For car radio. ‡ Ratio of I.F. output component to H.F. signal input.

The Pentagrid

A new single-valve frequency changer known as the Pentagrid, which hails from America, has lately made its appearance here. From preliminary experiments in *The Wireless World* laboratory it is fairly safe to predict that it will find wide application in superhets. It has distinct advantages over the hexode now popular on the Continent, since by virtue of an extra screen within the valve it does not require an external balancing circuit. Within the Pentagrid are the elements of a triode oscillator and variable-mu screen-grid first detector with sufficiently large grid base to allow of full A.V.C. control. The "mixing" is electronic in nature and the screening between elements so effective that there is no interaction between tuned circuits and no aerial radiation even when an H.F. stage is not used. Due to the avoidance of first detector harmonics, whistles are conspicuous by their absence and the efficiency of the new arrangement, judged by the increased output, is greater by two or three times than any other single-valve changer and is a distinct improvement over the conventional two-valve scheme with separate oscillator.

Valves for A.C.-D.C. and Car Radio

A range of A.C.-D.C. valves with 20-volt 0.18-amp. heaters has been introduced by Tungsram for sets which can be operated on any mains supply irrespective of voltage or frequency. No mains transformer is required, and the half-wave mains rectifier contains a 20-volt heater connected in series with the heaters of the receiving valves. When this arrangement is used on D.C. supplies the rectifier becomes a passenger and acts simply as a resistance dropping only 15 volts.

No review of new valves would be complete without mention of the all-metal Catkins which, although they do not introduce new electrical characteristics, are of fundamentally new construction and are destined to cause an entire revision of ideas in valve design.

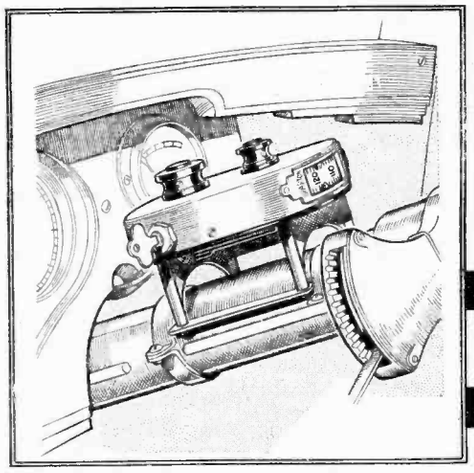
Valves likely to be introduced in the near future are a series of indirectly heated types for car radio and a new design for providing A.V.C. in battery sets.

A.C.—D.C. VALVES.

Type.	Use.	Filament. Volts.	Filament. Amps.	Anode Volts.	Screen Volts.	Impedance.	Slope (mA/V.).	Anode Current.	Output (Milliwatts).	Price.
Tungsram SE 2018 ..	Vari-mu	20	0.18	200	100	—	1.2	4.0	—	14/6
S 2018 ..	S.G.	20	0.18	200	100	330,000	1.2	3.0	—	14/6
R 2018 ..	R.C. and Det.	20	0.18	200	—	13,300	3.0	4.0	—	10/6
G 2018 ..	L.F.	20	0.18	200	—	7,000	3.5	7.5	—	10/6
P 2018 ..	Power	20	0.18	200	—	2,800	2.5	25	900	13/-
PP 2018 ..	Multi-Grid	20	0.18	200	200	31,250	2.5	2.5	1,100	17/-

A Car Set Tested

Special American Superheterodyne



THE Sparton superheterodyne, an effective and well-designed motor car set of American manufacture, was recently demonstrated to *The Wireless World* by Mr. R. W. Hydes, who is the makers' agent in this country.

Of even greater interest than the electrical design of the receiver are the mechanical details of construction, which are planned to allow of its being fitted in almost any type of car. The equipment comprises four separate units:—

(1) The receiver proper, mounted in a small but strong rectangular metal box, which may be mounted in any convenient position; accessibility need not be considered, as the set is remotely controlled.

(2) A small rotary H.T. generator, similarly enclosed.

(3) A moving-coil loud speaker designed for mounting under the dash or on the engine bulkhead.

(4) A remote control unit for attachment to steering column or dash. This includes an on-off switch, a cable-operated tuning control, a volume-adjusting potentiometer, and a pilot light.

Power from the Starter Battery

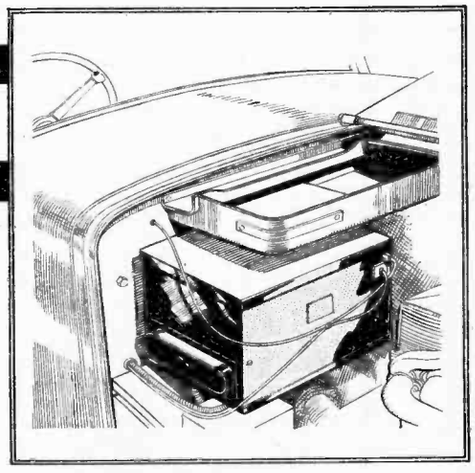
Low-tension current for the valves is drawn from the car battery, which also drives the H.T. generator and energises the speaker field.

The six valve stages of the set are arranged as an H.F. amplifier, a four-electrode detector-oscillator, one I.F. stage, a combined double-diode detector and A.V.C. valve, an intermediate L.F. amplifier, and finally a pair of push-pull pentodes.

Ample volume is obtainable, even when the car is travelling at a good speed, and, as for range, some fifteen or twenty stations were found to provide signals of programme value in broad daylight, on the open road, in spite of the necessarily limited pick-up of the small aerial which is built into the roof.

Without automatic volume control a car set is of little practical use while the vehicle is under way, as continuous adjustment is needed in order to compensate for the screening effect of bridges, buildings, etc. During our test such obstacles made practically no difference to reception, as the control system proved to be well capable of holding signal strength at a comfortable level. Bearing in mind the limited baffle area of the loud speaker, quality was all that one could expect or wish.

Interference from the electrical equipment of the car was almost non-existent, and even that from passing tram-cars could hardly ever be detected. Spark-plug suppressors, etc., are, of course, fitted where necessary to the electrical system of the car. The complete receiver costs £33, and the agent's address is 24-26, Burgess Street, Sheffield.



The Sparton Model 33 set fitted to a Talbot car. (Above) The remote control, clamped to the steering column, and (below) the receiver unit, mounted under the bonnet.

Practical HINTS AND TIPS

AIDS TO BETTER RECEPTION

Voltmeter Errors

WHEN a voltmeter is used to measure the H.T. voltages existing in a mains-driven receiver, there will inevitably be some error. The meter will show something less than the true voltage, and the greatest error will exist when the circuit resistances are high and when the meter resistance is low. Further, it should be remembered that voltage readings will be wildly inaccurate when the current consumed in the particular circuit under test is less than, or even comparable with, that required to actuate the meter.

A knowledge of these facts enables us to decide to what extent the indications given by the voltmeter may be trusted. Imagine that it is desired to measure the various H.T. and anode voltages in a typical H.F.-det.-L.F. set, such as that shown in skeleton form in Fig. 1. With the meter connected in position A, the total H.T. voltage may be read with a high degree of accuracy, for the reason that the internal resistance of the rectifier and smoothing system is low, and also because the extra current required to deflect the meter needle is bound to be considerably less than that flowing in the common anode circuit.

On transferring the instrument to position B, the H.T. voltage on the anode of the output valve may also be checked with hardly impaired accuracy. This is because the extra resistance of the output valve load will probably amount to no more than a few hundred ohms, and there will be no decoupling resistance in this circuit to add to the error.

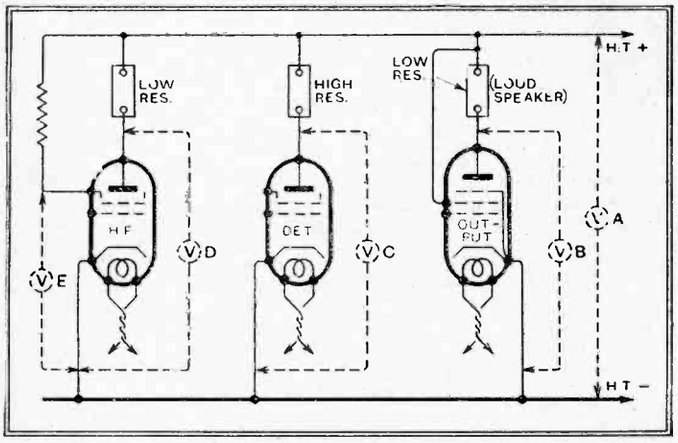


Fig. 1.—A guide to probable voltmeter errors: readings of anode voltage will be reasonably accurate where circuit resistances are low.

In measuring detector anode voltage, allowance must be made for a very considerable error; this is because the circuit nearly always includes a decoupling resistance of many thousands of ohms, and sometimes a coupling resistance as well. It may therefore be assumed quite definitely that the voltage shown by the meter C will be at least 20 or 30 per cent. low, and in some cases it will indicate less than half the true difference of potential existing between anode and cathode.

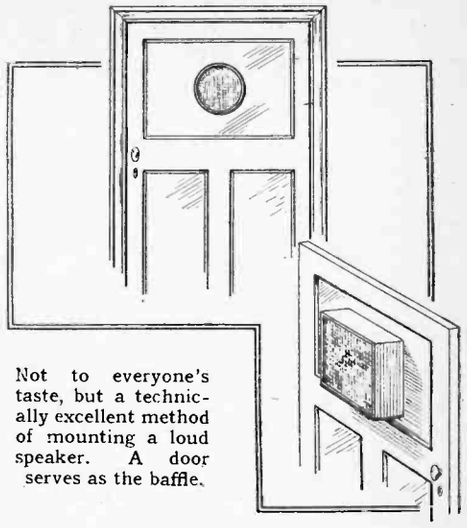
In H.F. circuits a decoupling resistance of a few hundred ohms is generally sufficient, and the ohmic resistance of H.F. coupling devices is negligibly low. It may therefore be expected that a reading of H.F. valve anode voltage taken by connecting the meter in position D will be reasonably accurate. Screening grid circuits, on the other hand, almost always include high resistances, and so the voltage read at E will be very much below the true value.

Reducing Stray Capacity

IT is sometimes recommended that when a compression-type condenser is to be mounted on a metal baseplate it should be raised about ¼in. above the metal by means of suitable washers or distance-pieces. This is done in order to reduce the comparatively high capacity which would otherwise exist between the condenser and earth; as often as not, this extra capacity is definitely undesirable, and at the best may restrict the tuning range of the set.

It has been found that with many condensers the maximum capacity attainable is reduced by mounting them in such a way that their lower backing plates tend to bow downwards as the compression screw is tightened. This should be borne in mind, and if there is any doubt a condenser with a rather higher capacity rating than would otherwise be chosen should be employed when it is to be mounted on distance-pieces, or used in any other way without the usual support of a solid backing.

Of course, this reduction in maximum capacity may be offset by mounting the condenser on a sub-base of non-conducting material such as wood or ebonite, which will provide a rigid backing, and at the same time avoid excessive stray capacity to earth.



Not to everyone's taste, but a technically excellent method of mounting a loud speaker. A door serves as the baffle.

The Best Baffle

ALTHOUGH the idea is not a new one, it may be pointed out that a communicating door between two rooms makes one of the most satisfactory baffles that can be contrived for a moving-coil loud speaker of the cone type. On æsthetic grounds the use of a door for this purpose may not suit everyone, but with a little forethought and ingenuity it is often possible to mount the loud speaker so that it is not unsightly; at any rate, the front of the aperture behind which the cone is mounted may be camouflaged quite successfully. The hole may be covered with metal gauze, held in position by a circular beading, the whole being painted in the same colour as the door.

With regard to the back of the door, it will generally be necessary to box-in the loud speaker in the manner suggested in an accompanying sketch. The back of the box, again, may be covered in with fabric or gauze, but should not be filled in with solid material. If the door is lightly built, resonances may be largely avoided by mounting the loud speaker on a heavy backing board before securing it in position.

Improvised Bias

WHEN a self-bias resistor breaks down, or when a resistor of the right value for this purpose is not available, it may be remembered that a bias battery of the right voltage may be used to replace it. This applies to true self-biased circuits, in which negative grid voltage is developed across a resistor in the circuit of the cathode lead of the valve concerned. In order that polarity may be correct, the usual procedure in connecting the bias cells in battery-operated sets must be reversed, and, instead of joining the positive pole to the H.T. negative-earth line, it must be joined to the cathode terminal of the valve-holder. The negative side of the bias battery is joined to earth, and then, assuming that the grid return lead is also joined to earth in the usual manner, the grid of the valve will receive negative bias.

NEWS *of the* WEEK

Current Events in Brief Review

2RN Returns

TO satisfy crystal listeners in the Dublin area, 2RN will shortly return to the air with its old 1½ kW. transmitter. We understand that the new wavelength will be 218 metres.

U.I.R. to Meet in Holland

THE next meeting of the Council of the International Broadcasting Union will probably be held in Holland in the autumn, soon after the new "Plan de Lucerne" is expected to come into operation.

New Hilversum Transmitter

HILVERSUM'S new transmitter has evoked many favourable observations from listeners on the 296-metre wave. The station is audible in England at any time of the day, although the aerial power does not exceed 20 kW.

A Good Scheme

"THE electrical apparatus in this establishment is equipped with anti-interference devices" is the inscription on a certificate which the Spinalien Radio Club of France is proposing to issue to traders and others who comply with the municipal decree to fit radiation suppressors. The certificate would be displayed in shop windows.

The World's Worst

MR. LEROY HALEY, W9GNK (postmaster at Tacoma, Colorado, U.S.), claims the poorest radio site in America.

We hope the claim is not disputed. The station is at the bottom of a canyon, 900 feet wide and 1,000 feet deep, 300 feet from a 10,000 horse-power hydro-electric generating station, and surrounded by tall pine trees, between two of which the aerial is strung. "On the east," says *Q.S.T.*, "the canyon wall goes on up for 6,000 feet more! Wow!"

Valve Price Cuts in Germany

DRASTIC reductions in the prices of German valves are to come into force on July 1st as a result of Government demands that radio should be available to all. According to our Berlin correspondent, the new prices will in some cases be 40 to 50 per cent. lower than those obtaining at present. The general public is being "kept in the dark" until near the date of the changes in order to allow traders to get rid of existing valve stocks at the current prices.

The cuts have been achieved by reducing the manufacturers' and traders' profits.

Policing the Ether Traffic

A NEW wavelength-checking station has been opened at Noiseau, France. The station will check the wavelengths of all kinds of stations, commercial and broadcasting.

For Blind Listeners

THE circulation of the "Braille Radio Times," published by the National Institute for the Blind, has this year increased by 500 copies a week.

Catkins Demonstrated

BY arrangement with the Marconiphone Co., Ltd., a public demonstration of the Catkin valve will be given this evening (Friday) by the London Chapter of the International Short-Wave Club at the R.A.C.S. Hall, Cavendish Grove, Wandsworth Road, S.W.8, at 8 p.m. *Wireless World* readers are invited to attend.

Short Waves for University Expedition

GOOD reception over distances of 1,000 miles has been obtained with a power of only 3 watts in a series of field tests carried out recently by two amateurs, who are supplying a complete short-wave transmitting and receiving equipment to the University of Oxford Expedition to the Arctic regions, under the leadership of Mr. A. R. Glen. The short-wave equipment, which will be used to maintain touch between two sledging parties and with the base camp, has been specially built by Mr. R. F. Loomes (G5RL) and Mr. N. E. Read.

The short-wave receivers are of the simple detector and L.F. type; each is contained in an air-tight aluminium case, which, in its turn, is enclosed in a teak travelling case lined with sorbo rubber. Each set has been equipped with two Mullard PM1HL valves, low tension being supplied from two dry cells and high tension from a Standard 100v. battery. A wavelength of 80 metres will be used for distances of less than forty miles, but when the sledging parties are separated by greater distances the 40-metre band will be used.

Free Seats for the Deaf

RADIO-AID, LTD., who have just installed a deaf-aid equipment at Madame Tussaud's Cinema, Marylebone Road, London, state that a limited number of free tickets to the cinema are available to deaf persons desirous of testing the equipment during a performance. Application should be made to Radio-Aid, Ltd., 4, Iddesleigh House, Caxton Street, Westminster, London, S.W.1.

Beromunster on Long Wave

BEROMUNSTER is already testing on a long wave in accordance with the proposals of the "Plan de Lucerne." Last week a small military transmitter was set up close to the station to carry out long-wave tests, and it was shown that field strength was considerably increased. Swiss listeners will probably be embarrassed by a long wave, as many of them have bought American receivers operating only on the medium-wave band.

PENALTY OF GREATNESS. These pictures show how European statesmen landing at New York must first undergo ordeal by microphone, almost at a moment's notice. In the top view is Mr. Ramsay MacDonald addressing listeners on the N.B.C. chain from the Berengaria. (Left) M. Herriot of France. (Right) Dr. Hjalmar Schacht of the German Reichsbank. (Below) Signor Guido Jung, Finance Minister of Italy.

Relaying Rabat

A LABOUR of love is being carried on by Dr. Veyre, owner of the amateur station, CN8MC, Casablanca, who daily relays the Rabat programmes for the benefit of the Berber population of Morocco. According to a Casablanca correspondent, crowds of natives gather round the local shops to hear loud speaker music relayed from CN8MC.

Quite a number of cafés in the hinterlands of Morocco are radio equipped, and hooded Arabs sip apéritifs and smoke French cigarettes while listening. CN8MC transmits on 48 metres on Mondays and Tuesdays.

Lucerne: The Last Week

THE sensation at the last week of the Lucerne Conference was the great fight between British and French delegates on the subject of France's second long wave. The British delegation (writes our Lucerne representative) was evidently of the opinion that France had decided to hand over the Eiffel Tower wave to Luxembourg at a later date, and put up a strong resistance. In the end the French gracefully withdrew their claim for a second long wave.

All the delegation, except perhaps the German, seemed up in arms against the Russians, who, by the way, have "sacrificed" two waves and refused to do more. They demanded, not without success, four exclusive waves for the Moscow transmitters, the intention being to prevent all reception of foreign stations in the Soviet capital. Russia also seems to have scored a point as regards its long-wave 500 kW station. The colossal power of this transmitter has caused all other countries to refuse to share the wave and brought about a separation of an extra kilocycle on each side; thus Moscow has the most exclusive European wavelength and can deal out as much propaganda as necessary!

The delegates, almost without exception, have fought shy of the new "shared" wavelengths, the argument being that these have not been tried, and countries may find themselves awkwardly placed when the plan leaves theory and becomes practice.

Class "B" Amplification

IT is regretted that an error crept into Table B on page 395 of our issue of June 2nd. Sound Sales market only two driver transformers. The first, known as "B," has a ratio per half secondary of 2:1 and sells at 9s., not 10s. as quoted. The other transformer, called "UB," has tappings to give ratios per half secondary of 2:1, 3:1 and 4:1; it sells at 10s.

Summer Evening Radio Classes

LECTURES on radio wave propaganda will be included in the electrical engineering course of the Manchester Municipal College of Technology, which opens summer evening classes on Monday next, June 12th. Full particulars are obtainable from the Registrar.

The Voice of Morocco

THE Moroccan stations may soon be regarded as regular programme providers for listeners in Europe. According to present plans, which are not confirmed, the stations at Algiers and Rabat will raise their powers to 75 and 50 kW. respectively, while Tunis-Kasbah, which at present transmits meteorological information for ten minutes only each day, will be transformed into an important broadcasting station with a power of 60 kW. The three transmitters will then be connected by cables.

How the Superhet Works. 3.

The FREQUENCY CHANGER and the I.F. AMPLIFIER

IN this series of articles the path of the signal through the circuits of the superheterodyne receiver is explained stage by stage. Previous instalments have dealt with the signal frequency stage, the H.F. stage, and the oscillator.

A New Circuit for Minimising Interference in the Superheterodyne Receiver

By W. T. COCKING

THE course of the signal has now been traced as far as the grid of the first detector and we have briefly dealt with the oscillator. Inspection of the general circuit diagram published with the first part of this series (see p. 378, issue of May 26th) will show that the coil between the points 6 and 2 of the oscillator coil assembly is coupled to the tuned winding and is connected in the cathode lead of the first detector. Since the grid of this valve is joined to the earth line through a tuned circuit, this coil is really in the grid-cathode circuit of the first detector, and, as a result, a voltage due to the oscillator is applied to the first detector grid as well as that caused by the signals.

Sideband Theory

Ignoring interference for the moment, we thus have two different voltages of different frequencies applied to the first detector—one due to the wanted incoming signal, and the other to the oscillator. The valve is adjusted to work as an anode bend rectifier, so that both sets of voltages are rectified. This is the part of the superheterodyne which is really complicated, for it is not always easy to see just what happens, and there is much misapprehension. For a complete understanding of the operation, a complicated mathematical analysis is necessary, but this is quite beyond the scope of the present article.

Some of the chief considerations involved in the design of the frequency changer will be considered later, and for the present it is sufficient to point out that although the input to the first detector consists of only two frequencies, the output contains many more. Due to the rectification process, there will be currents in the anode circuit of the signal frequency, the oscillator frequency, a frequency equal to the sum of the input frequencies, and a frequency equal to the difference of the input frequencies; in addition, there may be harmonics of all these, and there will certainly be the usual direct current consequent upon all rectification. Thus, if the incoming signal has a frequency of 1,000 kc/s, and the local oscillator is adjusted to 1,110 kc/s, the currents in the anode circuit will have frequencies of 1,000 kc/s, 1,110 kc/s, 2,110 kc/s, and 110 kc/s.

In general, however, the incoming signal will not be a single frequency, for it will be modulated. A modulated carrier can be considered in two different ways; it can be thought of as a simple wave of single frequency, the amplitude of which is varying at the modulation frequency, or it can be considered as a pure continuous wave accompanied by other similar waves spaced on either side of it by an amount equal to the modulation frequency. Thus, a carrier of 1,000 kc/s, modulated by a 5,000 cycles note, can be thought of as a wave of 1,000 kc/s, the amplitude of which is varying 5,000 times a second, or it can be considered as being a series of pure continuous waves with frequencies of 1,005 kc/s, 1,000 kc/s, and 995 kc/s. These two different viewpoints of modulation are known respectively as the amplitude variation and the sideband theories.

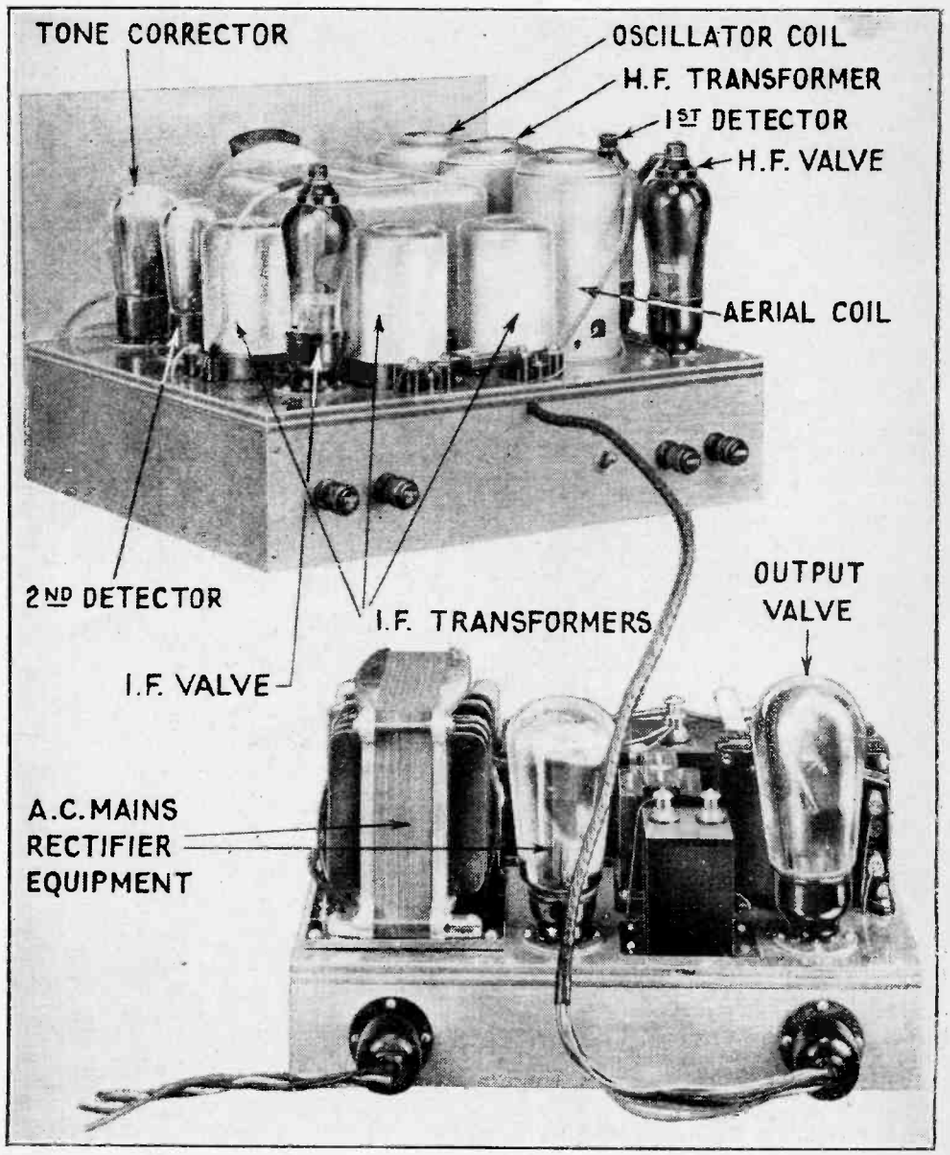


Illustration of a typical superhet, *The Wireless World* Monodial, with the various parts identified.

How the Superhet Works—

and they mean exactly the same thing. The theories have been the subject of much needless controversy; they are really two different ways of describing the same phenomenon, and they are both

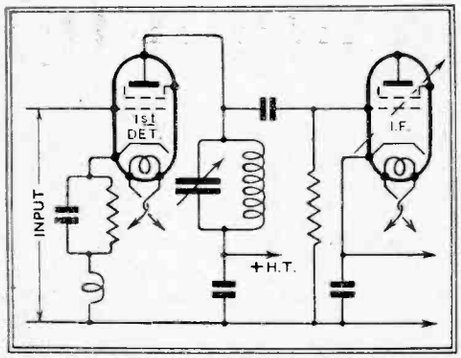


Fig. 1.—A tuned anode I.F. coupling can be used, but is not usually advisable, since the high-frequency detector output may reach the I.F. valve grid.

accurate and mathematically equivalent. We may choose, therefore, whichever is the more convenient for our purpose, and at different stages of the receiver we can change from one to the other at will. In general, the sideband theory is the simpler.

Band-pass I.F. Coupling

Let us apply it to the present case, therefore, and suppose that instead of an unmodulated signal of 1,000 kc/s, we have a signal of that frequency modulated at 5,000 cycles per second. The signal input to the first detector, therefore, will consist of a series of frequencies of 1,005, 1,000, and 995 kc/s, due to the signal, and a frequency of 1,110 kc/s from the oscillator. The output frequencies, therefore, will be 1,110, 1,005, 1,000, 995, 2,115, 2,110, 2,105, 115, 110, and 105 kc/s, and 5 kc/s, and possibly harmonics of these. Of these frequencies, that of 1,110 kc/s is the oscillator frequency; the group 1,005, 1,000, and 995 kc/s is the signal frequency with its sidebands; the group 2,115, 2,110, and 2,105 kc/s is a new frequency with sidebands due to the sum of the input frequencies; the group 115, 110, and 105 kc/s is another new frequency with sidebands due to the difference of the original frequencies; and the 5 kc/s frequency is the normal demodulation of the signal. Of this welter of frequencies in the output, it is the two new groups which interest us—the 2,110 kc/s and the 110 kc/s groups. The first thing to notice is that each group forms the equivalent of a modulated carrier of new frequency, but with the modulation unchanged. Thus, the first group is equivalent to a carrier of 2,110 kc/s modulated by a 5,000 cycles note, and the second to a carrier of 110 kc/s also modulated at 5,000 cycles. Either of these groups can be treated in exactly the same manner as an incoming signal of the same frequency; it can be amplified and passed through selective circuits until finally it is rectified in order to separate the 5,000 cycles, or other modulation from the carrier in the usual way.

For reasons to be dealt with later, it is the general practice to make use only of the low frequency, the 110 kc/s, components of the first detector output, and this is termed the intermediate frequency. A tuned circuit resonating at this frequency, therefore, is included in the anode circuit of the valve in order to select the intermediate frequency and reject all the others. The design of such a circuit follows normal H.F. amplifier practice, save that it is not usually permissible to connect the first detector anode to a tapping on the coil nor to use a normal type of H.F. transformer. The matter is not usually so important with a screen-grid first detector valve as with a triode, but it is usually desirable that there should be a condenser connected between the valve anode and some point at earth potential.

A tuned-anode type of intervalve coupling would serve admirably, therefore, and the arrangement shown in Fig. 1 would be quite possible. It must not be forgotten, however, that we have a large number of different frequencies in the circuit, of which only the 110 kc/s group is required. Even though it may be very small, the tuned anode circuit offers some impedance at the highest frequency, so that with this simple coupling an appreciable voltage due to the unwanted frequencies may find its way to the grid of the next valve. These frequencies serve no useful purpose at this point, and their presence tends to reduce the input handling capacity of the valve for the wanted signal. It is the general practice, therefore, to use a considerably more selective type of intervalve coupling, and the circuit of Fig. 2 is commonly employed.

Use of Variable-mu Valve

With this arrangement there is no direct connection between the grid of the I.F. valve and the anode of the first

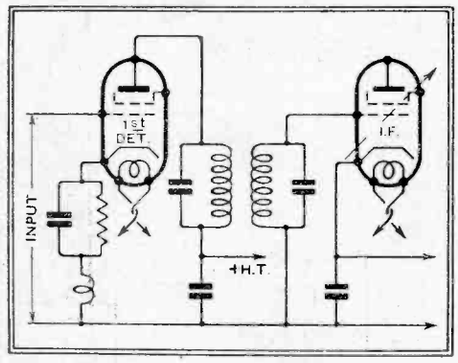
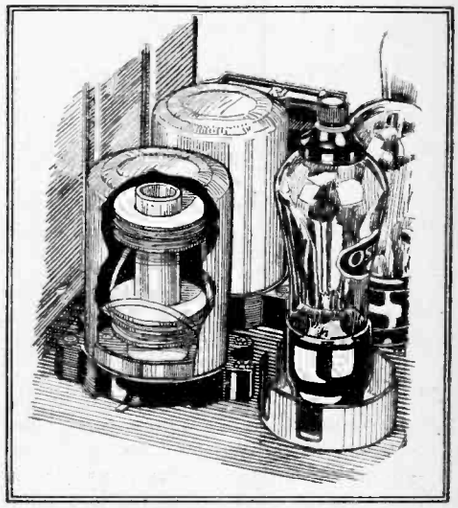


Fig. 2.—A band-pass I.F. coupling is the most satisfactory, for it gives high selectivity, and largely prevents unwanted frequencies from reaching the I.F. valve.

detector, and the coupling is entirely through the mutual inductance between the two coils. Each circuit is tuned to the intermediate frequency, and the coupling between the coils is adjusted to give the desired type of resonance curve. Since the selectivity with two circuits is much greater than with only one, it is found that only the intermediate frequency group of the first detector output can reach the I.F. valve grid at any appreciable strength.

In the general receiver circuit (p. 378 issue of May 26th) an even more complex coupling is employed, and no fewer than four tuned circuits are connected between the first detector and I.F. valve. The filter is built up from a pair of double-tuned or band-pass circuits similar to those of Fig. 2 coupled together by a small capacity condenser C11. Through the use of this multiplicity of circuits a very high degree of selectivity is obtainable.



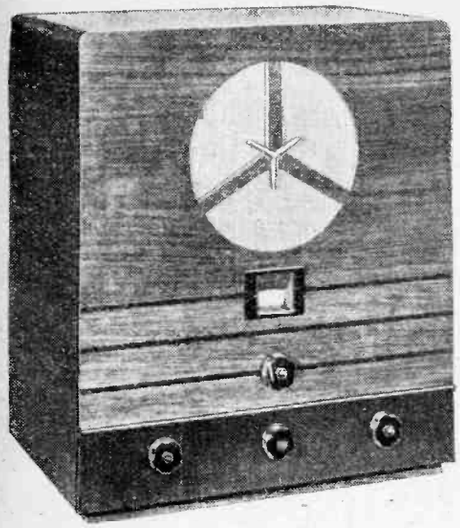
Two typical I.F. band-pass coils with adjustable coupling are shown in this illustration.

The voltages appearing across the terminals of the last of these four circuits are applied to the grid of another variable-mu valve which acts as the I.F. amplifier. Its operation is identical with that of the H.F. valve, save that it works at a different frequency, and it is coupled to the second detector through a pair of tuned circuits which act as a band-pass filter. The valve is biased negatively by the same amount as the H.F. valve, and its cathode, in fact, is connected directly to that of the H.F. valve. The variations of bias imposed on the latter for volume control, therefore, occur also on the I.F. valve, so that the amplifying power of both is reduced simultaneously.

The load impedance of an I.F. valve is not so important as that of the H.F. stage, since cross-modulation effects are far less likely to occur. From the point of view of distortion, of course, it is still advisable to keep the load impedance at a moderate value. It is found, however, that the usual type of I.F. transformer is entirely satisfactory in this respect, for the dynamic resistance of the tuned circuit is about 100,000 ohms.

LOW-FREQUENCY VALVE VOLTMETER

FOR measuring voltages at speech frequencies a valve voltmeter which can be calibrated by D.C., and in which the calibration is independent of valve characteristic, is undoubtedly a valuable asset in the laboratory. Such an instrument is described in the June number of *The Wireless Engineer*, copies of which can be ordered through newsagents or direct from the publishers of *The Wireless World*.



Murphy A4

A Four-valve Superheterodyne Giving Excellent Quality of Reproduction

FEATURES.

Type.—*Four-valve superheterodyne receiver with pentode frequency changer. Moving-coil loud speaker. Provision for pick-up and external loud speaker.* ***Circuit.***—*Pentode detector-oscillator-variable-mu I.F.—anode bend triode detector—pentode output. Band-pass input filter.* ***Controls.***—*(1) Tuning, with illuminated dial calibrated in wavelengths; (2) Volume control (radio only); (3) Waverange and on-off switch.* ***Price.***—*£14 10s.* ***Makers.***—*Murphy Radio Ltd., Welwyn Garden City, Herts.*

IN the Murphy range of receiving sets the new A4 model has been introduced to bridge the gap between the A3A straight three-valve receiver and A8 eight-valve superheterodyne with automatic volume control. It is a four-valve superheterodyne designed for use with an outdoor aerial, and, as might be expected, the range and selectivity are definitely better than in the A3A, though not quite so good as in the A8.

In our opinion, however, the set's claim to distinction rests primarily on the excellence of the quality of reproduction. There is a crispness and realism which is all too rare in receivers manufactured on a quantitative basis. The frequency range covered does not appear to be wider than that of other sets of similar type, and the principal response is probably confined between the limits of 90-100 cycles to 4,500-5,000 cycles, but the exemplary behaviour of the set and loud speaker over this range more than compensates for deficiencies at the extremities of the audible frequency range. The bass response is smooth and full, and resonances in the loud speaker and box resonance in the cabinet, if present, have been skilfully merged to give a sensibly uniform output over the lower part of the musical scale. The same sort of effect is apparent in the upper register, and with the set accurately tuned and the tone control set to give maximum high note response, the balance is just right. Speech is natural, and the set excels in the reproduction of incisive sounds such as are met with in dance music and the cinema organ.

High Intrinsic Selectivity

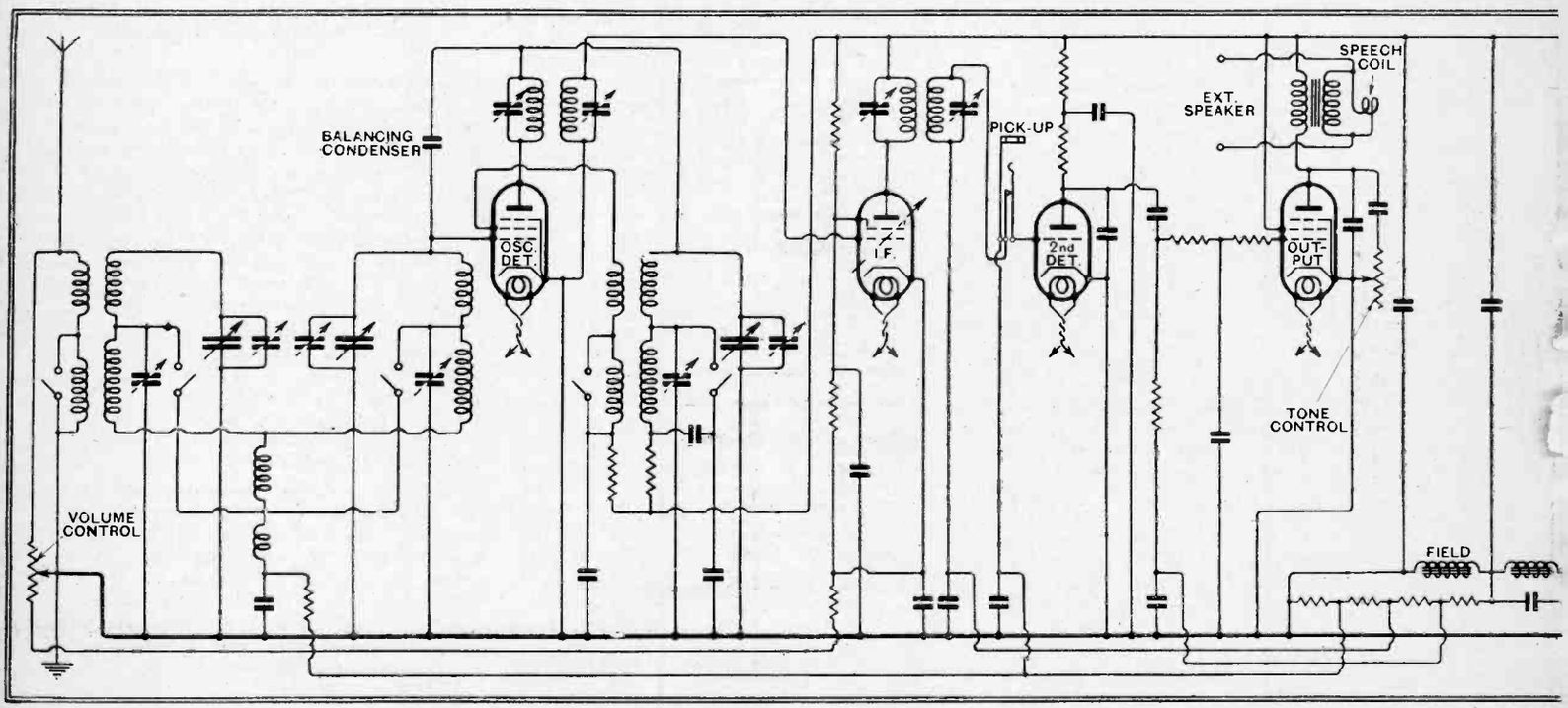
The tone control is continuously variable and is useful in reducing background noise on weak signals, though the set is not unduly irritating from this point of view, and on stations of medium strength is as quiet as any straight set. Those who prefer the mellow type of quality can adjust the tone precisely to their taste.

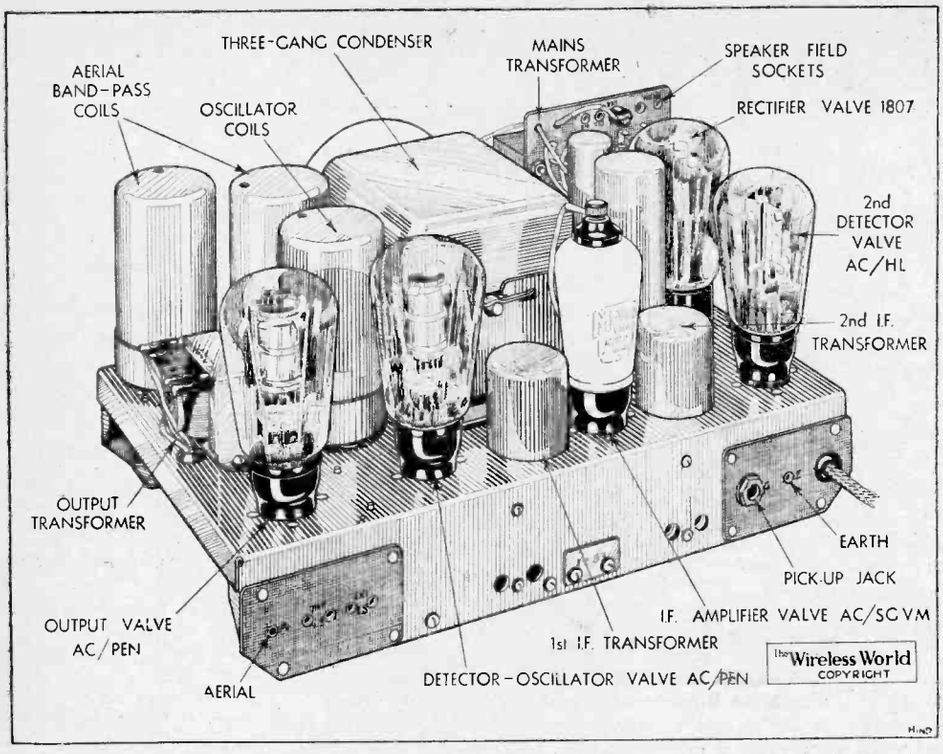
A rapid search round the dial is sufficient to convince one of the liveliness of the set from the point of view of range and the ease with which stations may be tuned-in. The set is not equipped with automatic volume control, so that a ready hand must be kept on the volume control. When overloaded, however, the volume decreases, so that unexpectedly strong stations do not produce unduly startling noises. The four or five Continental stations that it is possible to pick up on medium waves in daylight were received in London with more than usual clarity and an ample reserve of volume.

Any estimate of the selectivity of a superheterodyne receiver should take into account not only the intrinsic selectivity of the set, but also the degree of interference and the number of stations lost due to second channel whistles. In the A4 receiver, instead of a multiplicity of whistles of medium strength covering most of the medium wave band, there are, in the London area, two fairly strong whistles, one on Poste Parisien and the other just above North Regional. On long waves there was one whistle at about 1,225 metres. In other districts, of course, the position and strength of the second channel whistles would depend on the wavelength of the local stations and their distance from the receiver.

The intrinsic selectivity on medium waves is very good, and only two channels are lost on either side of the two Brookmans Park transmitters with the set working at full sensitivity on an efficient outdoor aerial in Central London. On long waves Königs-

The use of a pentode as a single-valve frequency changer is an outstanding feature of the circuit which has been developed on well-tried lines.

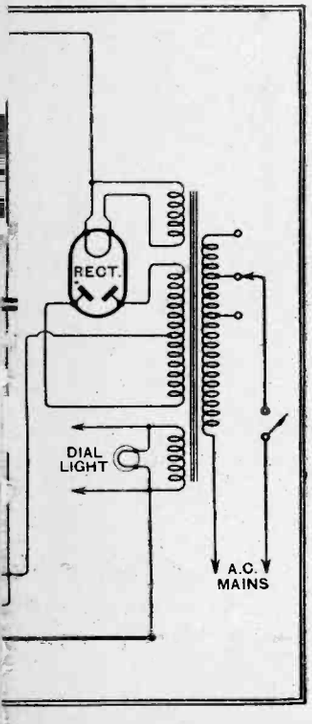




Plug and socket connections to the loud speaker facilitate the removal of the Murphy A4 chassis from the cabinet. Double screening covers are used on the I.F. transformers.

wusterhausen was clear of its adjacent stations save for slight side-band "splashing" which could be dealt with by the tone control.

An inductively coupled band-pass filter in the aerial circuit contributes materially to the selectivity, and there are four tuned circuits associated with the I.F. amplifier. The single-valve frequency changer (detector-oscillator) is of the self-neutralised pentode type described in this journal on July 29th and August 5th last year. To ensure a close balance between the inter-electrode capacities and consequent freedom from radiation and interaction between the circuits, an external condenser of a few micro-mfds. has been connected between the working grid and the low potential end of the I.F. transformer primary.



The I.F. stage is perfectly straightforward, and volume is here controlled by varying the bias and, to a certain extent, the screen potential. Part of the volume control resistance is also shunted across the aerial circuit.

A jack is provided for pick-up connections in the grid circuit of the anode bend detector, which is resistance-coupled to the pentode output valve. Stray I.F. voltages are prevented from reaching the output by a two-stage resistance-capacity filter in the grid circuit.

The output from the full-wave valve rectifier is smoothed by a tuned L.F. choke in addition to the loud speaker field which is connected in the negative lead. As a result mains hum can only be detected by placing the head alongside the loud speaker grille. From this point of view the set is one of the quietest we have tested.

Chassis Easily Removed

In design and construction the chassis maintains the reputation Murphy's have established for clean workmanship and finish. Plug and socket connections for the field winding and output to the speaker greatly facilitate the removal of the chassis from the cabinet—a point which will be appreciated by the service man. The loud speaker itself is rigidly mounted on a thick batten fixed transversely in the cabinet, which is built on solid lines, and is finished in walnut and rosewood veneer. Although the price is low there is no suggestion anywhere in the set of cheapness, and both from the point of view of appearance and performance the A4 is unquestionably good value for money.

There are equivalent models for D.C. mains and batteries, the latter being equipped with "class B" output stage. The price in both cases is the same as that of the A4—£14 10s.

BLUE PRINTS

For the convenience of constructors full-sized blue prints are available of the following popular *Wireless World* sets that have been recently described, price 1s. 6d., post free.

Monodial A.C. Super. (Booklet, price 1s. 8d. post free.)
Modern Straight Five. (June 22nd and 29th, 1932.)
Short Wave Two. (November 4th and December 23rd, 1932.)
Monodial D.C. Super. (December 2nd and 9th, 1932.)
Straight Three. (December 16th, 1932.)
Modern D.C. Three. (December 30th, 1932, and January 6th, 1933.)
All-wave Monodial Super. (January 27th and February 10th, 1933.)
Modern A.C. Quality Amplifier. (February 17th, 1933.)
Ferrocart III. (February 24th and March 3rd, 1933.)
* **A.V.C. Monodial Super.** (March 17th and 24th, 1933.) With 2·5 watt or 5 watt amplifier. State which is required when ordering.
The Class "B" Ferrocart Receiver. (April 17th, 1933.)
Universal A.C. Short-wave Converter. (April 28th, 1933.)

* Price of this blue print is 2s.

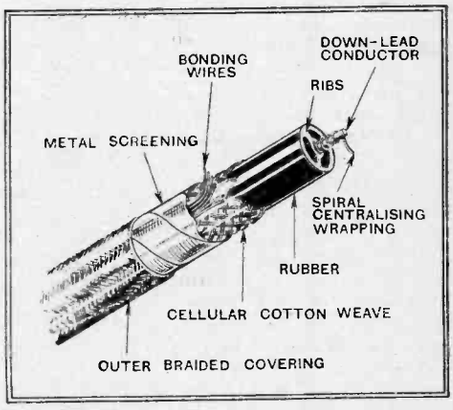
These can be obtained from the Publishers, Iliffe & Sons Ltd., Dorset House, Stamford Street, London, S.E.1.

Minimising Electrical Interference

"Metocel" Down-Leads

THE firm of Ward & Goldstone, Ltd., of Pendleton, Manchester, were, it is believed, the first in this country to introduce a shielded aerial down-lead; their original production was described fully in *The Wireless World* of March 17th.

Although this type of down lead is still available, a cheaper, but nevertheless very effective, alternative to it has now been put on the market under the trade name of "Metocel." From the accompanying sketch it will be seen that the conductor is centred in an extruded insulating rubber covering planned on the "tube within a tube" principle, with spacing ribs which ensure a large proportion of air dielectric. Still more air spacing is introduced by the use of a loosely woven braided covering between the outer rubber tube and the wrapping of metal foil which acts as a screen.



"Metocel" screened cable; how self-capacity and dielectric losses are reduced.

In order that the capacity of the lead may not change in wet weather (and thus upset ganging) a weatherproof external covering is added, but for the "outdoor" type only; a similar cable for indoor use is braided with ordinary cotton covering. Both types cost only 8d. per foot, any length being obtainable. Suitable connectors and other fittings are also produced, their uses being explained in a pamphlet in which methods of installation are described.

Capacity between conductor and screen was found to amount to no more than 11.25 micro-microfarads per foot—a commendably low figure, on the attainment of which the makers are to be congratulated.

The use of a "Metocel" down lead should confer a large measure of immunity from many forms of electrical interference; loss of signal strength should be almost negligible.

Second Channel Suppression

An Effective New Input Filter

By R. I. KINROSS

THERE is a tendency in the interests of economy to cut down the number of signal-frequency circuits in a superhet, but unless special precautions are taken, second channel interference is likely to prove troublesome. A new input filter is described in this article combining the virtues of inductive and capacitive coupling which satisfactorily minimises the effect of "image" frequencies.

IT is fairly well known that receivers working on the superheterodyne principle fell into disrepute a few years ago for two reasons. The first was because of the poor quality of reproduction obtainable, and the second because of the degree of interference experienced throughout the waveband from a powerful local transmitter. The superheterodyne receiver owes its present well-deserved popularity to the use of well-designed I.F. band-pass filters which provide good quality without any sacrifice of selectivity. The second difficulty has been solved in the more expensive type of superheterodyne receivers by the use of selective signal-frequency circuits which, if enough are used, provide a very fair degree of freedom from second channel and kindred forms of interference due to the local station.

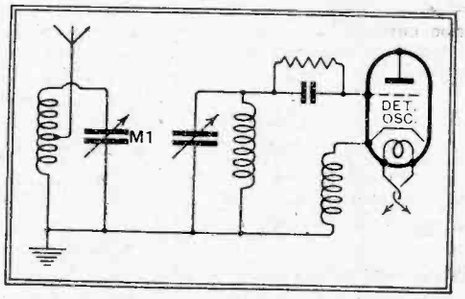


Fig. 1.—A very satisfactory inductively coupled circuit for the signal frequency stage of a superheterodyne.

The causes of this interference have been already fully described in an article in *The Wireless World* of March 2nd, 1932, and it is sufficient to say here that it can occur when a receiver is tuned to a frequency differing from that of a powerful local station by twice its (the receiver's) intermediate frequency or by some simple fraction of the latter.

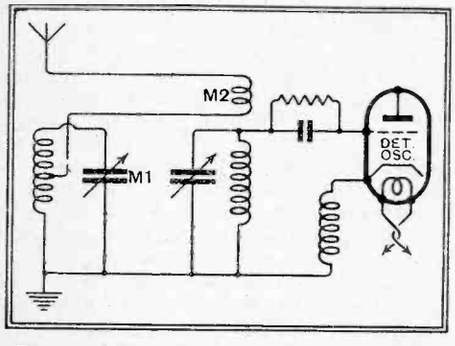


Fig. 2.—The image frequency will be cancelled out at one frequency by the inductively coupled winding, M2.

Assuming that the amplifying and rectifying conditions are as linear as is practicable, the degree of interference experienced for any given intermediate frequency will depend solely on the selectivity of the signal-frequency circuits. Until recently it has been usual to employ at least three or four of the latter, but lately the need for more economy in design has led to the use of only two tuned signal-frequency circuits. Under these conditions serious interference will occur, and it will now be shown what steps may be taken to reduce this.

Experience has shown that two inductively coupled tuned circuits, as shown in Fig. 1, are by far the most suitable form of a signal-frequency band-pass filter for superheterodyne receivers. Fig. 2 shows the same band-pass filter, but with the addition of the coupling M2. The object of this coupling is to feed the image frequency direct from the aerial into the secondary circuit in such a way as to be equal in strength yet opposite in phase to that which is leaking through the primary circuit *via* M1. The result is that the E.M.F. produced on the grid of the valve by the image frequency in the arrangement shown in Fig. 1 will be completely cancelled out in the arrangement shown in Fig. 2.

This arrangement was actually tried on a receiver close to Brookmans Park, using an I.F. of 125 kc/s. With a plain inductance coupling an annoying whistle was heard when listening to Brussels (509 m.) due to second channel interference from the London Regional. By suitably adjusting M2 it was possible completely to remove this. It was found, however, that almost as serious interference was still caused by the National Transmitter (261.5 m.) on 335 m. unless

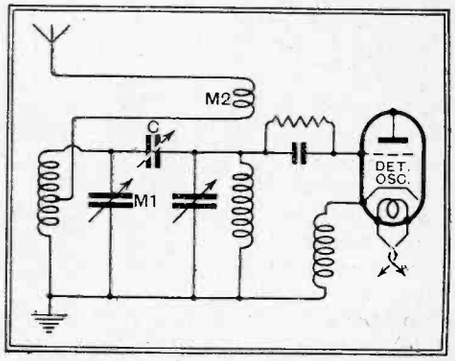


Fig. 4.—Combining the virtues of inductive and capacitive coupling.

M2 were readjusted by increasing its value. If this were done, of course, the interference from the Regional Transmitter would return to about its original intensity.

It was therefore decided to try a capacitive coupling as shown in Fig. 3, but this arrangement, though excellent at the particular frequency for which it was adjusted, again failed to work throughout the waveband. The merits of the two circuits are shown in Figs. 5 and 6, where in the one case suppression is arranged for about 320 metres, and in the other on about 500 metres. These at once suggested to the author an arrangement combining the two methods of suppression. In contrast with the results usually obtained when such perfect ideas are tried in practice, it may at once be said that the hopes entertained for the success of the arrangement shown in Fig. 4 were fully justified as shown by Fig. 7. It is important, however, that the capacitive coupling be used for suppression on the lower, and the inductive coupling on the upper part of the medium waveband.

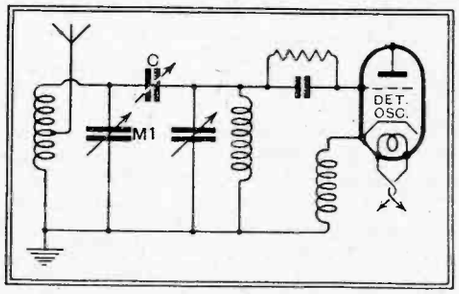


Fig. 3.—The coupling known as "top capacity" does not prevent second channel interference throughout the waveband.

The actual values of M2 and C were easily obtained mathematically, but as both of these are extremely small, it will be found best to make them semi-adjustable, and so obtain the best results by trial and error. If the band-pass coils are unscreened, M2 may consist of two or three turns of wire on a wooden former 1½in. in diameter. This former should be

Second Channel Suppression—

mounted along the side of the secondary coil by means of a screw through a hole drilled eccentrically in the former. When the best position has been found, the

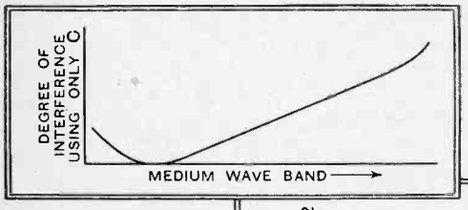


Fig. 5.—Suppression at about 320 metres using "top" capacity coupling.

screw should then be tightened up. Assuming the direction of rotation of the band-pass coils to be the same from the high potential end to earth, the direction of the coupling coil will be in the opposite direction from the aerial to the primary tap. If the coil is screened the amateur will have to make some provision for adjusting M2 through the can, the coupling coil being in this case about ½in. in diameter and placed inside the secondary.

The condenser C may consist of two screws so arranged that the distance between their heads (which should be about ¼in. in diameter) is adjustable.

Adjustment is carried out as follows. Tune in a station on which interference is experienced. If this be above 350 m. adjust the value of M2 until this disappears. Tune in another station below 350 m. on which a whistle is heard and adjust the value of C until this disappears. It may be found now that M2 will require a slight amount of readjustment on the first station. Care should be taken to reduce stray capacities between the aerial and grid of the first valve to a minimum since the value of C is only of the order of five micromicrofarads, and this value, naturally, must not be exceeded elsewhere in the circuit.

It will be seen that the aerial band-pass filter of Fig. 1 feeds direct

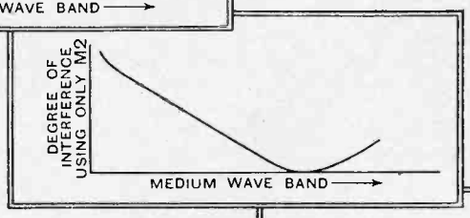


Fig. 6.—The use of the small inductive winding causes suppression at about 500 metres.

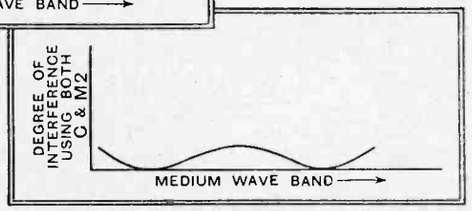


Fig. 7.—The suppression curve when using both inductive and capacitive coupling is nearly linear.

into the detector-oscillator, and although the former is tuned to a frequency differing from that of the oscillator by the intermediate frequency of the receiver, a certain amount of energy will be radiated from the aerial.

In Fig. 4 this rediation will be considerably decreased due to an action similar, but in a reverse direction, to that described above.

NEW BOOKS

RADIO RECEIVER SERVICING AND MAINTENANCE. By E. J. G. Lewis. Pp. 169, with 75 figures. Sir Isaac Pitman and Sons, Ltd., London, 1933. Price 7s. 6d. net.

IN the author's introduction it is stated that this book is intended to help the radio dealer, the salesman, and the keen amateur. The needs of this class of reader are catered for rather than those of the advanced service-man who is seeking information on the more elusive type of fault.

It is rightly emphasised that a mere list of possible faults and their cure is of little value. The underlying principle throughout has been to explain briefly the purpose and functioning of each section or component of a receiver, and then to enumerate the faults that may arise, their diagnosis, and cure.

The opening chapter deals simply but adequately with such fundamental considerations as the electron theory, Ohm's law, capacity, inductance, and tuned circuits. In later sections, valves, circuits, and loud speakers and other components and accessories are discussed in detail. Coming to the purely "service" section, chapters are devoted to testing equipment and the procedure to be adopted in locating faults.

In a manual intended for readers without much fundamental knowledge, it might have been advisable to give greater attention to the procedure to be followed when carrying out eliminative stage-by-stage and point-to-point tests, showing the deductions that may logically be made at each step. However, the book is so practical, so replete with facts, and so well arranged, that, having digested its contents, the reader will gain sufficient knowledge to enable him to set to work in a logical manner.—H. F. S.

A TEXT BOOK OF WIRELESS TELEGRAPHY AND TELEPHONY (Second Edition). By W. Greenwood, B.Sc.(Eng.), A.M.I.E.E., A.C.G.I. Pp. 307, with 210 diagrams and illustrations. London. The University Tutorial Press, Ltd. Price 5s. 6d.

THE book is intended (according to the Preface to the First Edition) for the reader who has general physical or electrical knowledge but is not a wireless engineer. A knowledge of the principles of electricity is thus assumed, with only an intermediate standard of mathematics. Written with this orientation, the book succeeds very well in presenting the general principles of wireless, covering the whole field in a clear, expository manner. Mathematics are kept to a minimum in the text, but a final chapter on "A Few Mathematical Investigations" gives a more extended treatment (for those who wish it) of such problems as general a.c. circuit theory, the theory of the condenser discharge, coupled circuits, electromagnetic waves, and modulation. A chapter on measurements is also of considerable value to readers interested in more than general descriptive matter.

The volume under review is a Second Edition. The first was written when broadcasting and short-wave communication were in their very early infancy. Unfortunately, it shows traces of this chronology, and in the work of bringing it up to date, the author has been neither sufficiently ruthless in expunging obsolete material nor so complete as one might have desired in the exposition of most recent practice. Thus, the chapter on valves contains too much of the First Edition and too little of modern valves, such as the screened-grid, pentode, or indirectly heated-cathode types. In the same way, the chapter on wireless telephony contains too much of methods which must have been only of historical interest even at the time of the First Edition, and does not sufficiently explain the modern transmitter.—J. F. H.

APPLICATION OF THE CATHODE RAY OSCILLOGRAPH IN RADIO RESEARCH. R. A. Watson Watt, J. F. Herd, and L. H. Bainbridge Bell. 290 pp., 17 plates and 113 diagrams. H.M. Stationery Office. 10s.

MOST of the literature relating to the cathode ray oscillograph is distributed among the technical journals and transactions of societies, and for the most part is concerned with the results of investigations rather than the technique of manipulation of this most useful research tool.

The present volume deals primarily with the work of the Radio Research Station,

A PORTABLE "PORTABLE." The new Pye Q/MC battery portable lives up to its name.

Slough, on direction finding and wave propagation, and gives a very full account of circuit arrangements and the practical difficulties and problems involved. Most of this information will be found to be of equal importance to workers in other fields of radio research and the chapters on time bases and photographic recording may be cited as examples. There is a useful list of references to important papers on cathode ray and allied subjects in the appendix. The absence of an index is partly compensated for by a more than usually detailed table of contents.—F. L. D.

Correspondence

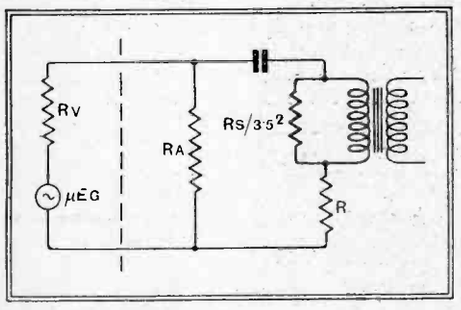
The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

Increasing Bass Response

WHILE I appreciate the utility of the practical results described in the article on "Increasing Bass Response," I wish to disagree with the theoretical analysis given.

It was suggested that the A.C. voltage across the anode resistance would be constant at all frequencies; actually, the constant voltage should be introduced in series with the valve resistance Rv. Then again it is stated that the resistance load across the transformer secondary is equivalent to a *series* resistance in the primary circuit, whereas, of course, it should be represented by a resistance $Rs/3.5^2$ in parallel with the transformer primary. The completed equivalent circuit, with the transformer secondary load transferred to the primary side, is therefore as shown in the accompanying diagram. At resonance, the impedance



of the load in the valve anode circuit, which is the portion of the equivalent circuit to the right of the dotted line, falls to a very low value; consequently the majority of the available E.M.F. is lost in the valve resistance Rv, and the output at resonance is much less than would be the case if the E.M.F. across Ra remained constant. This explains the observed results without making the load on the secondary of the transformer a predominating factor.

A minor criticism of the original article is that the resonance curve (fig. 5) is plotted to a linear scale, so that the apparently large peak represents a gain of only 2.4 decibels, while the response curve to be corrected (fig. 1, curve B) shows a loss of 25 db. at 60 kc/s.

D. A. BELL.

Location of the Speaker

WITH reference to your editorial in the issue of the 19th regarding the location of the speaker in modern receivers, I do hope that you will be able to influence the manufacturers to design the coming season's receivers so that the speaker can be used apart from the set itself, especially in the case of the more powerful mains receivers.

Though I have been in business here but a short time, I could have sold many more of the better class of instrument if the speaker were separate from the receiver proper. The fact that an extra speaker can be used as an alternative does not appeal, as the one in the set is then idle and wasted. I see no reason why cabinets cannot be built so that the two portions can be used one above the other or apart, and the speaker attached by either a short or long lead as the case may be.

Another failing with many sets, too, is the tuning scale. Why not *always* an open scale calibrated in wavelengths, and where names of stations are used an assurance to the purchaser that the scale will be replaced by a new one in the event of a wavelength shuffle? How many receivers now offered have the Western Regional and National marked?

In conclusion, please accept my thanks for *The Wireless World* and *all* it contains, especially the very fair and useful reviews of commercial receivers. These are most useful, and when produced in front of a "prospect" often convince that something good is being offered.

W. A. F. EDWARDS.

Glastonbury, Somerset.

Automatic Volume Control

WITH reference to the criticisms made by Mr. Chambers of my recent letter, I would offer the following observations:—

He states that the loss of sensitivity is nil, as A.V.C. is only operative with a loud signal. This is in agreement with my comment, but at the time my letter was written —several weeks before it received publication—the merit of A.V.C. was stated to be that of a remedy for fading His paragraph explaining that A.V.C. does not operate on the modulation is, of course, correct, and no one would suggest it to be otherwise. In fact, I used this point in my original letter and made it quite clear that A.V.C. is actuated by the amplitude of the carrier and the amount of control is not governed by the modulation, the extent of which is responsible for the output signal.

Your other correspondent—Mr. Hodgson —appreciated this but disagrees with my remark that the resultant carrier of a weak station is partially demodulated by the time it reaches the second detector. The standard overall test for the superheterodynes for which I am responsible is that of applying a measured modulated signal input and noting the watts developed at the output. This test readily reveals (a) that very little signal voltage is developed at the second detector until a certain initial value of signal voltage is applied at the aerial terminal and, (b) that following a linear diode second detector the voltage developed across the output load does not start to rise in like ratio to the potential at the second detector until an appreciably further advance of aerial input has been made. These effects are, no doubt, due to the properties of the anode bend first detector and the subsequent H.F. amplifier but nevertheless support my original observation—with which Mr. Hodgson disagrees—that the extent of modulation for a weak signal is less than for a strong one assuming that they are each equally modulated initially. A.V.C. is controlled by the carrier amplitude at the second detector, an observation with which a designer with the merest equipment would obviously not disagree.

By "some measure of A.V.C." I implied that which I have always used in my own designs—the self-biasing anode bend second detector—where the sensitivity falls with increase of carrier amplitude. This form of detection, by the way, has the advantage of being capable of handling widely different values of signal potential without overloading and is as distortionless as any system, in that the narrow modulated fringe falls on the straight part of the grid characteristic.

I agree with what is said with regard to Q.A.V.C. and might add that this has been embodied in my own designs for some months past. All the favoured systems of A.V.C. were summarised in my original letter in a form which revealed more than a theoretical acquaintance, and these have been available in practical working form to builders of superheterodynes bearing my name subject to using two triodes in place of the combined diode-triode only just issued.

Everyone realises the aims and effects of A.V.C., and the purpose of my letter was to contradict the general belief, then being voiced, that A.V.C. was the cure-all for the fading of the distant station. Although your correspondence columns contain the only two criticising letters which have come to my notice, on this point of fading and fading distortion they do not disagree but rather raise technical issues, the fundamentals of which are known and appreciated. The listener whose set is not A.V.C. equipped need have no regrets.

F. H. HAYNES.

London, E.C.1.

FOREIGN BROADCAST GUIDE

ATHLONE

(Irish Free State).

Geographical position: 53° 24′ N.; 7° 58′ W.

Approximate air line from London: 360 miles.

Wavelength: 413 m. Frequency: 725 kc/s. Power: 60 kW.

Standard time: Greenwich Mean Time (I.F.S. adopts B.S.T.).

Standard Daily Transmissions.

13.30 B.S.T., time signal, weather, news, etc.; 18.00, light music (records); children's hour, news, time signal, talks; 20.00, main evening progamme; 22.00, station orchestra or play; time signal, weather, news. On Sundays, special sporting broadcasts towards 15.00; and main programme at 20.30. Special sponsored broadcasts, 21.45–22.45 (almost daily).

Announcers: Man and woman.

Call: In Gaelic and English: *Se Seo radio Ath Luain agus radio Corcaighe* (These are the Athlone and Cork radio stations). When Dublin is mentioned it bears its Gaelic name: *Baile Ath Cliath.*

Usually closes down with the playing of the Irish Free State National Anthem and good-night greetings in both Gaelic and English.

Relay: Cork, 224.4 m. (1,337 kc/s), 1 kW.

Broadcast Brevities

By Our Special Correspondent

Site Chosen in Northern Ireland

FOR better or for worse, the site has been chosen for the B.B.C.'s high-power station for Northern Ireland. I understand that the title deeds are now changing hands.

The transaction is wrapped in that dark shroud of mystery in which the B.B.C. always conceals new projects, but I can say that the new station will not be situated on any of the sites so far observed by the newspaper sleuths.

Several Miles from Belfast

Actually, the station will be built several miles away from the city in a district notable for its fecundity in the matter of one of old Ireland's most famous vegetables. I must not say which. It is rumoured that the farmers around will roll their eyes in dismay when they see the uprooting of good vegetables simply for the sake of a broadcasting station.

Droitwich Details

THE new National station at Droitwich promises to be quite the most interesting of the B.B.C. establishments. The two 700ft. masts will be equipped with lifts. In bold outline the transmitter buildings will follow the usual B.B.C. scheme, but the layout will differ in certain respects. For instance, heavy machinery is to be installed in a well sunk below ground level with the transmitter units occupying cubicles in a surrounding gallery.

The Midland Regional aerials will be slung, umbrella fashion, beneath those of the long-wave transmitter.

A Daventry Junk Sale?

The more economically minded are already discussing what is to happen to the old gear at Daventry. What an occasion it would be if Mr. Ashbridge could stage a grand junk sale on that windy hill! It would start a great pilgrimage of amateurs from all parts of the country, not excluding Aberdeen, and a still more impressive pilgrimage on the return journeys, for, despite rumours, there is quite a lot of usable material at 5XX.

A Holy Secret

However, no such auction is likely to be held. Some of the gear will actually be used at Droitwich and some of it will go into stock.

Where the B.B.C. keeps its stock is one of those profound secrets to which some of the engineers themselves cannot supply an answer. Suffice it to say that the stock does exist, and that as the years pass by its antiquarian value goes steadily up.

Complete Opera on Records

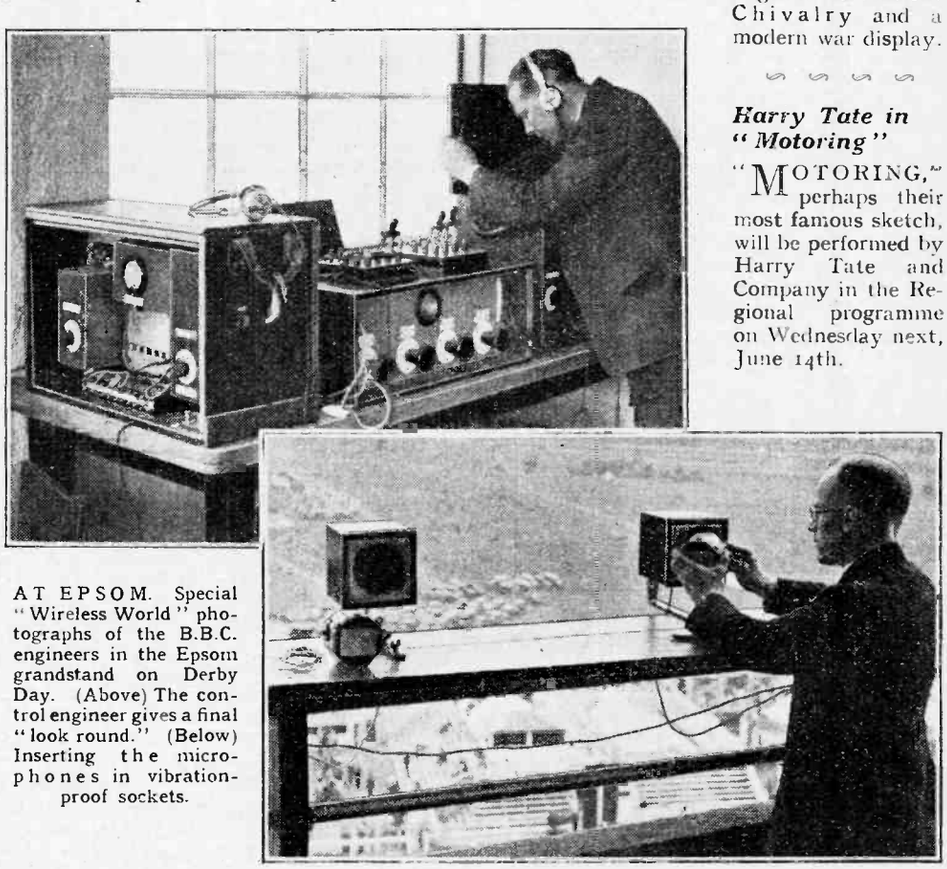
THE only opera that the B.B.C. has yet broadcast complete in the form of gramophone records is "Pagliacci," by Leoncavallo, which was heard through the pick-up some years ago. This afternoon (Friday) listeners to the National programme will again hear the complete opera on gramophone records. The performers are the principals and chorus of La Scala, Milan, the conductor being Maestro Sabajno.

The New Controller

THE great reorganisation of the B.B.C. staff and the separation of the Administrative from the "Output" side reaches its climax with the appointment of Colonel Alan G. C. Dawnay, C.B.E., D.S.O., M.A., to the new collateral post of Controller, Output Division. Col. Dawnay will wield the same power in the artistic and programme branch that Sir Charles Carpendale exerts on the administration side.

A Happier Winter?

The new Controller assumes office on September 1st, so it rather looks as if the Corporation intends to make things hum during the winter. Listeners, however, will be the final arbiters, for no amount of organisation can atone for lack of vitality and originality at the microphone. Let us hope that this new era in B.B.C. management will mean a still more accurate appraisement of what the ordinary listener wants and a determination to see that he gets it.



AT EPSOM. Special "Wireless World" photographs of the B.B.C. engineers in the Epsom grandstand on Derby Day. (Above) The control engineer gives a final "look round." (Below) Inserting the microphones in vibration-proof sockets.

Carillon Broadcast

BELL music always comes over the ether very realistically, and to those who like carillon chimes the broadcast from Midland Regional on June 9th should be specially interesting. On this occasion the carillon will be broadcast from the new Church of Our Lady of the Rosary at Saltley, Birmingham

The largest bell weighs 25 cwt. and is a product of the Croydon firm which founded the two largest peals in the world at Chicago and New York. Herbert Withers is the carilloneur.

Aural Mobility

WHAT listeners to the broadcast of the Aldershot Tattoo lose on the spectacular side should be partially compensated for by their aural mobility, for, after hearing the massed bugles at the opening of the Tattoo to-morrow (Saturday), we shall be switched over from the Rushmoor Arena to the Tower of London for the Ceremony of the Keys. Then, before returning to Aldershot, we shall hear Mr. Stuart Robertson and the Wireless Male Voice Chorus in marching songs, followed by an eye-witness account of "The Battle of Omdurman," written by the late Major A. J. Hill-Smith during the Egyptian Campaign. We shall then be transported once more to Rushmoor to hear the dismounted bands of the Aldershot Command.

And So To Bed

Ambrose and his orchestra will take up the strain for part of their usual Saturday evening relay from the May Fair Hotel, but thirty-five minutes later listeners will again be back at Aldershot for the closing episodes, which will include a Pageant of Ancient Chivalry and a modern war display.

Harry Tate in "Motoring"

"MOTORING," perhaps their most famous sketch, will be performed by Harry Tate and Company in the Regional programme on Wednesday next, June 14th.

The Tourist Trophy

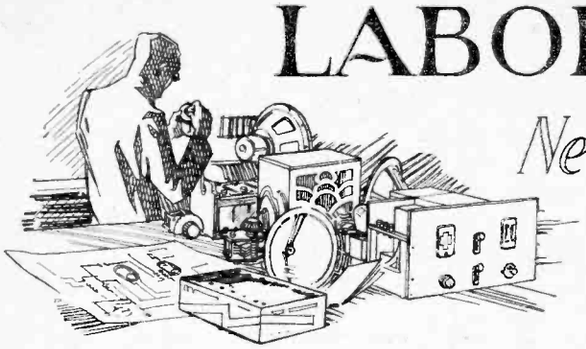
IMMEDIATELY following the motor cycle race in the Isle of Man for the International Auto-cycle Junior Tourist Trophy on Monday afternoon next, June 12th, an eye-witness account will be relayed for North Regional listeners.

New Scottish Regional Director?

WHO will be Director of the B.B.C. in Scotland? Several candidates are in the running, but I plump for Mr. Joseph Duncan, general secretary of the National Farm Servants' Union of Scotland. Mr. Duncan has paid several visits to Broadcasting House in the last few days, and, unless the indications are very deceptive, Scotland may consider the position is filled.

LABORATORY TESTS

New Radio Products Reviewed



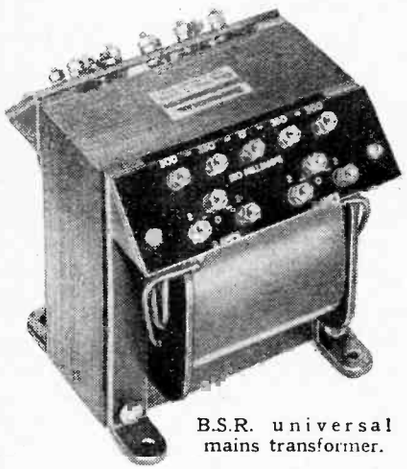
B.S.R. UNIVERSAL MAINS TRANSFORMER

A MAINS transformer which is very appropriately described as a universal model has been introduced by the Birmingham Sound Reproducers, Old Hill, Staffs. It is built on very generous lines and provides four separate L.T. windings, two of these are rated at two amps each, one at three amps and one at five amps. The high voltage secondary winding gives 500-0-500 volts maximum, but tappings are provided for an output of 350-0-350 volts so that either the "B" or the "C" class rectifying valves may be used. This winding will deliver up to 120 mA. without an appreciable voltage drop.

Tests were made with a "C" class valve, the filament current for which was taken from the 4-volt 3-amp. winding. With the remaining L.T. windings fully loaded measurements were then made of the smoothed D.C. output at various current loads. The smoothing equipment consisted of a choke of 100 ohms resistance and two 4-mfd. condensers.

Current in mA.	Volts.
20	654
40	625
60	596
80	565
100	536
120	507

The 500-0-500 secondary winding is exceedingly well regulated as the voltage changed by the small amount of 3.2 per cent. only throughout the tests. Regulation of the L.T. windings is equally satisfactory.



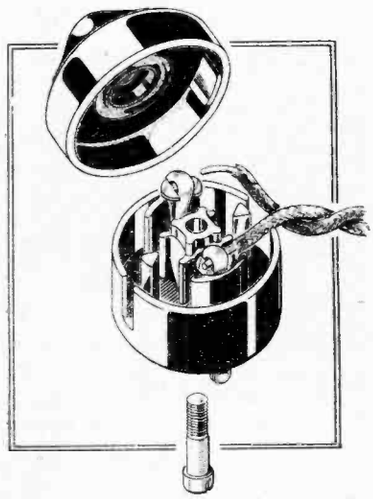
B.S.R. universal mains transformer.

The rectifier was operated at 3.9 volts while the two 4-volt 2-amp. windings each gave 3.84 volts and the 5-amp. winding 3.89 volts. On half-load the voltages do not rise beyond the usual tolerance permitted for A.C. valves. The primary is tapped to suit supply mains of from 200 to 250 volts, and the price is 55s.

In common with all B.S.R. products the workmanship and general finish are of a very high standard, and this model should prove exceedingly useful in the hands of the experimenter requiring a high-class transformer having universal application.

CLIX WALL PLUG

ELECTRO LINX, LTD., 79A, Rochester Row, Westminster, London, S.W.1, have extended their range of Clix specialities and now include a series of wall plugs made in vertical, side entry and earthing pin models, and in all B.E.S.A. ampere ratings. In design these plugs constitute a radical departure from the usual practice, and much



Clix wall plug fitted with self-centring pins.

of their experience gained in the manufacture of small wireless connections is applied to the new plugs.

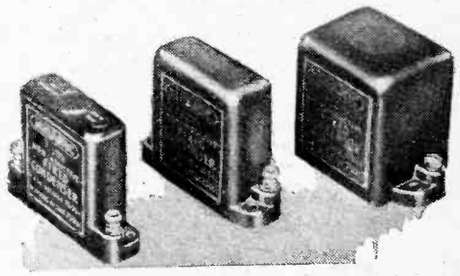
Comparatively large tolerances are permitted in the internal diameter of the standard socket, but so far as the Clix wall plug is concerned, quite big variations will not result in a bad contact, for they are fitted with spring prongs fashioned in the form of a cotter pin similar in design to those employed in their "Master" wander plugs. Moreover, the pins are not rigidly positioned, but are permitted a small lateral movement, and thus have the advantage of being self-centring.

The 5-amp. model examined made a perfectly good contact when inserted in sockets varying in diameter by as much as three to four times the permitted tolerance; furthermore, they are very robust, and seem well capable of standing up to hard wear. A simple but quite effective wire grip is employed in place of screw connections for the leads. The bared end of the flex is threaded through the eye of the cotter-pin-type prong and is gripped firmly by the cover plate when fixed in position by its screw.

The price of the 5-amp. model is 9d.

IGRANIC CONDENSERS

THE Igranic range of large capacity fixed condensers are made in one-, two- and four-mfd. sizes, the normal working voltage being 250 D.C. They are of the non-inductive type and are suitable for use, there-



Igranic non-inductive condensers.

fore, in anode and grid circuits for by-passing H.F. currents as well as in smoothing circuits. A specimen of each size was tested and in every case they successfully withstood D.C. potentials of 800 volts, this being 50 volts in excess of their test rating.

These condensers are mounted in attractive bakelite cases and the prices are, 2s. 3d. for 1 mfd., 2s. 9d. for 2 mfds. and 5s. for 4 mfds. The makers are Igranic Electric Co., Ltd., 147, Queen Victoria Street, London, E.C.4.

ORMOND TRANSFORMERS

IN order to meet the special requirements of Q.P.P. amplification, The Ormond Engineering Co., Ltd., Rosebery Avenue, London, E.C.1, have added to their range of L.F. transformers a miniature push-pull input model having a ratio of 1 to 8. Listed as type R531CT, it is similar in size and construction to their general purpose transformer, model R531. Both embody a high permeability nickel-iron core and utilise the same style of moulded case, the overall size of which is 3in. x 1-11/16in. x 2¼in.

Although these transformers perform best when used with a parallel-feed circuit, for a more uniform response is obtained, small amounts of D.C. can be passed through the primary, but this should not exceed 2 mA.

Ormond Q.P.P. push-pull inter-valve transformer; step-up ratio 1 : 8.

The measured primary inductance of the Q.P.P. model is 26.5 henrys with no D.C. flowing and with 3.5 volts A.C. applied to the winding. With 2 mA. of D.C. superimposed the inductance falls to 14.5 henrys. Measurements made under similar conditions with the general purpose model, which has a step-up ratio of 1 to 3.5, gave the inductance as 38 henrys without D.C. and 19.6 henrys with 2 mA. The price is 7s. 6d. in each case.

The Wireless World

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CONTENTS

EDITORIAL COMMENT

Television

A Phantom Audience?

IN a Leader in this month's issue our contemporary, *Television*, takes to task a contributor to the *Evening Standard* whom he accuses of a change of front in his attitude towards television. The accusation is based upon the publication recently by that contributor of a statement that "fewer than 5,000 people have televisors in this country and some experts would estimate the number at half that figure," whilst it was alleged that the same author last summer estimated that between 5,000 and 10,000 televisors were already in use.

Television is justified in calling attention to apparently contradictory estimates of this kind, and it is part of the obligations of an editor to enlighten public opinion on matters coming within the sphere of his journal's activities. Unfortunately, *Television* has still left the question in the air and has not proceeded, as we hoped it would, to attempt to give us the correct figure.

It is, in our view, of paramount importance that anyone likely to be concerned in furthering the interests of television should have available some indication of the response the public is giving to the B.B.C. transmissions. No better indication could be found than an accurate statement of the approximate number of television receivers or parts which have been sold up to date. We would strongly urge that it is in the best interests of all parties, however meagre the figures may prove to be, that they should be made known. In the early days of broadcasting the Post Office receiving licences were an excellent index of public interest, but since television reception is covered by the broadcast licence, the licence figures provide no information on the popularity of television.

The B.B.C., as is well known, has spent a great deal of time and money in arranging for satisfactory transmissions in conjunction with the Baird Company, and from our own experience of reception under more or less ideal conditions we are satisfied that the transmissions are far ahead of the facilities for reception. A talk with officials of the B.B.C. elicited the information that they, too, appear to be in the dark as to how many television enthusiasts constitute their audience. For all we know B.B.C. television programmes may be radiated for the benefit of a phantom audience.

A Voice from the Air

New Ultra Short-Wave Test

THERE is a natural tendency among amateurs to-day to imagine that all the "plums" in wireless research must inevitably go to the highly specialised professional. Up to a point this attitude is justified, but opportunities do occasionally occur when the free-lance experimenter and the specialist can compete on equal terms. Such an opportunity, we believe, arrives on Sunday, June 25th, when two well-known contributors to this journal, Messrs. S. G. Morgan and H. L. O'Heffernan, are inviting the co-operation of listeners up and down the country in the reception of ultra short-wave transmissions from an airplane.

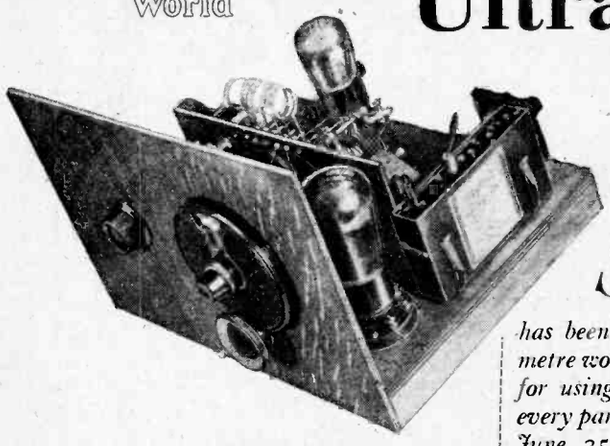
So far as we are aware, transmission on "optical" wavelengths has not yet been attempted from the air, and some highly important observations may be expected if listeners will help in the experiment, full particulars of which, together with a design for a 5-7-metre receiver, appear elsewhere in this issue.

Wireless World

Ultra Short Wave Two

Simple Two-valve Super-regenerative Receiver for 5-7 metre Working

By H. B. DENT



SIMPLICITY and ease of control form the basis of this receiver design, which has been specially evolved for 5 to 7 metre working. A practical opportunity for using this set will occur in nearly every part of Great Britain on Sunday, June 25th, when the first amateur transmissions on ultra short waves from an aeroplane will take place.

ELSEWHERE in this issue particulars are given of a special short-wave test arranged by two amateur experimenters and to take place on a wavelength of five metres. Although not an entirely unexplored field, very little is known outside certain official quarters as to the practical usefulness of these wavelengths, so that this venture might bring to light some hitherto unpublished facts regarding transmission and reception on the very short wavelengths. It is known that their range is somewhat restricted, being accepted generally as an optical one, which, if this contention be true, means that the horizon is their limit, for it is assumed that they do not follow the curvature of the earth.

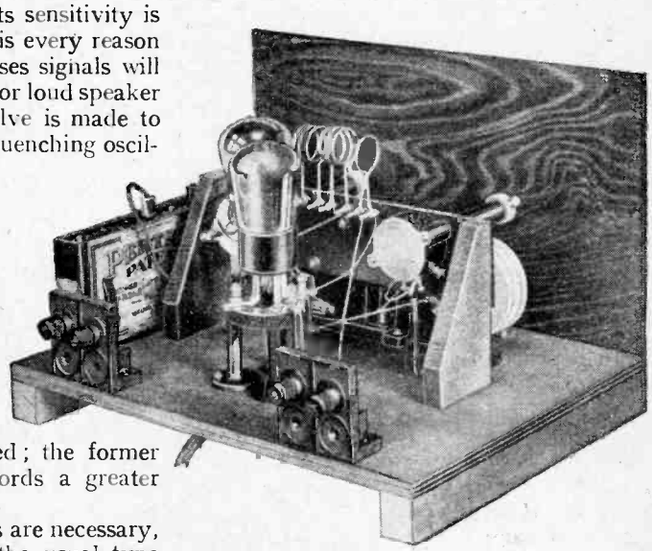
Your Urgent Attention, Please!

Since the success of these tests relies largely on the number of reports received from widely spaced observation posts, as many collaborators as possible are invited to participate, and, in order to further this end, a receiver designed especially for use on the 5- to 7-metre waveband is illustrated and described here.

The set is a simple two-valve super-regenerative receiver intended for head-phone reception; but, as its sensitivity is of a very high order, there is every reason to believe that in many cases signals will attain an intensity suitable for loud speaker reproduction. A single valve is made to serve the dual function of quenching oscillator and detector, its sensitivity being controlled by a 50,000-ohm resistance (R2, Fig. 1) in the H.T. supply lead to this valve. A single, low-frequency amplifier is employed and coupled to the detector by a step-up transformer. In the last stage either a pentode or a triode valve may be used; the former is recommended, as it affords a greater amplification.

A few special components are necessary, but the remainder are of the usual type employed for broadcast use, and many of these can be found in the workshop, for those that have been replaced by more up-to-date designs would be quite suitable for our purpose, since we are not specially concerned with a particularly high quality of reproduction.

The special components comprise one small variable condenser (C2) having a very low minimum capacity and a maximum value of not more than 35 mmfds. This is used to tune a circuit consisting of two small coils L1 and L2 joined in series with a semi-variable condenser C1. This has a maximum value of 50 mmfds. (0.00005 mfd.), and is of the type usually employed for trimming purposes.



Unnecessarily long leads are avoided in the detector circuit by raising the valve above the baseboard. Note the mounting of the sub-panel.

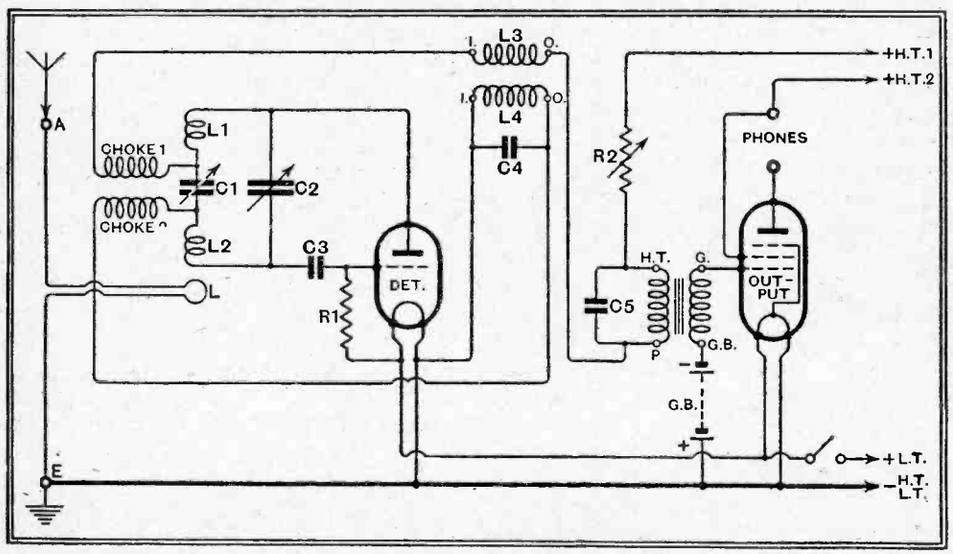


Fig. 1. The theoretical circuit diagram; values of components are: C1 = 50 mmfds. max., C2, 35 mmfds. max., C3 = 0.0001 mfd., C4, 0.01 mfd., C5, 0.001 mfd., R1 = 2 megohms, R2 = 50,000 ohms variable.

The two H.F. chokes, Choke 1 and Choke 2, come within the category of special components, and could, if desired, be home-made. Those fitted in the receiver are the Eddystone 5-10-metre type. A home-made choke consisting of fifty turns of fine-gauge wire spaced to occupy one inch and wound on a ½in. former would answer the purpose.

The quenching coils, L3 and L4, are wound on a two-section bobbin built up from thin plywood to the dimensions given in Fig. 3. Each slot contains 500 turns of No. 34 enamel wire, and both coils are wound in the same direction. Their respective inner and outer ends are connected as marked on the theoretical circuit diagram (Fig. 1).

For the small tuning coils, L1 and L2, three turns only of No. 16 S.W.G. tinned copper wire are required in each case. They are wound on a ¾in. former, and the turns spaced to occupy ½in. in length. Both coils are wound in the same direc-

"Wireless World" Ultra Short Wave Two—tion, and when assembled this sense must be maintained. That is to say, ignoring the presence of C1, coils L1 and L2 may be regarded as one continuous winding. The aerial coupling coil, L1, is a single turn having the same diameter as the others, and all three coils are spaced ⅜in. apart. A normal aerial can be used.

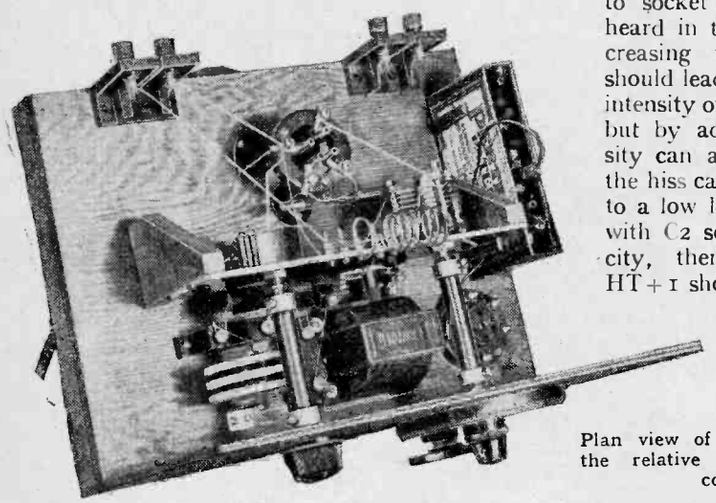
Several of the special components, such as the quenching coils, small tuning coils, H.F. chokes, and the small sub-panel, ready drilled, can be obtained from the Scientific Supply Stores (Wireless), Ltd., 126, Newington Causeway, Southwark, London, S.E.1.

Choice of Valves

The tuning coils, variable condenser C2, semi-variable condenser C1, and the variable resistance R2, are assembled on a small Paxolin sub-panel, 8½in. long and 2in. wide, screwed to two wooden supports 3¾in. high. This is mounted 3½in. back from the front panel so as to avoid hand capacity effects, and the two controls, namely, C2 and R2, are each fitted with 3in. ebonite extension rods.

Little need be said regarding the assembly and the wiring, for the various illustrations and the drawings are self-explanatory. The bulk of the wiring is carried above the baseboard; in the under-deck space is the filament wiring, output leads, and the on-off switch. Incidentally, the baseboard is mounted on one-inch battens.

The set is designed for two-volt valves, and for the detector any valve normally serving this function is suitable. Of the many different types tested mention can be made here of a few only: the Mullard PM2DX, Marconi HL2, Osram HL2, Mazda HL210, Cossor 210 Det., Eta BY1815, and the Hivac H210, were all found quite satisfactory. The detector (HT+1) requires between 40 and 60 volts, the best operating conditions varying slightly with different valves, while the output stage (HT+2) can be operated at any voltage up to its maximum. The grid bias must be adjusted accordingly. Either a small power triode or a pentode will serve the purpose. Of the latter type such valves as the Mazda Pen 220, Marconi P.T.2, Osram P.T.2, Mullard PM22A, or the Cossor 220HPT are recommended as being suitable types.



Plan view of the receiver showing the relative position of all the components.

Before connecting the batteries adjust C1 to within a fraction of a turn of maximum capacity; set R2 at minimum resistance, and adjust C2 to read about 75 on the 0-100 division dial. Now connect the batteries, switch on the L.T., and move the HT+1 wander plug from socket to socket until a faint hiss is heard in the headphones. Decreasing the capacity of C2 should lead to an increase in the intensity of the background hiss, but by adjusting R2 its intensity can again be reduced. If the hiss cannot be brought down to a low level by the resistance with C2 set to minimum capacity, then the wander plug HT+1 should be moved one or two sockets nearer the negative end of the battery.

The hiss is characteristic of super-regenerative circuits, and signifies that the set is working correctly. The hiss practically disappears when the receiver is tuned to a carrier wave, and when signals are heard R2 can be adjusted to give the loudest signals with the minimum of background. The condenser C1, being in series with the two coils L1 and L2, has a marked effect upon the

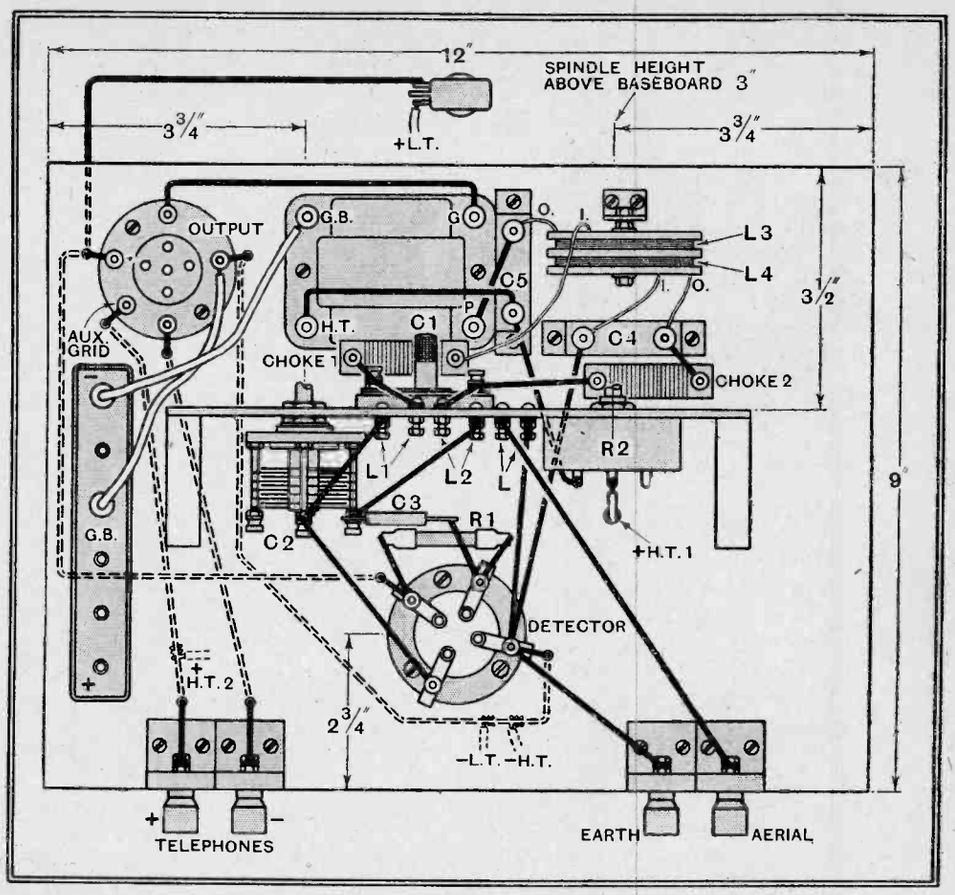


Fig. 2. Layout of the components and the practical wiring plan. The leads shown dotted are carried below the baseboard.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

1 4-pin short wave valveholder (Eddystone No. 501)
1 Microdenser 35 mmfds. (Eddystone No. 900)
2 Ultra short wave H.F. chokes 5-10 metres (Eddystone No. 928)
Scientific Supply Stores.
2 Extension rods, 3in. (Eddystone No. 925)
Bulgin, Red Diamond.
1 5-pin A.C. valveholder (W.B.)
Benjamin, Junit, Eddystone, Wearite, Trix, Lissen, Telsen, Graham Farish.
1 50,000 ohm. potentiometer (Bulgin V.C.36)
Wearite, Wurmel, British Radiophone, Igranic, Lewcos, Colvern.
3 Valveholder supports (Bulgin T.S.1.)
1 pair grid battery clips (Bulgin No. 3)
1 Knob ¼in. hole (Bulgin K.18)
1 Baseboard mounting trimming condenser 0.00005 mfd. (J.B. No. 1037)
1 L.F. transformer ratio 1 : 3 (Ferranti AF10)
Igranic, Telsen, R.I., Varley, Lissen, Lewcos.
1 Fixed condenser, 0.01 mfd. (Dubilier No. 620)
1 Fixed condenser, 0.001 mfd. (Dubilier No. 620)
1 Fixed condenser, 0.0001 mfd. (Dubilier No. 665)
T.C.C., Igranic, Graham Farish.
1 Grid leak with caps and wire ends, 2 meg. (Loewe FZ128/30)
1 Indigraph slow motion dial with large knob (Igranic No. 2296/62)
1 5-way battery cable, 30in. with plugs (Belling-Lee)
Bulgin, Goltone, Lewcos, Harbros.
4 Terminal mounts (Goltone R38/99)
Junit, Belling-Lee, Lissen.
4 Terminals, L.S.+, L.S.-, A, E. (Belling-Lee Type "R.")
Clix, Igranic, Eelex, Burton, Goltone.
1 9-volt grid battery
1 On-off switch (British Radiophone No. 407)
Bulgin, Igranic, Claude Lyons.
2 Wander plugs, G.B.+, G.B.-. (Clix Type "B")
Belling-Lee, Eelex.
1 Bobbin with 2 quenching coils (See text).
3 Tuning coils (See text).
1 Wooden panel, 12in. x 8in. x ⅜in.
1 Baseboard, 12in. x 9in. x ¾in., mounted on 1in. battens.
1oz. No. 20. tinned copper wire.
Screws required: 5, ¼in. No. 4 csk/hd; 8, ¼in. No. 4 r/hd; 5, ⅜in. No. 4 r/hd; 8, ⅜in. No. 4 csk/hd; 4, ¾in. No. 4 csk/hd; 6, 6B.A. ¾in. r/hd; 2, 6B.A. ¼in. csk/hd; 6B.A. nuts.

"Wireless World" Ultra Short Wave Two—tuning range as well as upon regeneration, and very small variations in its capacity might be tried from time to time. The setting given above for this condenser will bring the 5-metre tuning point between 20 and 30 on a 100-division dial. It varies considerably with the valve used.

Although no regular transmission takes place on this waveband it is not devoid of interest, for several experimental stations use it, and this receiver gives the enthusiast an opportunity to explore an entirely new field which may soon become quite a profitable one for the listener.

The Receiver described is on view at 116, Fleet Street, for the benefit of those who may wish to call and inspect it.

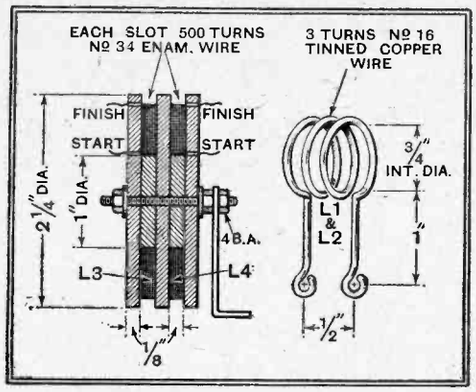


Fig. 3.—Dimensional drawing of former for coils L3 and L4, also details of small tuning coils L1 and L2.

Ultra Short Waves from a 'Plane

Amateur Effort in Which All Listeners Can Share

TEN years or more ago the amateurs were startling Government and commercial wireless concerns with their achievements on the "useless" short-wave band. And now the possibility of fresh pioneer work for amateurs is opened up by important tests about to take place on the ultra short waves.

LISTENERS all over Great Britain are invited to take part in the reception of 5-metre speech signals from an airplane on Sunday, June 25th, when a machine equipped with an ultra-short-wave transmitter and receiver will cover a triangular route between London and Liverpool.

It is hoped that amateur reception reports will reveal new possibilities on the very high frequency band.

For the first time in wireless history, listeners all over Great Britain are to be given an opportunity to participate in an airplane test which, it is hoped, will unravel many problems concerning the very high frequencies and their behaviour over varying tracts of country.

On Sunday, June 25th, Mr. S. G. Morgan (G6SM) will leave Heston Aerodrome or Hanworth Park at 10 a.m. on a 'plane flight to Liverpool, returning via Hull or Leeds to London in the afternoon. During the flight it is hoped to maintain two-way telephonic communication on the wavelength of 5 metres with Mr. H. L. O'Heffernan, operating station G5BY.

Certain amateurs have already notified their willingness to undertake reception, but it cannot be too strongly emphasised that if amateurs are once more to "pull off" a success they must help in large numbers, supplying reports from all parts of the country. It is one of the essential aims of the test to discover how far the waves can be picked up and whether, indeed, they are limited by the so-called "optical range."

It is believed that the 'plane, flying at a height of 10,000 feet, will have an extremely wide optical range, but it is quite possible that owing to phenomena at present only half understood the signals may get past the horizon, follow the curvature of the earth, and so enable amateurs beyond to score record reception. It is possible, too, that atmospheric conditions may affect the strength and direction of the transmissions.

To encourage listeners all over Britain to participate, *The Wireless World* publishes in this issue the design for an extremely simple 5-7-metre receiver, which practical tests have shown to be eminently suitable for such a test as that outlined. It comprises a super-regenerative circuit which greatly facilitates tuning on the very high frequencies and overcomes to a large extent the disadvantages of hand capacity effects and sharpness of tuning. All the parts are readily obtainable, and the assemblage of the set should not take more than a few hours.

Further details of this pioneer air test will be given in next week's issue. Readers to whom it makes an appeal now have at least nine clear days in which to rig up the little set ready for G6SM's signals on Sunday week.

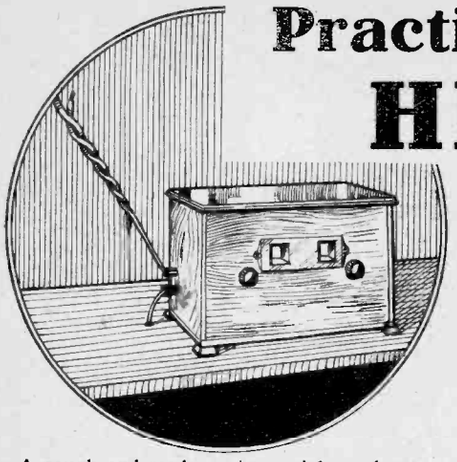
Readers who wish to try out their receivers before the test should note that 5-metre transmissions are sent out nightly at 11 p.m. (B.S.T.) from G5CB at Bedford Park (Chiswick) and G6JP at Hammersmith. These transmissions consist of duplex telephony between the two stations. Various aerials are used by G5CB, the most usual being a horizontal current-fed half-wave Hertz. Reports of these tests will be welcomed by Mr. D. Walters (G5CB), Fairfax Corner, Bedford Park, London, W.4.

In next week's issue of *The Wireless World*—two days before the airplane test—it will be possible to publish the complete schedule of transmissions from the air and the probable route to be taken, together with the approximate times of arrival at various points. In the unfortunate event of unsuitable weather the flight may have to be postponed until the first favourable Sunday, but listeners would be wise to have their receivers ready in time rather than rely too much upon the fickleness of the English climate.

It is hoped that readers will appreciate the fascinating possibilities of the test and send in their reports to *The Wireless World*, Dorset House, Stamford Street, London, S.E.1, or to Mr. S. G. Morgan (G6SM), 3, High Street, Croydon, Surrey. All reports will be welcome, whether they are received from within a few miles of the 'plane's route or 200 miles away.

"ULTRA-SHORTS" RECEPTION ON A CAR. Mr. L. H. Thomas (6QB) demonstrating one method of reception on the very high frequencies. An ordinary aerial will be suitable for use with *The Wireless World* "Ultra Short Wave Two."

When the speech is once tuned in it may be possible to hold it long after the airplane has left the locality, and thereby, perhaps, create a new record for ultra-short-wave reception!



A rough-and-ready series aerial condenser, made by cutting the lead-in wire and twisting together its ends.

Practical HINTS and TIPS

AIDS TO BETTER RECEPTION

IT is well known that the sensitivity of the average receiver tends to fall off as wavelength is increased; most receivers seem to work at their best at about 300 metres. As a result of fitting automatic volume control, there is generally an apparent levelling up of amplification, especially when the set has a fair reserve of sensitivity.

Levelling Up Sensitivity

This effect is, of course, a spurious one, as A.V.C. can do nothing to increase the sensitivity of the top end of the waveband, nor should it reduce sensitivity at lower wavelengths. The aural impression that it does so seems to be due mainly to the fact that the overloading, which is normally produced by so many stations working in the neighbourhood of 300 metres, is no longer taking place.

When it is suspected that the receiver is behaving abnormally it is always wise, before making a test, to disconnect the A.V.C. valve, or to render the control inoperative in some other way.

ALTHOUGH it has never been suggested as being a suitable appliance for precision work, various ways of making a buzzer "kick" a tuned circuit into self-oscillation have been described in these columns. The radiation from a circuit energised in this way is apt to be inconstant, and for this reason the device is not really suitable as an aid to making absolute, or even comparative, measurements. It would appear, however, that the oscillations generated in the circuit remain substantially constant so long as the average value of pulsating current flowing through the buzzer windings from the battery is also constant.

Constant Buzzer Output

Thus, by connecting an ammeter or milliammeter between the buzzer and its battery, and observing the amount of current flowing, one can decide whether any serious change has taken place. This is useful when making comparative tests with an appreciable interval of time between them; it is reassuring to know that the output from the source of testing signals has remained unchanged.

MUCH as we may dislike the idea, most of us are forced, at some time or another, to obtain selectivity, if only temporarily, by the expedient of inserting a small condenser in the aerial lead. Selectivity gained in this way is, of course, at the expense of range.

The Simplest Selectivity Device

Many readers are aware that a small condenser may be improvised from a length of twisted twin flex. Similarly, an aerial series condenser may be made in a moment by cutting the leading-in wire, if of the insulated type, and twisting together the two ends for a length of three or four inches, as shown in the accompanying illustration. The greater the area of overlap the higher is the capacity of the condenser formed by the two wires.

THE amount of smoothing provided by a loud speaker field winding is enough for all practical purposes in many sets, especially as the anode current supplied to the earlier valves in the receiver usually receives additional smoothing by the decoupling resistances and condensers which are usually fitted.

Extra Smoothing

For the benefit of those who are hypercritical with regard to background noises, and who therefore wish to fit extra smoothing, it may be pointed out that the additional choke and condenser which will be used for this purpose should always be inserted on the rectifier side of the existing smoothing equipment, as shown in Fig. 1. It is

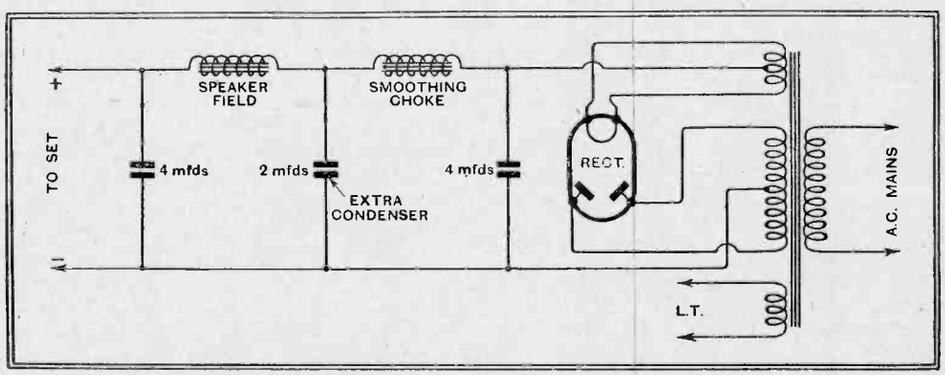


Fig. 1.—Correct positions for an extra smoothing choke and condenser.

especially important that this position should be chosen in cases where the loud speaker is not fitted with a hum-neutralising coil. Indeed, these remarks apply particularly to these cases, as otherwise more scientific methods of reducing hum may be used than that now being advocated, which must admittedly be classed among the "brute force" systems.

For the extra smoothing choke needed for the purpose in question, an inductance of some ten henrys is enough. D.C. resistance is of importance, and the addition of more than 200 ohms or so is always to be avoided. If care be taken the loss of voltage in the choke, under average conditions, need not exceed 10 or 20 volts.

IT is inevitable that the addition of a Class "B" output stage to an existing battery-operated receiver will add appreciably to the amount of current drawn from the L.T. accumulator; the extra load may amount to something between 50 and 100 per cent. It is accordingly desirable in many cases to take suitable steps against an undue reduction in L.T. voltage due to the extra demands made upon the battery.

Adding Class "B"

The accumulator leads should be no longer than is necessary; and if they are of very light flexible wire it might be as well to replace them by a heavier conductor. Battery terminals should be clean, and any corrosion should be removed from the "spade ends" through which connections are often made.

A loss of voltage sometimes takes place in the on-off switch, and if this component be of an out-of-date pattern, likely to introduce a resistance of even a small fraction of an ohm, it should be discarded in favour of a more modern type. Lastly, it may be worth while going to the trouble of replacing the existing filament wiring of the set with heavier wire.

While dealing with this subject, the reader may be reminded that the smallest and cheapest type of "mass" accumulator has a fairly high internal resistance, and is only intended for supplying a set of which the L.T. consumption is low. If the estimated total filament current is found to exceed the recommended discharge rate of the existing cell, it should be replaced by a larger one.

The Sound Film

2. Freedom for Camera and Microphone

By DALLAS BOWER

A camera crane in action. (*Photo: Universal Pictures, Ltd.*)

IT soon became obvious to the supervisors of sound departments that cameras would have to be capable of being used without booths in order to give them greater flexibility. The technical problem was to achieve a camera which would possess all the attributes of the normal instrument, but which, in action, would be perfectly silent. Adjustments of a minor nature were made to the gate mechanisms by one or two well-known manufacturers, but, as a cine-camera is an exceedingly delicate and complicated piece of machinery to design and build, rather than spend a great deal of money in research and time, the idea of sound proofing was still adhered to, in contradistinction to an entirely new type of instrument.

It would have been imprudent for camera manufacturers to have approached the problem other than in this way as professional ciné-cameras are very expensive. Already the big production organisations had plenty of first-class instruments in excellent condition, and, moreover, the initial sums expended as a result of the coming of sound itself, made it unlikely that producing companies would be inclined to scrap good cameras for an improvement which, although extremely advantageous, could hardly be described as vital from a commercial viewpoint. Very *profitable* films had been produced using cameras operating in booths. And that, very properly, to the financial departments of the studios, was the only issue involved. So if cameras were to be used as they had been in the days of mute-film production, an inexpensive form of sound proofing would have to be devised, or they must stay in booths.

Modern Camera "Blimps"

The first course that suggested itself was to wrap them in absorbent materials, such as heavy blankets or sponge-lined woollen bags, but these first attempts at "blimps" were not very successful. They were not sufficiently soundproof to shut out all the noise; they were dirty and not too convenient in operation. A booth in miniature was the real requirement. As a result, the modern camera blimp has been evolved. Its form is a carefully constructed box in which the ciné-camera, still a self-contained unit which can be taken out, can operate without being heard at all. The outer shell is usually of wood, and the inside construction, based on the well-known principle of mass-elasticity-mass, consists of alternate layers of sorbo-sponge and felt-lined wood. The essential controls, eyepiece, focus adjustment, etc., are brought through the blimp so that the cameraman is as much in control of his instrument as if it were non-soundproof.

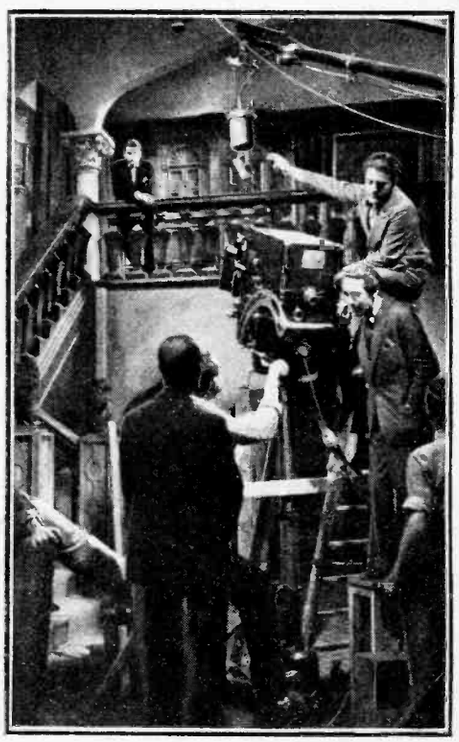
THE noise caused by the operation of the ciné-camera has presented a problem since the early days of talkie production. In this article the author describes two methods of overcoming the difficulty: first by the use of camera "blimps," and, secondly, by the taking of "wild" or non-synchronous sound records in crowd scenes.

The adjoining illustration shows a modern blimp in its closed position ready for shooting. It will be noticed that the mounting is such that alteration of angle can be made in a few seconds, and for change of set-up the whole device is wheeled to the required position by means of the tri-car arrangement supporting the vertical adjustment column. For loading with film and inspection of the interior of the camera proper the top of the blimp can be lifted up into such a position as to expose the bare camera entirely.

In the same illustration and that on the next page will be noticed the microphone supported at the end of a metal boom. It soon became apparent that microphones would have to be as free for moving about as cameras. The early method of using a multiplicity of microphones on shots where there were a number of characters moving about within the shot was unsatisfactory for a variety of reasons, the most important being the very careful manipulation required of the recordist in bringing one microphone into action while taking another out, the complete lack of guarantee that an actor or actress would move *exactly* to the required positions for both camera and microphone at one and the same time during the actual shot as he or she did during rehearsal, and variation of hiss level in the amplifiers of different microphones.

Silent Movement

The ideal arrangement is to use one microphone only whenever possible, in such a way that it may follow the players as they move about. Obviously, this most desirable end was quite impossible with heavy amplifiers and microphones suspended from the ceiling. Consequently, prior to any considerations of booms for manipulating microphones around the set, it was necessary to develop a more compact microphone and amplifier unit which could be handled with comparative ease on brail lines and tackle. In the Western

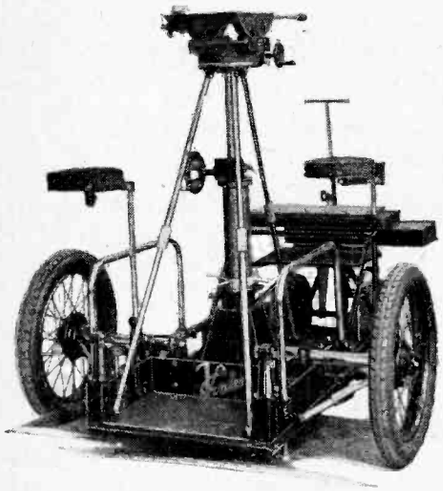


A typical set-up for a modern sound film. Note the microphone on its swinging boom.

The Sound Film—

Electric and R.C.A. systems, units were developed which were quite light enough to be suspended at the end of a counter-poised boom, and full use was made of this by booms being introduced to studios throughout the world within a short time of their conception, to be used exclusively from henceforth.

The essential requirements of a microphone boom are that it should be free to move in any direction, that it should operate noiselessly, and that its overall size and construction should not make it too heavy. The modern boom consists of



A tracking truck designed to transport the microphone boom noiselessly from point to point in the studio.

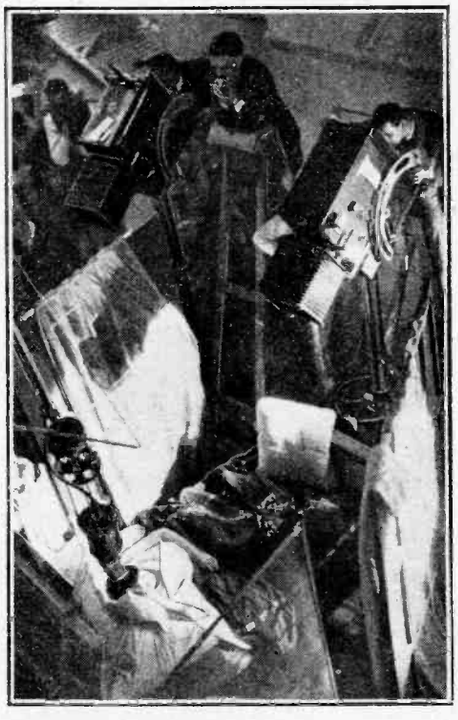
a tripod mounted on wheels for transportability about the studio, not with intention to move it by this means while in operation. A vertical column supported by the tripod carries at its top a universal joint which holds the boom proper. At the apex of the tripod are the necessary controls for moving it in both vertical and horizontal directions, while, as the picture above indicates, lines attached to a cross-tree on a swivel at the end of the boom enable a vernier adjustment to be made in the horizontal direction. The boom arm itself takes the form of a telescopic tube, which can be lengthened or shortened at wish and during operation. This elaboration may seemingly be unnecessary to those unacquainted with the nature of complicated shooting, but it is, in fact, absolutely essential for efficient working as a real universality of movement from a fixed point for the whole device could not be achieved without it.

Making "Wild" Shots

The microphone and camera are to-day free enough to allow resource to the invaluable technique of the mute film, but, even with modern blimps and booms, it is more convenient to take complicated moving camera shots without sound than with it. Consequently, it has become, and is becoming, more so as time passes, a practice to take all moving camera shots without sound except those in which the camera distance is such that lip synchronisation for dialogue is necessary. Post and pre-synchronisation, re-recording, and sound editing, which we shall discuss later in detail, are all, apart from the specific qualities of each, a means of giving the greatest possible freedom to the ciné-camera—the ciné-eye, in fact, which may see just what it pleases.

Let us take two examples of moving-camera shots which would be best taken silent and the sound added afterwards. First, we will suppose our viewpoint is the same as the camera's. The view we see is a big hotel reception hall with people going about their business just as one sees in any establishment of the kind, and, having absorbed this for a short while, we move forward across the hall, passing people and having people cross our path as we go, arriving at the grill-room, passing amongst its tables and their occupants, until eventually we arrive at a particular table where we find two people seated in whom we are particularly interested. Such a shot is very common in modern sound films and is called "a forward tracking shot." It is done by using a tracking truck as shown on this page. This, as the picture indicates, is a truck on which the camera can be mounted, and on which the camera-man and his assistant sit while it is pushed over those parts of the set the director wants to show—in our example, the hotel hall and grill-room. Now, although the tracking truck itself will run silently enough, the business of directing the action of the players, the instructions the camera-man and director, or both, may wish to give during the actual shooting, make such a shot much more difficult to do if the sound is recorded synchronously with it.

Obviously, no sound other than that it is desired should accompany the



Elaborate arrangements for filming Gloria Swanson in bed. The cameras, in sound proof "blimps," and the swinging microphone are clearly shown.

shot—in our example, the gentle bustle and conversation of a large hotel—can be allowed. As a result, studio conditions must be the same as for dialogue shots from a fixed camera position; absolute silence everywhere except the voices of the players. Upon a moment's consideration, however, it will be understood that there is no reason why the sound we hear should be exactly synchronous, because what we are seeing is not a view which implies one specific sound but a variety of sounds at different pitch and volume. No one particular person is talking. We may therefore take a "wild" or non-synchronous record of the generalised sound, which is what we need, and when that record is mounted by the film editor with the "mute," or photograph, it will appear just as if the sound were coming from the people and objects we see on the screen.

Using the Camera Crane

Our second example, although similar to the first, is different in so far as it would be impossible to record the sound at the same time the picture is being photographed, whereas in the other case that would have been quite possible, but not wise or efficient. Again, our viewpoint is the camera's, and the scene a battlefield. We see first a single soldier lying in the mud. He starts to crawl slowly forward, and we follow him as though we were walking backwards. Suddenly, our speed increases slightly, and we go farther away from him, so widening our view, to see that a whole line of soldiers are advancing on their hands and knees. All we hear is the swish of the mud and gentle jangle of accoutrement. Then we swing round to our right (or left) to find a disused farm-house. We no longer move backwards but wholly to our right (or left), rising as we do so. We come up quite close to a window with broken panes—and poking through one of them is the muzzle of a machine gun. The only means by which a shot such as this can be put into practice is with a camera crane. Obviously, it would be impossible to record the comparatively quiet sounds—the men crawling—while the crane is in action as it would make far too much noise. Again, we record wild tracks of the sounds we need, for the editor to mount in the editing room when the shooting of the film is finished.

BOOKS RECEIVED

Television for the Amateur Constructor, by H. J. Barton Chapple, Wh. Sc.L., B.Sc., with a Foreword by J. L. Baird.—Including the general theory of television, fitting up a home workshop, and general advice and directions for constructing television receivers of the Baird type. Pp. 233 + xx, with 102 diagrams and 48 plates. Published by Sir Isaac Pitman and Sons, Ltd., London. Price 12s. 6d.

Patents Explained, by H. J. W. Wildbore.—A short summary of information and facts useful to manufacturers and inventors, explaining in simple language the kinds of invention adopted for protection, the way in which a patent is obtained and the effect of the patent when granted, and including the new provisions introduced by the Act of 1932. Published by the author at 101, Leadenhall Street, London, E.C.3. Price 5s.

How the Superhet Works. 4

SELECTIVITY and TONE CORRECTION

The Action of the Second Detector

By W. T. COCKING

THIS, the fourth article of a series on the theory of the superheterodyne, explains why selectivity is so greatly improved if tuned circuits resonating at a comparatively low frequency (the I.F. wavelength) are used. The problems of sideband attenuation and subsequent tone-correction are also covered.

IN the preceding instalments little mention has been made of the selectivity of the intermediate frequency circuits, and as this is the *raison d'être* of the superheterodyne it is fitting to give the matter considerable attention. Let us suppose that we have the carrier of the wanted station on 1,000 kc/s, and that there is an interfering station on 1,010 kc/s. The aerial tuned circuit favours the wanted carrier, so that on the grid of the first valve the wanted carrier is stronger, relatively, to the unwanted, than it was in the aerial. Similarly, the intervalve coupling again favours the wanted carrier, and, as a result, the disparity at the first detector grid is increased.

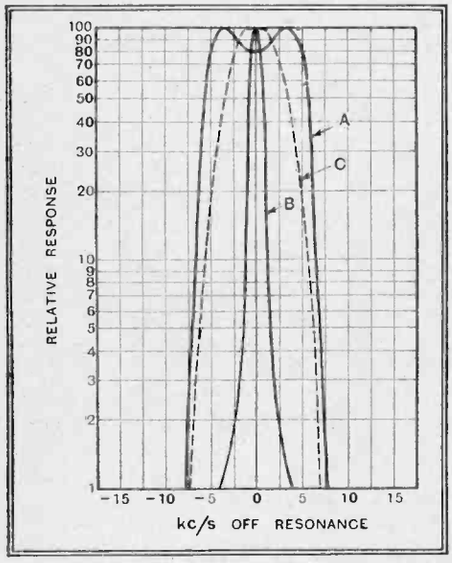


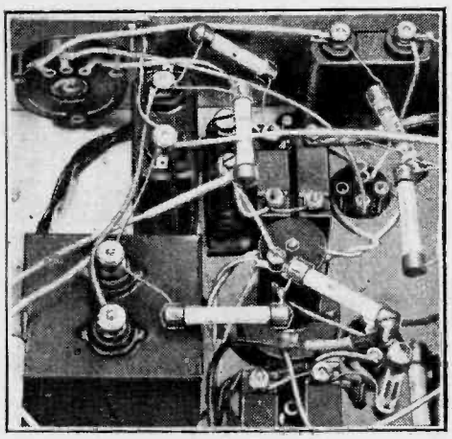
Fig. 1—The type of resonance curve to be expected in an I.F. amplifier. Curve A is for a purely band-pass receiver; curve B for a very sharply tuned amplifier; and curve C for a semi-band-pass arrangement.

This, of course, is the normal selective action, and if the wanted station be weaker originally than the interference, very many tuned circuits would be necessary if amplification were carried out throughout at the signal frequency, when this has a high value. Changing the frequency to a lower value, however, gives us a great gain. The intermediate frequency for the wanted carrier becomes, as before, 110 kc/s, and that for the interfering station 100 kc/s. The difference is still 10 kc/s, and at first sight there appears to be no advantage. The gain is to be found, however, in the fact that the selectivity of a tuned circuit, expressed in the practical form of its power of rejecting a current at a fixed frequency different from resonance, increases as the resonance frequency becomes lower. For equally efficient circuits at all frequencies, the power of rejecting an unwanted station spaced from the wanted one by a fixed percentage frequency difference is a constant. Thus, at 1,000 kc/s a station on 1,010 kc/s is 1 per cent. off tune, but at 110 kc/s a station on 100 kc/s is nearly 10 per cent. off resonance.

Selectivity with Quality

With circuits of equal efficiency, therefore, one tuned to 110 kc/s is as effective in rejecting a station on 100 kc/s as would be a circuit tuned to 1,000 kc/s in rejecting a frequency of 1,100 kc/s. The vast improvement to be obtained in selectivity through the use of a low resonance frequency for selective circuits can readily be seen, for the effect is really to increase the percentage frequency separation of stations.

The question of quality of reproduction must be considered, however. Although from the point of view of interference a station spacing of 10 kc/s at the intermediate frequency is equivalent to a spacing of 100 kc/s at the signal frequency, the sidebands occupy a proportionately large range. They still spread by only about 5 kc/s on either side of the carrier, but the I.F. tuned circuits are likely to attenuate them much as signal frequency circuits would reduce a sideband spread of 50 kc/s. The problem of selectivity without sideband cutting in an I.F. amplifier, therefore, is similar to the reception of a carrier of 1,000 kc/s, modulated by a frequency of 50,000 cycles. Unless we are very careful we shall find that the high intrinsic selectivity is not an unmixed blessing, for it will be accompanied by a serious degree of sideband cutting.



The components associated with the second detector and tone-corrector stages of a superhet.

A series of tuned circuits on the broadcast band is not usually productive of very great sideband cutting, even if the band-pass principle is not employed. On the intermediate frequency, however, it is usually entirely prohibitive, and special circuit arrangements become necessary.

Type of Resonance Curve

One method is to use band-pass filters in order to obtain an overall resonance curve for the receiver which is substantially flat-topped with very steeply sloping sides, as shown in curve A of Fig. 1. Another method is to permit sideband cutting to take place, and to correct for the attenuation of high notes in the L.F. amplifier; the type of resonance curve then found is shown by curve B. The third way out of the difficulty aims at a compromise between these two, and this is the one adopted in the receiver of Fig. 1 of the first instalment of this series. The I.F. circuits are adjusted to give a characteristic passing only a narrow band of frequencies without attenuation, and tone correction is employed to restore the moderate loss of high notes which results. This type of resonance curve is shown by curve C.

The choice between the different methods will depend largely upon circumstances, and no definite ruling can be given. The full band-pass circuit is probably too difficult to adjust without special apparatus, and it is chiefly suitable for manufactured sets. Full sideband cutting is usually prohibitive when the required selectivity is obtained by ordinary means, although it is not necessarily so with special circuits, on account of the difficulties of tone correction. In general, for

How the Superhet Works—

home constructed sets, the middle course is the wisest, and it readily permits both high quality and selectivity to be obtained.

It will thus be seen that the input to the second detector of the receiver described in the first article consists of a voltage due to the desired signal, which still carries the original modulation. The modulation, however, has been affected by the passage through the receiver, and the higher musical frequencies are represented much less strongly.

Diode Action

The action of the detector is quite complex, for it rectifies, amplifies, and provides tone correction in conjunction with its associated circuits. It is by no means difficult to understand, however, if considered from the viewpoint of the circuit of Fig. 2. In this illustration two valves are shown doing the work which is normally performed by one; in the actual circuit of Fig. 1 (first article), the anode of the diode and the grid of the triode are the same electrode. The I.F. voltages developed across the secondary of the last I.F. transformer are applied simultaneously to both valves, through the grid leak and condenser R9 and C12.

Rectification occurs in the diode, and, as a result, there is a direct current flow round its anode-cathode circuit. This current flows through the grid leak R9, and there is consequently a voltage drop across it in such a direction that the anode takes up a potential negative with respect to the cathode. Since the grid of the triode is joined directly to the diode anode, and the cathodes of the two valves are common, the triode grid is also biased negatively. When a signal is applied, therefore, the steady anode current of the triode is reduced, and in practice this may readily be seen by connecting a milliammeter in the anode circuit of the detector.

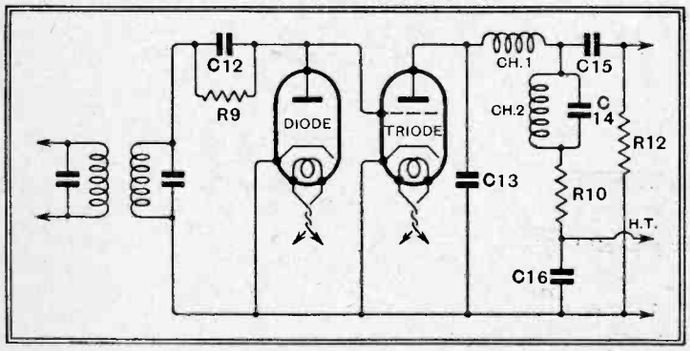


Fig. 2.—A simplified diagram showing the action of the second detector split between two valves. The tone-correction circuit in the anode of the triode should be noted.

In addition to the steady direct current through the grid leak, there are also currents of the modulation frequency, which in turn set up alternating voltages across this resistance. These are applied to the grid of the triode, and cause corresponding variations in the anode current of this valve. In the output of the triode, therefore, we have a whole series of currents of different frequencies to sort out, just as we had in the case of the first detector.

In this case we require only the modulation frequencies, and neither the direct nor the I.F. currents are of any use to us. The direct current causes no trouble, but a filter is required to prevent the I.F. currents from reaching the later circuits, and, accordingly, the choke Ch1 and condenser C13 are introduced. For the best results their values should be such that the choke offers a high impedance to currents of the intermediate frequency, and the condenser has a low reactance at that same frequency.

If a large condenser be used for C13, the load impedance of the triode to I.F. currents will be small, and only a small I.F. potential can be developed in the anode circuit. As a result, only a small current can be fed back to the grid of the valve through the inevitable capacity which exists between the grid and anode electrodes. The tuned grid circuit, therefore, will not be damped, and its full efficiency will be maintained.

Tone Correction

It is found in practice, however, that when the capacity is large enough for this to occur it seriously attenuates the higher modulation frequencies. These are already weak, and require abnormally high amplification, so that the effect is inadmissible. In general, therefore, we shall have to choose a value for this by-pass condenser small enough to have no appreciable effect upon the modulation frequency response, and tolerate quite a large damping of the tuned circuit.

The general shape of the overall response curve of the receiver, as far as the second detector, is of the form shown in Fig. 3 (curve A), and it will be seen that there is a serious loss of high notes. If this is to be avoided in the overall response it is obvious that the coupling between the detector and the following valve should have a response curve which is the inverse of this one (curve B), so that the final result will be a straight line, curve C.

If we use a simple form of impedance coupling, the amplification given by the triode action of the detector, Fig. 2, will depend upon the value of the valve load impedance at that frequency. We can, therefore, make the amplification vary with frequency by the simple expedient of choosing a circuit the impedance of which

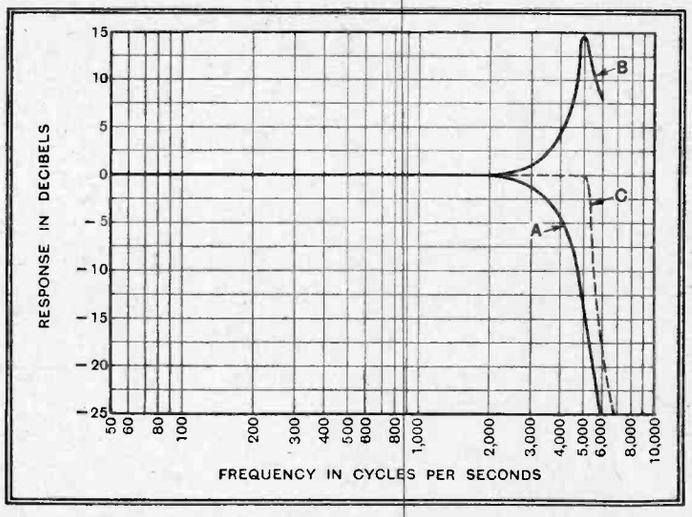


Fig. 3.—Curve A represents the effect upon quality of the sideband cutting of the receiver, while curve B shows the required shape of tone-correction curve to compensate for this. Curve C is the result of combining the two.

varies with frequency in the requisite manner. A parallel tuned circuit in series with a resistance will do this. The load impedance to modulation frequencies, therefore, consists of the choke Ch2, which has a definite value of resistance, the parallel condenser C14, and the resistance R10. At very low frequencies the reactance of C14 is high, and that of Ch2 negligibly small. At these frequencies, therefore, the coupling simply consists of R10 in series with the D.C. resistance of the choke, and for the values shown is about 1,400 ohms.

Overall Response Curve

The valve has an internal A.C. resistance of some 10,000 ohms, with an amplification factor of 35. The amplification at low frequencies, therefore, is about 4.3 times; quite a low value. As the frequency is increased the impedance of the tuned circuit rises, but it does not change greatly until 2,000 cycles is reached. Up to this frequency, therefore, the amplification remains substantially constant. When this frequency is passed, however, the impedance rises rapidly until it reaches its maximum at about 5,000 cycles, after which it again falls off. At 5,000 cycles the parallel tuned circuit has a dynamic resistance of about 22,500 ohms, and with the 1,000 ohms series resistance this means a total load impedance of 23,500 ohms. At this frequency, therefore, the amplification is about 24.5 times.

It will be seen, therefore, that, as a result of this non-uniform stage of amplification, correction is obtained for the sideband cutting which has been permitted in the I.F. and signal frequency tuned circuits. The overall response curve to the output of the second detector, therefore, is substantially a straight line over

How the Superhet Works—

the range of modulation frequencies up to 5,000 cycles. All subsequent amplification must obviously apply to all frequencies equally so that the overall response curve will still remain flat.

The potentials appearing across the load impedance of the detector are transferred to the grid of the following valve by means of a condenser and resistance C15 and R12, and this valve is itself coupled to the output stage by means of an L.F. transformer. These circuits differ in no way from those employed in any ordinary straight set, and they have been fully described many times in the pages of this journal, so that no useful purpose would be served by treating them here. This remark applies also to the decoupling circuits, the mains and other associated equipment.

We have now examined in some detail the purely superheterodyne portion of the apparatus, and have traced the course of a signal in the aerial to its appearance as a series of low-frequency currents in the anode circuit of the second detector. The fundamental operating principles of the superheterodyne, therefore, should by now be clear, and we can proceed to a more detailed discussion of a number of the more important design considerations.

Previous articles in this series have dealt with the following stages of the superheterodyne receiver:—(1) The signal frequency stage: (2) the H.F. stage and the oscillator; (3) the frequency changer and the I.F. amplifier.

In Next Week's Issue:—

The Two-Unit Portable

Exceptional Quality and Volume Combined with Compactness

UNTIL Class "B" amplification was introduced, it was generally accepted that good reproduction and ample volume could not be combined with compactness in a self-contained receiver. But now, thanks to the inclusion of this and other recent developments, the Two-unit Portable compares well with a heavy mains-operated stationary receiver.

The true portability of the new set has been greatly enhanced by building it as two separate units, which are connected together in a moment by a flexible cable, and which can be accommodated in cars, motor boats, yachts, etc., much more conveniently than the conventional portable set.

LIST OF PARTS

After the particular make of component used in the original model, suitable alternative products are given in some instances.

1 2-gang condenser, 0.0005 mfd., with air-dielectric trimmer (Utility Type W.312)
1 Set of 2 coils (aerial and H.F. transformer) (Varley "Nicore")
3 4-pin valve holders, anti-microphonic (Benjamin "Vibrolder")
1 7-pin valve holder, Class "B" (Benamin)
1 Variable condensers, bakelite dielectric, 0.0003 mfd. (Burton)
1 Fixed condenser, 2 mfds. (Igranic No. 2231/70)
1 Fixed condenser, 1 mfd. (Igranic No. 2231/69)
1 Fixed condenser, 0.01 mfd., tubular (British Radiophone)
3 Fixed condensers, 0.1 mfd., tubular (British Radiophone)
2 Fixed condensers, 0.005 mfd., tubular (British Radiophone)
1 Fixed condenser, 0.0002 mfd., tag type (Igranic)
2 Fixed condensers, 0.0003 mfd., tag type (Igranic)
1 Potentiometer, 10,000 ohms, with 3-point switch (British Radiophone Type No. 484)
1 L.F. transformer, 3½:1 (Ormond Type 531)
1 L.F. transformer, Class "B" (Wearite)
1 H.F. choke, screened (Graham Farish Type H.M.S.)
1 Fixed resistor, 1 megohm ½ watt (Erie)
2 Fixed resistors, 1,000 ohms ½ watt (Erie)
1 Fixed resistor, 5,000 ohms ½ watt (Erie)
1 Fixed resistor, 10,000 ohms ½ watt (Erie)
1 Fixed resistor, 20,000 ohms ½ watt (Erie)
2 yds. 5-way cable (Goltone No. R.39/5 MR)
2 Cases and frame ("Camco")
1 5-pin adaptor plug (Bulgin Type P.3)
1 Valve holder, 5-pin, chassis mounting type (Clix)
2 Plugs (Clix No. 10)
2 Insulated sockets (Clix No. 11)
2 ozs. No. 20 tinned copper wire, 6 lengths Systoflex, etc.
Screws: 24 ¼in. No. 4 R/hd.; 4 ¾in. No. 4 R/hd.; 4 ¾in. No. 4 R/hd.; 6 ¾in. No. 6 R/hd.
1 L.T. accumulator cell, unspillable (Oldham PZV3)
1 H.T. battery, 130 volts (Pertrix No. 312)
1 Bias battery, 4½ volts (Siemens Size G.1)
1 Loud speaker, permanent magnet, Class "B" type (Blue Spot No. 29 P.M.)
Valves: Mullard PM.12M, metallised, Mullard PM.1HL, Mazda L2, Mazda PD220.

DISTANT RECEPTION NOTES

THE new Belgrade transmitter appears to be working on 430.4 metres, though full power does not seem to be used yet except on occasional evenings.

On 209.8 metres the 1.5 kilowatt Pecs relay has recently come into operation. Though the wavelength is shared with two other stations Pecs comes through so strongly that it is frequently to be received without interference. The station is well worth trying for when conditions are favourable on the shorter wavelengths of the medium band.

It is rather interesting if you possess a set which will do it by means of plug-in coils or otherwise, to run over the band of wavelengths between 560 and 938 metres. There are several well heard stations in this region, and the band is one of which considerable use will be made if and when the Lucerne plan comes into service. At the present time the stations most worth attention are Ljubljana on 574.7 metres, Monte Ceneri which is using various wavelengths in an endeavour to find a suitable one, and Budapest on 840 metres.

New Ether-Policing Gear

The Brussels Laboratory of the U.I.R. is, I understand, being completely re-equipped with frequency-checking instruments. This is very good news; but it is one thing to be able to discover wavelength wanderers, another to compel them to recognise the error of their ways, and quite another to prevent them from doing it again!

There seems to be a perfect mania amongst German stations at the moment for adopting new interval signals. Hamburg's old HA in morse is to be replaced by the opening bars of an old German tune, and other stations that are doing the same kind of thing are Frankfurt, Heilsberg, and Langenberg.

This is certainly the most amazing summer for long-distance reception that we have had since the beginning of broadcasting. June began with a record heat-wave for the time of year, and the heat-wave itself was a continuation of a drought of several weeks' duration. Add to this British Summer Time plus a full moon, plus absolutely cloudless skies, which meant that there was hardly any real darkness, and you have a combination which nine out of ten long-distance men would regard as the worst possible for the reception of distant foreign stations. Yet it required only a few minutes at the controls of the wireless set on any evening to convince oneself that almost any number of stations could be received—and well received.

As an instance of the excellence of reception at the height of summer I may mention that the other afternoon, when wanting some music at tea-time, I found all of the long-wave stations, as well as Brussels No. 1, Prague, Langenberg, Rome, Leipzig, Strasbourg, the Poste-Parisien, Brussels No. 2, Breslau, Hilversum, Heilsberg, Trieste, Nürnberg, and Fécamp, all coming in at fine strength.

On the long waves Radio-Paris, Zeesen, Warsaw, and Motala provide superb reception, and on the medium band the pick of the stations in addition to those already mentioned are Lyons Doua, Stockholm, Katowice, Hamburg, Milan, Bordeaux Lafayette (now quite in form again), Frankfurt and Gleiwitz.

D. EXER.

News of the Week

Events of the Week in Brief Review

Modes at the Mike

THE most successful talks at Hilversum recently have been the dressmaking lessons sponsored by the "Avro" association, and an explanatory pamphlet has sold to the tune of 20,000.

B.B.C., please note!

Television and Talkies

THE cinema seems to be meeting its rival, television, half-way. Mr. M. H. Aylesworth, President of the Radio Keith Orpheum Corporation, and of the American National Broadcasting Company, has announced plans for the construction of a television studio at Hollywood early in the summer.

5-Metre Fever in U.S.

NO fewer than two hundred amateurs in New York, it is estimated, are now working on the 56 m.c. (5-metre) band. A large network of stations in the city has been organised to handle short-distance messages, telephony or modulated C.W. being used.

In New Hampshire State, a 5-metre transmitter has been erected at the summit of one of the loftiest mountains in the neighbourhood, and distances up to nearly 150 miles have been covered. Regular traffic is handled by this station, particularly in connection with forest fires.

There are indications that amateurs in this country are also perceiving the exceptional possibilities of the ultra short waves, particularly as a solvent of the selectivity problem.

The King's Birthday Honours List

IN the list of Honours issued in connection with His Majesty's Birthday is a peerage conferred upon Sir Edward Iliffe, C.B.E., the chairman of Iliffe and Sons Ltd., proprietors of this journal. Sir Edward is past-president of the Association of British Chambers of Commerce. He represented the Tamworth Division of Warwickshire in the Conservative interests from 1923 to the end of 1929, when he resigned. During the War he was appointed Deputy Controller, and afterwards Controller, of the Machine Tool Department of the Ministry of Munitions, remaining until the Armistice of 1919 in order to supervise the liquidation of contracts.

For many years he acted as chairman of the Coventry and Warwickshire Hospital, and took an active part in the administration thereof. He is an Officer of the Legion of Honour and a Justice of the Peace for Warwickshire. Sir Edward's main business interests are in connection with publishing and insurance. He is proprietor of the local evening paper at Coventry, and is associated with Lord Camrose and Sir J. Gomer Berry in many newspaper enterprises. He is chairman of the Guildhall Insurance Company, Ltd., and a director of the London Assurance Co.

International Listeners' Union

WE learn that a "Union Internationale des Auditeurs" is under discussion, the object being an organisation which would unite the amateurs and listeners of different countries to defend their common interests and represent them at international radio conferences. The French International Federation of Radio Clubs has undertaken to join.

French Broadcasting in India

THE B.B.C. may soon have a competitor in India in the shape of a broadcasting station at Pondicherry, which would relay the daily programmes of the French Radio Colonial station at Pontoise. According to a French official announcement, the station would be in direct telegraphic touch with Paris.

French Listeners to Pay

AT long last it has been ordained that French listeners must pay. The Chamber of Deputies and the Senate have both voted in favour of receiving licences, 50 francs to be payable annually on valve sets and 15 francs on crystal. They have turned a deaf ear to appeals to postpone this enactment until after the passing of the long-promised Broadcasting Bill. As our Paris correspondent remarks, no one knows better than a parliamentarian how remote that happy day may be!

The much-discussed tax on valve imports is also an accomplished fact. In future, 3 francs will be payable on valves retailing at 50 francs, 4 francs on 50-70-franc valves, and 5 francs on all exceeding this price.

Holland is now the only European country where listening is free.

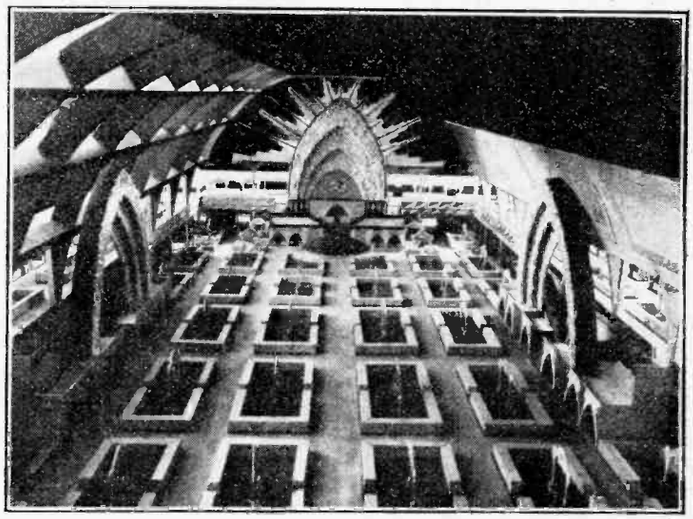
Toulouse on High Power

LARGE deputations from ten of the French Departments have petitioned the Postal Authorities to permit Radio Toulouse to operate the new 60-kW. transmitter now standing idle at St. Agnan. It is believed that the official permit will not long be withheld.

Listen for the Tom-Tom

LOUD speakers which will do justice to the rich tones of the tom-tom may soon be in demand in African villages. According to the French "Dépêche Coloniale" several negro chiefs have sent in a petition to the Government of the Haut-Katanga province asking for the erection of a broadcasting station which would be suitable, among other things, for the transmission of tom-tom concerts for loud speaker reception in the villages.

Enterprising manufacturers might seize the opportunity to submit tenders for portable amplifiers for reproducing war whoops.



OLYMPIA IN MINIATURE. Here is a foretaste of pleasures to come in the shape of a model indicating the decorative scheme for Olympia Radio Show to be held from August 15th to 24th.

Big London Field Day

MANY clubs in the London area will co-operate with the Golders Green and Hendon Radio and Scientific Society on Sunday Ju , in a big direction-finding contest which constitutes the Society's main summer competition for 1933. Col. Ashley-Scarlett, the retiring President, is again to be in charge of the arrangements, as he has been for the last seven years.

The Society's D.F. competition is always one of the big events of radio's "London Season," and is notable for originality in portable set design and resourcefulness in the use of these receivers under difficult conditions. It is believed that this year's competition will have a record entry.

Lucerne: Lost and Saved

AFTER one of the most hectic weeks in the history of radio legislation it is now possible to say that Europe will have a new wave plan of sorts. According to our Lucerne correspondent, a "Plan Définitif" is now maturing which transforms the original "Plan" almost out of recognition. Under the new "Plan" wavelengths would be allotted to the British stations as follows:—

Daventry	1,500 m.	(200 kc/s)
Athlone	530 m.	(565 kc/s)
North Regional and Jerusalem (20 kW.)	450 m.	(668 kc/s)
Midland Regional (later Scottish Regional) and Skoplje (Southern Serbia)	396 m.	(758 kc/s)
Scottish Regional (later West Regional) and Salonika	373 m.	(804 kc/s)
London Regional	342 m.	(877 kc/s)
West Regional (later Northern Ireland Regional) and Haifa	307 m.	(977 kc/s)
North National (later Midland Regional) and Dnepropetrovsk	296 m.	(1,013 kc/s)
Scottish National and Bournemouth and Stalino	295.5 m.	(1,050 kc/s)
Belfast and Alexandria	271.5 m.	(1,104 kc/s)
London National and West National and Istamboul	259 m.	(1,158 kc/s)

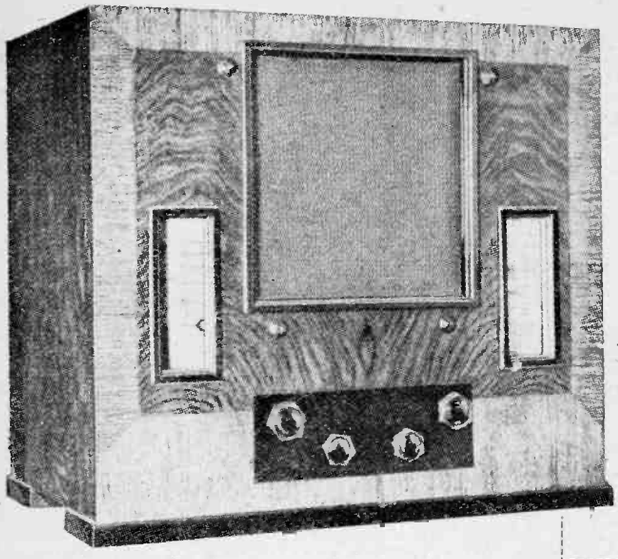
On Thursday, June 8, the Conference appeared to be breaking up on a question of "shared" wavelengths. These were mainly objected to by those countries which feared that international propaganda would be valueless without exclusive waves. However, the firmness of the Chairman M. Muri (Swiss) in adjourning the Conference until the following afternoon no doubt helped to clear the air. At the time of going to press Britain and eleven other countries were still objecting to the principle of shared wavelength. Under the latest scheme Germany would have seven exclusives and France five, while Britain would have none.

More "Hams" Than Ever

SOME remarkable statistics concerning amateur transmitting activity in the United States have just been made public by the American Radio Relay League.

Outstanding among the figures are those relating to messages handled by amateurs. During 1932 no fewer than 1,194,995 messages were dealt with by 20,656 operators, which contrasts strikingly with 1926 (the first year for which statistics were compiled), when 294,972 messages were handled by 8,140 amateurs. As is well known, American "hams" have an extensive network of stations for the transmission free of charge of private messages.

Another noteworthy fact is that there are now over 30,000 amateur transmitters in U.S.A., the popularity of the hobby, it is thought, being due to its inexpensiveness in these days of trade depression.



H.M.V. "Superhet Selective Five"

MODEL 438

A High-grade Receiver at a Very Reasonable Price

FEATURES

Type: *Table model superheterodyne; five valves including rectifier; moving-coil loud speaker; provision for mains or external aerial, gramophone pick-up and external loud speaker.* ***Circuit:*** *Band-pass input circuit compensated for image interference; screen-grid detector oscillator—variable-mu I.F.—screen-grid second detector—pentode output valve.* ***Controls:*** *(1) Tuning with independent illuminated wavelength scales; (2) Combined radio and gramophone volume control; (3) Tone control; (4) Wave-range, gramophone and on-off switch.* ***Price:*** *15 gns.* ***Makers:*** *The Gramophone Co. Ltd., 363-367, Oxford Street, London, W.1.*

THE four-valve superheterodyne (five with rectifier) bids fair to be one of the predominant types in the coming season. In selectivity and range it is incomparably superior to the straight three-valve set and it can be sold at a price very little in excess of that asked for the latter type. The problem of obtaining good quality of reproduction no longer presents any real difficulty, and the only remaining objection to the simpler type of superheterodyne, viz., second channel interference whistles, has been met in the H.M.V. Model 438 by a clever compensation circuit associated with the input band-pass filter.

First impressions, however, are less concerned with technical details than with the general appearance and performance of the set. The finish of the cabinet maintains the H.M.V. high standard, but a more modern note is struck in the general design and the dual tone walnut veneer panelling is skilfully arranged to balance the rectangular loud speaker grille and tuning scales. In spite of the fact that only four stages are employed, there is nothing of the "midget" superhet about this receiver, and looking at the wealth of detail constructional work in the chassis one wonders that it can be produced at the price.

Independent vertical tuning scales calibrated in wavelengths and stations are allotted to the medium- and long-wave ranges, the appropriate scale being illuminated through contacts on the main control switch. The volume control is well graduated and functions both on radio and gramophone reproduction, and a tone control is provided to give the purchaser scope in adjusting the reproduction in accordance with his own views.

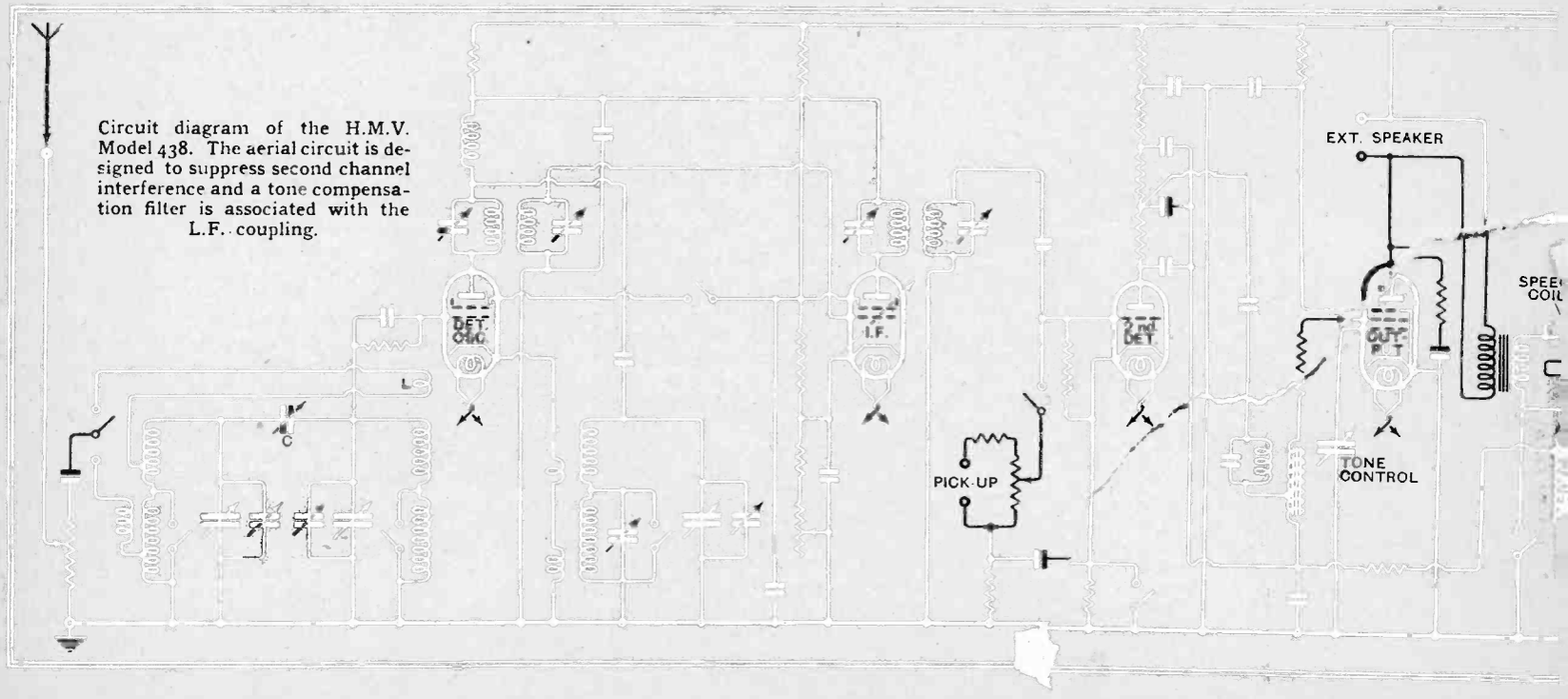
Tone Control

Personally, we were content to accept the maker's own compromise in the matter of quality, and the tone control was left in the "high" position throughout the tests. The top cut-off has been adjusted to 5,000 cycles, and this gives just the necessary high note response to balance the characteristically full bass usually associated with H.M.V. sets without letting through atmospheric background noise or record surface scratch. The full bass response which adds so much to the realism of orchestral broadcasts does not intrude into the range of frequencies used in speech, which is quite natural and free from hollowness.

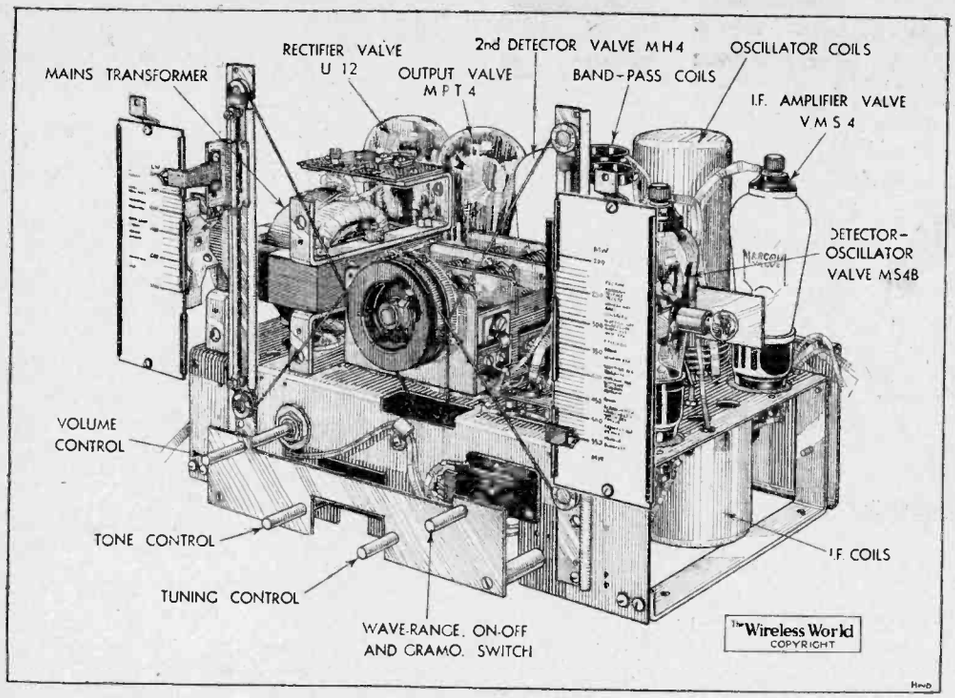
The range on both long and medium waves is probably the maximum commercially obtainable with four stages. It is certainly equal to, if not slightly better than, that of any other superheterodyne of its type so far tested. The daylight range on medium waves is always a useful indication of performance in this respect, and with the Model 438 we were able to tune in nine Continental stations on this wave-range at mid-day without extending the set to its maximum sensitivity.

The selectivity is just what we would expect from the circuit, and not more than two to three channels are lost on either side of the medium-wave local station transmitters at fifteen miles, but more distant stations on adjacent channels are easily separated. Zeesen on long waves comes through well in London with only an occasional "twitter" from Radio-Paris and no background from Daventry.

From the point of view of second channel or image frequency interference the performance is definitely above the average for



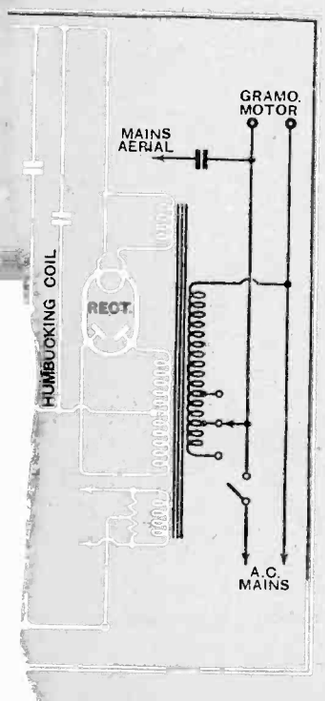
Circuit diagram of the H.M.V. Model 438. The aerial circuit is designed to suppress second channel interference and a tone compensation filter is associated with the L.F. coupling.



The chassis is notable for the detail work in the cord drive to the vertical tuning indicators, and the high standard of finish throughout.

a set employing a conventional intermediate frequency. Not a single station is lost on the medium waveband from this cause. The intermediate frequency is of the order of 125 kilocycles, and in London one would expect at least two second channel whistles from the Brookmans Park transmitters on 590 and 335 metres. The former could be detected faintly when Brussels was not working, but caused no interference on that station even under daylight reception conditions. No trace of the 335-metre whistle or of any others due to harmonics could be found.

The means by which these results have been achieved are simple and ingenious. Any residue of signal from the local station which succeeds in breaking through the band-pass filter when the latter is off tune by twice the intermediate frequency is neutralised by injecting a small E.M.F. direct from the aerial into the secondary tuned circuit in opposite phase. In the upper part of the medium waveband this function is performed by the small coupling coil L, and in the lower part by the condenser C of about 5 micromfds. By giving the direct magnetic coupling between the two elements of the filter the right sense, and carefully adjusting the value of C and the coupling from L, immunity from second channel interference is obtained over the whole waveband. An incidental advantage of this arrangement is that radiation from the oscillator is further reduced.



The detector-oscillator is of the screen-grid type with cathode coupling. When reproducing gramophone records the screen-grid is open-circuited and the oscillator is put out of action. Radio volume, as usual, is controlled in the I.F. stage, and the rest of the circuit follows well-tried practice. The use of a tuned tone compensation circuit in series with the feed to the L.F. auto-transformer is, however, of interest. This has been included to ensure a sharp cut-off at 5,000 cycles without affecting the amplification of frequencies immediately below this value.

It is possible to connect external loud speakers of high or low resistance to the set, and terminals are available for running a gramophone motor. The pick-up may be left permanently connected to the set as the switching is arranged to isolate it from radio-frequency circuits when receiving broadcasting.

From every point of view the Model 438 is a first-class job which sets a new standard of value for a class of receiver which is steadily gaining in favour.

"Omega" 25-watt Amplifier

A Three-stage A.C.-power Equipment

THE "Omega" 25-watt power amplifier is a self-contained, portable three-stage A.C. unit designed to have a universal application, for it can be used either for gramophone reproduction, as the low-frequency and power section of a radio receiver, or in conjunction with a microphone. A three-position switch is fitted, which not only enables the amplifier to be connected separately to these several pieces of apparatus, but also enables the microphone output or the gramophone to be superimposed on the radio reproduction.

The model tested and illustrated here incorporates the gramophone equipment consisting of a Garrard induction motor and a B.T.H. Senior gramophone pick-up. This equipment is, however, optional.

The circuit employed comprises a 164V valve resistance-capacity coupled to a 104V valve, this stage being linked by a one-to-two ratio transformer to a DO24 power valve. The output from this stage is fed through a choke capacity filter to the loud speaker terminals. A volume control is included and located between the first and second valves. High-tension current is obtained from a D.W.4 full-wave rectifier working at an anode potential of 430 volts. Mullard valves are used throughout. A Ferranti milliammeter is fitted in the anode circuit of the power valve. Anode and grid circuits are fully decoupled, and every precaution has been taken to preclude L.F. instability and parasitic oscillation.

The unit is enclosed in a massive cast aluminium case finished in blue cellulose enamel and fitted with a removable front adequately ventilated. Carrying handles are provided.

On the right-hand side of the case are the loud speaker terminals, mains, and gramophone motor switch, mains input socket, and the milliammeter. The turntable and pick-up arm are mounted on the top, where, also, is the volume control and the selector switch.

Gramophone reproduction is, on the whole, very pleasing; there are no apparent reson

Hughes "Omega" 25-watt power amplifier embodying gramophone equipment.

ances, the middle and upper registers are well balanced, but the bass inclines slightly towards the weak side. Nevertheless, there is a quite good output of 100 cycles, and it is only at frequencies below this that the falling off in amplification is at all apparent. If a loud speaker having a good bass response is used, this small deficiency in the amplifier will generally pass unnoticed. One advantage, however, accrues, for the almost entire absence of mains hum is one of the features of this amplifier. The overall response characteristic, including the pick-up, is sensibly flat from 150 cycles up to 3,500 cycles. The amplification begins to fall off above this point, but rises again between 7,000 cycles and 8,000 cycles, then follows a further decline.

On the whole, the Omega 25-watt amplifier is a very workmanlike job, being robust and capable of hard wear, easily transportable, and giving a good, all-round performance. It is made by F. O. and H. S. Hughes, Ltd., 128a, Narborough Road, Leicester, and the price complete with gramophone equipment is £30. The amplifier alone costs £25.

UNBIASED

By FREE GRID

Have Catkins Nine Lives?

IT is surprising what a large amount of enterprise is exhibited by the showmen at our old country fairs. I am moved to make this remark as the result of a visit made to 'Appy 'Ampstead on Whit-Monday. Everyone is familiar with such amusements as coconut shies and skittle alleys, but one genius whose spirit has evidently moved with the times had evolved a new variation on the old theme.

A row of Catkin valves was set up in valveholders mounted on the top of sticks, each valveholder being correctly wired up and connected to a large-scale milliammeter, which was conveniently placed by the pay desk. The usual charge of seven for sixpence was made for the wooden balls, and the prize, consisting of the valve itself, was awarded to the person who struck it with such vigour as to cause the milliammeter needle to kick.

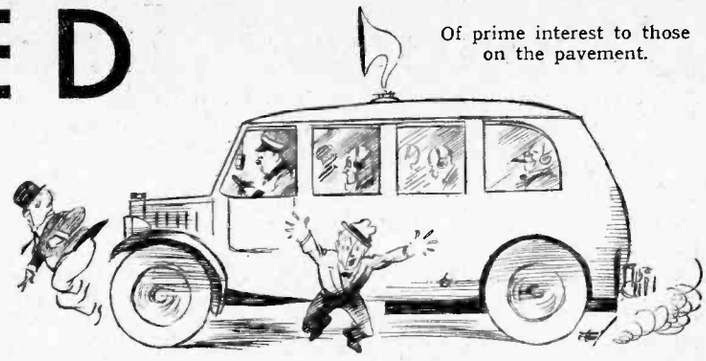
It was quite clear, of course, that, apart from knocking the valve clean out of its holder, the only way to agitate the milliammeter was by a direct hit, which so damaged the valve that its electrical characteristics were altered.

The former alternative seemed impossible, as the valves were well and truly rammed home into their holders, and the second no less so, for in spite of repeated hits which I saw scored the milliammeter needle remained stationary, even though some of the valves had been struck so hard by a few "leg theory" bowlers that they were bent almost double and formed an inverted letter U.

In spite of repeated hits . . .

Not unnaturally I suspected dirty work, and said so in no uncertain terms to the proprietor of the show. So far from letting fly a volley of abuse, which I expected, he actually invited me to check up on the circuit, and, taking me behind the scenes, removed a few of the bent valves and allowed me to examine them on some valve-testing equipment made by a well-known firm.

After exhaustive tests I was forced to apologise for my suspicions; nevertheless, I still feel that there was some factor I may have overlooked, and I hope, therefore, that some of you will make a point of visiting the show on August Bank Holiday in order to check my results.



Of prime interest to those on the pavement.

Bus Radio

I HAVE just had my first ride through the streets of London in a wireless-equipped bus. The vehicle is actually intended for use in the North, but was doing private trials in the great metropolis.

Each seat was equipped for a pair of headphones, and either of the two Brookmans Park programmes could be received at will by plugging into one or other of two jacks fixed to the seat in front. Reception was very good, but the thing which, to my mind, lifted the whole thing out of the common rut was the provision of a microphone by the side of the driver.

At each stopping place, having put all 'phones in circuit with the mike by a small switch affixed to his steering column, he reeled off the name of the stopping place and the local places of interest, and then the names of the places which the bus would pass before reaching its destination and disgorging its weary load.

The first part of the announcement was obviously only of interest to people in the bus; for the last part, which was of prime interest to those on the pavement, the driver switched the output of the amplifier to a large public-address type loud speaker mounted on the roof.

Such an arrangement, you will say, would be a source of annoyance to certain passengers who desired none of the information. Even this had been thought of by the all-wise bus company, for, near to the two jacks I have mentioned, was a third with a little red warning light beside it, together with an explanatory note neatly executed on ivorine.

The notice explained that if the 'phones were kept in No. 1 or No. 2 jacks either of the programmes would be received without interruption. Immediately the driver switched in his mike the red light would be illuminated and those passengers desiring to receive his words of wisdom would immediately transfer their 'phone plugs to No. 3 jack.

Actually I found that every woman passenger, regardless of the broadcast programme, at once plugged in to the driver's remarks directly the red light showed.

There is something profoundly psychological in this, but at the moment it escapes me.

Like Casabianca

I SEE that a learned professor has been disparaging the use of lightning switches. The average lightning flash, he said, consists of a current of fifteen hundred million amperes propelled by a voltage of two thousand million, and it's no use expecting any lightning switch to stand up to that.

Are we to gather from this that the learned man honestly thinks that a lightning switch ought to stand up to it without batting an eyelash? It is high time that he learnt that, apart from its normal function of dealing with small charges, the ordinary lightning switch, in the case of a direct hit, is expected to do its duty by perishing miserably. It should, in fact, emulate the half-witted youth who, we are told, was fool enough to stand on the burning deck when everybody else had done the sensible thing.

A Quiet Hour

PICKING up a "late extra" which had been left in a bus the other night, I turned to the radio page to see what new thing had happened in wireless since I had breakfasted. I found that the paper was full of suggestions from its readers for novel outside broadcasts which they desired the B.B.C. to attempt. One man, whose suggestion was given prominence, wanted the voice of the City of London on Saturday night, including such noises as the "din of the dirt track, the dance hall, and dog-racing."

It is true that the name and address of the good gentleman indicated that he hailed from the back blocks of Scotland, but I should have thought that the spread of popular knowledge would have reached up there long ago, and that this blown-away Norwegian would have known that on Saturday night—or indeed on every other night for that matter—the city is one of the most deserted spots in the world.

Broadcast Brevities

By Our Special Correspondent

A Broadcasting Hall at Olympia

THE B.B.C. may soon take an opportunity to satisfy the thousands of disgruntled listeners who have never had, and are never likely to have, a chance of attending a vaudeville performance at Broadcasting House. I understand that arrangements are going forward for the erection of a Listening Hall at the Olympia Wireless Show, accommodating at least 1,500 people. If the plans materialise, vaudeville performances and perhaps a few orchestral concerts will actually be broadcast from the Hall.

Better Than Studio Claques?

Whether listeners in their homes will appreciate the presence of this vast studio audience is another question; I rather fancy that a really large assemblage will be far less distracting than the usual collection of twenty or more "deadheads" who feel under an obligation to clap out of common courtesy to their hosts, whether the "turn" be good or bad.

Sir John at Madame Tussaud's

I SUPPOSE the real test of greatness is not the inclusion of one's name in "Who's Wh " but representation among the gallery of wax celebrities at Madame Tussaud's. This special honour, I hear, is to be conferred on Sir John Reith in the near future.

More Secret Tests

WHY is the B.B.C. maintaining such deathly secrecy over the tests now proceeding in the synchronisation of West National and London National? The first experiment was made in the middle of last week, and on most evenings now it is possible at a reasonable distance from London to get a suspicion of a second carrier wave on the 261.5-metre wavelength.

Let Listeners Know

Possibly by the time these lines are read the Engineering Department may have seen fit to take the public into their confidence—a far safer course, for nothing infuriates a listener more than unexplained whistles superimposed on his favourite transmission.

Surely, it would be better for the Chief Engineer to make a clear public statement on the test and its objects, explaining that everything that is being done, whether successful or otherwise, is intended to serve the best interests of all listeners? The public would then feel encouraged to co-operate, and many helpful reports might result.

Empire Programme Innovation

THE first Children's Hour to be transmitted from the Empire short-wave station at Daventry will be included in the Indian Zone programme on July 20th, when Du Garde Peach's play "The Rose of England" will be the principal feature.

Although such a programme may scarcely appeal to the Indian population, it should bring a real breath of home to Anglo-Indians scattered throughout Asia.

In Western Australia

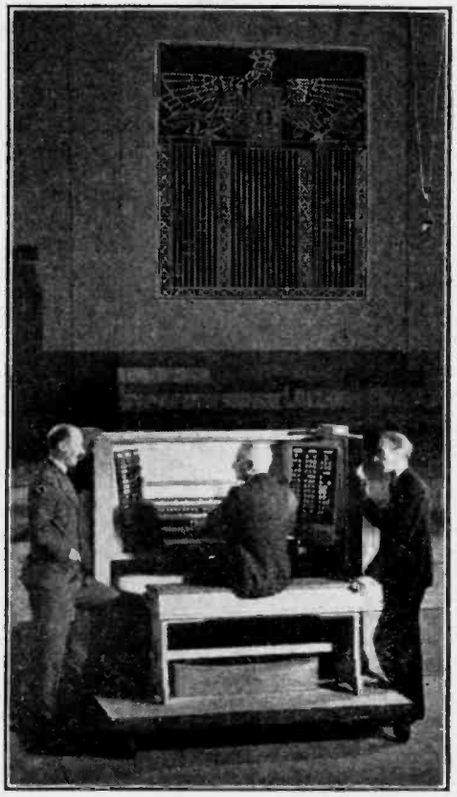
Incidentally, the Indian programmes are heard very clearly in Western Australia, reports going to show that listeners in Perth hear these transmissions very much better than those of Zone 1, which are specially intended for Australia and New Zealand.

Hallé Concerts for the North

NORTHERN listeners will be grateful to the B.B.C. for completing negotiations with the Hallé Society for the broadcasting of ten of the Society's concerts during the next season.

New Organ To-night

TO-NIGHT should be a great occasion for all lovers of legitimate organ music, as distinct from the cinema variety, for at 8 p.m. we are to hear the inaugural recital on the new Compton instrument in the Concert Hall at Broadcasting House.



HEAR IT TO-NIGHT. Sir W. G. Alcock at the console of the new organ in the Concert Hall of Broadcasting House. Dr. Adrian Boult is standing on the left; on the right is the B.B.C.'s official accompanist, Mr. Berkeley Mason.

I hear that Sir W. G. Alcock, as designer, is showing pardonable pride in this child of his brain, and came up specially to London from Salisbury to be photographed at the console of the organ. He is taking part in the recital this evening, together with Mr. Thalben-Ball and Mr G. D. Cunningham.

Part of the programme will consist of an organ concerto by Handel, in which the B.B.C. orchestra, conducted by Adrian Boult, will take part.

Northward Bound

MR. A. PATERSON, who has been in charge of the B.B.C.'s £10,000 sports ground at Motspur Park, is to take sole charge of the Aberdeen Station.

No Thrills at the "Proms"?

THERE are to be no "sensations" at this year's Promenade Concerts which open at the Queen's Hall on Saturday, August 12th, and continue for eight weeks, finishing on Saturday, October 7th. There will be the usual number of first performances.

This will be the thirty-ninth summer season under the conductorship of Sir Henry Wood and the seventh under the auspices of the B.B.C. The concerts will be broadcast from one or other of the B.B.C. stations each night.

Dresden Programme for London

ON July 1st London Regional listeners will hear a relay from Dresden carried out in co-operation with the Central German Broadcasting Company and the Reichs-Rundfunk-Gesellschaft. The programme, which will last one hour, will consist of Act 1 of "Arabella" by Richard Strauss, conducted by Clemens Krauss, with Eva Plaschke van der Osten as music producer.

A Voyage to Lilliput

"GULLIVER'S Travels" are to be drawn upon for a programme by Lance Sieveking to be broadcast on the National wavelength on June 28th under the title "A Voyage to Lilliput." As on the occasion of the last Lilliputian broadcast in 1931, Mr. Sieveking's production will rely largely on the clever music of Robert Chignell.

Two More Regional Stations?

AT the time of writing, my news basket is filled with conflicting messages concerning the ultimate fate of the "Plan de Lucerne." One very interesting item emerges.

I am told that the British delegation (which, of course, includes Mr. Ashbridge and Mr. Hayes, of the B.B.C.) has been demanding waves for two new stations, styled respectively "North Scottish" and "North Eastern."

A Border Transmitter

Now "North Scottish," wherever that may be situated, is scheduled to use a frequency of 1,104 kc/s., at present the property of Rennes, P.T.T., and later to be allocated to Belfast until North Scottish is ready.

"North Eastern" defeats me. Can the B.B.C. be flirting with the idea of a station on the Scottish Border, perhaps near Berwick-on-Tweed?

Tactless

It is all very mysterious. A Lucerne friend of mine who dared to ask the British delegates for the merest hint of an explanation was made to understand that he was a tactless person.

Broadcasting the Neo-Bechstein

LAST week Christopher Stone treated us to a broadcast of a recording of the Neo-Bechstein piano, the instrument which was described and illustrated in *The Wireless World* of January 27th last. It would now be an excellent thing to give us a direct broadcast of the Neo-Bechstein, which would lend itself admirably to the purpose, as the output could be directly coupled to the amplifiers.

What about it, Programme Branch?

Correspondence

The Editor does not hold himself responsible for the opinions of his correspondents.

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Stamford Street, S.E.1, and must be accompanied by the writer's name and address.

"Pick-ups and Bass Response."

HAS not Mr. Willans (in his letter published in the June 2nd issue of *Wireless World*) misread the data supplied by Mr. Bloxam in connection with the article on "Increasing Bass-Response"?

I read the data in question as indicating that at 100 cycles the electrical output (presumably voltage) is approximately 40 per cent. greater than that at 240 cycles.

In this case the variation of pick-up output, in terms of decibels, would not exceed 3 dbs.

The derived curve (pick-up plus recording) would then indicate a variation of level of the order of 4.5 dbs. between 50 and 100 cycles.

I support Mr. Willans' contention, however, that the use of resonances in the design of components intended for everyday application is a practice to be deprecated.

I append three reasons for this belief:—

(1) Resonance phenomena are notoriously complex and, used indiscriminately, can be as detrimental as they can be helpful.

(2) There exists already a multiplicity of variables in the electro-acoustic chain, and the encouragement of others (of ill-defined characteristics) does not make for simplification of the art.

(3) "Tone-correction" can be performed with greater precision elsewhere in the system.

The manipulation of resonance phenomena is essentially a matter for the filter designer, in whose hands a resonance loses all its fickleness, and becomes an asset of considerable worth.

Let component manufacturers continue, therefore, to strive after a flat response characteristic and one that has as broad a frequency range as possible.

By this means will the path of progress be smoothed and a satisfactory basis for the judgment of meritorious design be provided.

London, W.13. GEORGE E. POHU.

Components

I NOTED your leader on the all important question of quality or price, and suggest this article is to a large extent a fitting reply to your leader of April 7th under the heading of "Price of Components—The Case for Reduction."

I particularly would draw your attention to your phrase in the original article—"We have now *almost* reached the point when it can be profitable to buy a complete set in order to make use of the parts in constructing some new circuit employing the latest principles, and discarding the surplus material, rather than buying the components as separate items"—(my italics).

Firstly, we have not reached this stage, and the only cases approaching this possibility are those in which obsolete "end of season" sets figure, or bankrupt stock is offered; in both instances the material is either out of date or obviously inferior as bankruptcy is not an advertisement in favour of quality.

A correct analysis of the set and component markets will reveal that set manufacturers are compelled more or less to stabilise their designs for at least twelve months, and new types appear about once a year, round about show time, whereas new developments which arise from time to time all the year round are immediately available to radio constructors, such as your readers, in the form of new components; thus constructor circuits are usually at least nine months ahead of set manufacturers' designs.

A point that is often missed is the universal fittings features that have to be embodied in components, but are often totally dispensed with in manufactured designs. Other items of separate and extra cost include technical literature, fixing templates, free blue prints, separate packing and despatch, etc., etc.

Another important point is the home constructor himself; he is keener to-day than ever, more technically minded and demands a high degree of quality allowing no "skimping." The home-constructed set scores in many cases over the manufactured job because performance and not price is the first consideration, and the constructor is able to employ a combination of H.F. and L.F. circuits that manufacturers dare not introduce, as they are always endeavouring to limit their types to the lowest possible number for reasons which will be obvious to your readers.

Faulty marketing of shoddy components must not be allowed to ruin the British radio trade, which gives employment to hundreds of thousands. There is every indication that British radio fans do not want second-rate components; let anyone who doubts spend a day on some of the component stands at Olympia.

London. "OBSERVER."

THE UBIQUITOUS AMPLIFIER. Loud speakers and microphones are much in evidence at the World Economic Conference in the Geological Museum, South Kensington. Marconi engineers are here seen fitting Catkin valves to a large amplifier.

I HAVE only seen two letters published up to the present in reply to your efforts to get the price of components reduced. Doubtless you have had several and possibly these are a fair sample of the many. Evidently one correspondent has a financial interest in the component trade and is therefore biased. I entirely agree with Mr. Curtis' remarks in your May 26th issue and so, I imagine, do most other people.

It is possible to quote from memory many components which have not been reduced in price for five years. The other day I came across an old catalogue or two and in two instances of well-known makers of transformers and coils there had been no reduction for the above period.

There is also the case of the 2-volt double-grid valve, which is still priced at 20s., whilst the screen grid is 3s. 6d. less, and the pentode half a crown.

There are many other items which could quite possibly be reduced and allow a fair margin of profit, notably coils, mains transformers, some fixed condensers, etc.

Many a good circuit appears from time to time in *The Wireless World*, but genuine experimenters may hesitate to make them up by the price of some of the components.

"OLD HAND."

W.W. Universal Short-Wave Converter

I DESIRE, through the courtesy of your Correspondence columns, to record my appreciation of your "Universal Short-wave Converter."

The converter has been included in a modified "Monodial" (A.V.C.) receiver, deriving H.T. from the same source. The unit is completely shielded from the rest of the receiver, and decoupling precautions have been taken. Results have far exceeded expectations.

The list of stations received at good entertainment value is too long to enumerate here, but special mention must be made of daylight reception.

On Whit Monday at 14.00 hours W3XAL on 16.87 metres was received at full volume with negligible background. It was broadcasting a description of the World's Fair at Chicago. This was followed by a talk on the Agricultural Adjustment Act and the weather report. For four hours the entire programme was received, which speaks well for A.V.C. I may add that this particular station has been most consistent during the past week.

W8XK (19.72 metres) is another station which is well received during daylight.

In conclusion, I must remark upon the wonderful ease of operation and the entire absence of hand-capacity troubles, particularly on the shorter wavelengths.

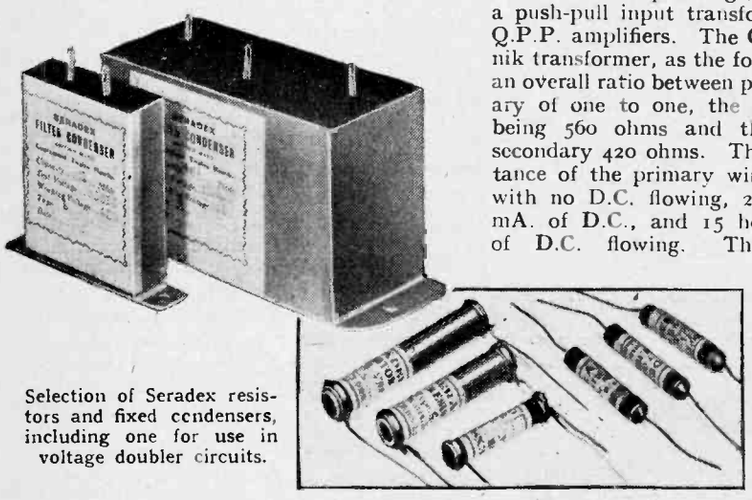
ZETA.

LABORATORY TESTS

NEW RADIO PRODUCTS REVIEWED

SERADEX RESISTORS AND CONDENSERS

THE Seradex range of Glasswound resistors has been considerably extended and now includes four types, viz., the G.125, G.250, G.500, and the G.800, their respective rating being 1.5, 2.5, 5, and 8 watts. They derive their designation from the method of construction adopted, for the resistors are of the wire-wound type on a tubular glass former. They are available in a wide range of values, the 1.5-watt type extending from 25 to 10,000 ohms, the prices varying between 9d. and 1s. 3d. The 2.5-watt models are obtainable up to 20,000 ohms in value at prices between 1s. and 1s. 6d., while the 5-watt models extend to 30,000 ohms, the smaller values costing 1s. 3d. and the higher resistances 1s. 9d. In the 8-watt style resistors up to 50,000 ohms are made and these range in price from 1s. 6d. to 2s. each.



Selection of Seradex resistors and fixed condensers, including one for use in voltage doubler circuits.

Tests made with several specimens show that the measured resistances are in very close agreement with the marked values, the maker's statement that they are accurate to within 2.5 per cent. is fully substantiated. At maximum load the temperature rise is not above the normal for resistances of this type.

The range of moulded resistors, listed as the type M-150 and rated at 1.5 watts dissipation, extends from 100 ohms to 2 megohms. Although an accuracy of 4 per cent. is claimed the specimens tested showed a much closer agreement than this when dissipating their maximum wattage, and the temperature rise is no greater than that of other makes of similar type. The price is 8d. each for all values.

Some sample fixed condensers of the 400-volt D.C. working type were tested also. These are of the non-inductive style and are contained in rectangular metal cases. They are available in sizes of from 1 to 8 mfds., the prices ranging from 1s. 6d. to 7s. 1d., according to capacity. In this series is included some block condensers arranged as 4+4 mfds. and 8+8 mfds., which are especially suitable for use in voltage doubler circuits; the former costs 7s. 3d. and the latter 14s. 6d. Tested at 800 volts D.C. we found no trace of leakage, neither did a single specimen fail to withstand this voltage during a prolonged test. They represent excellent value for money and the makers are Trevor Pepper, Wake Green Road, Birmingham, 13.

Selection of Lissen components, including 126 kc/s. I.F. transformer, new Class "B" input transformer and high inductance smoothing choke.

LISSEN TRANSFORMERS

THE range of Hypernik L.F. transformers made by Lissen, Ltd., Lissenium Works, Worple Road, Isleworth, Middlesex, has been extended, and now includes two new models, the one designed for use with the Class "B" output stage, while the other is a push-pull input transformer for use with Q.P.P. amplifiers. The Class "B" Hypernik transformer, as the former is known, has an overall ratio between primary and secondary of one to one, the primary resistance being 560 ohms and that of the whole secondary 420 ohms. The measured inductance of the primary winding is 36 henrys with no D.C. flowing, 23.3 henrys with 2 mA. of D.C., and 15 henrys with 5 mA. of D.C. flowing. The transformer is housed in a neat bakelite case of small dimensions and its price is 12s. 6d.

The Lissen Q.P.P. transformer affords a voltage step-up overall of one to eight, and is designed to carry up to 4 mA. of D.C. in the primary circuit. Its inductance varies between 20 and 35 henrys, according to the D.C. current flowing. It is enclosed in the same size and style of moulded bakelite case as the other new model, and the price is 12s. 6d. also.

In their new range of smoothing chokes is a miniature model fitted with a high permeability core but capable of carrying D.C. current up to 25 mA. Suitable for use in eliminators and mains receivers taking a total anode current within its range, it maintains a satisfactorily high value of inductance throughout, for with no D.C. flowing its inductance is 90 henrys, with 10 mA. 52 henrys and with 25 mA. 41.5 henrys. There are several uses to which a choke having this order of inductance can be put, and where its rather high resistance —namely, 1,500 ohms—is of little consequence. It is housed in a neat bakelite case and the price is 7s. 6d.

Lissen superheterodyne I.F. transformers consist of two separate coils wound in slotted formers and fixed in relation to each other. Both are tuned by small semi-variable condensers accommodated in the base of coil former and correctly adjusted to give band-pass tuning at a frequency of 126 kc/s. No further adjustment is necessary.

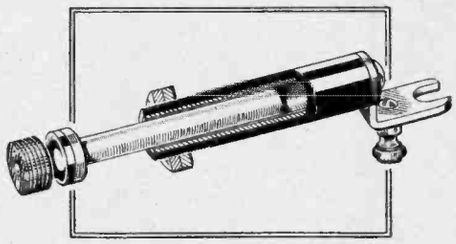
Some specimens when tested were found to be correctly adjusted to 126 kc/s, and the peak separation was approximately 5.7 kc/s. Various specimens tested showed a good agreement in matching. These I.F. transformers are fully screened and the price is 7s. 6d.

PRESSLAND TERMINAL COP

THE Pressland Terminal Cop is a small selectivity device which may be attached either to the aerial terminal of the receiver or mounted on the terminal strip in place of or adjacent to this terminal. It consists of an ebonite cylinder 2½in. long and ½in. in diameter, having at one end a spade connector for fixing to the aerial terminal. Pressed into the inside of this cylinder is a brass tube lined with insulating material, and in the centre is an adjustable brass plunger fitted with a terminal and an ebonite finger grip.

The device is in effect a small variable condenser, but with the difference that in the position of maximum capacity the two plates are short-circuited, giving a straight-through connection. By adjusting the position of the plunger any value of capacity between 0.00002 mfd. and 0.00015 mfd. can be placed in series with aerial lead, thereby affording a simple but effective control of selectivity. Volume may be controlled also by this means. The actual minimum value of the condenser is slightly less than 0.00002 mfd., but the plunger is then only just beginning to engage and the slightest jolt will displace it.

It should prove a very useful addition when a ready means of selectivity adjustment is required, and the price is 2s.



Pressland Terminal Cop selectivity device.

The makers are Clifford Pressland (Sales), Ltd., 84, Eden Street, Kingston-on-Thames, London.

Change of Address

THE Eta Tool Company, hitherto occupying premises at 70a/70c, Asylum Street, Leicester, having now taken over the business of Gandy and Co., 18, Metcalf Street, Leicester, manufacturers of woodworking machines, will in future carry on both their coil winding machine business and the manufacture of woodworking machines from this address. The telephone number is Leicester 5386.

READERS' PROBLEMS

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Amplifier for Headphones

IT is asked whether any special precautions should be observed in designing a mains-operated amplifier for use with headphones instead of for a loud speaker. Apparently the amplifier is to be used for feeding a number of pairs of phones.

A standard amplifier with an output of, say, 100 milliwatts for each set of 'phones should be suitable for this purpose. Smoothing should be exceptionally thorough, as a residue of hum which might pass unnoticed with a loud speaker would probably be annoying for headphone work. Especial care should be taken in isolating the 'phones from the mains, either by means of double-wound transformers or a choke-capacity feed system; whichever system be adopted there should be a large margin of safety in the matter of insulation resistance. The question of matching the 'phones to the output valve should also be considered.

Stage-by-Stage Hum Tests

WE are asked to describe the proper course of procedure to be adopted in locating the source of hum in a det.-2 L.F. "quality" set. It is operated from A.C. mains, and apparently the hum has only recently become noticeable.

As a set of this kind is usually free from complications, it should not be difficult to find the cause of the trouble. Referring to Fig. 1, the grid leak of the output stage should be short-circuited, and if the hum persists, it may obviously be assumed that the trouble lies in the output stage—the valve, loud speaker field, or, even possibly, in the mains smoothing equipment.

If, on the other hand, the hum disappears, the test may be carried a stage farther by short-circuiting the grid leak of the preceding valve. If hum is still audible, this valve, or its associated apparatus, is at fault. Replacing the valve or attending to the decoupling in its anode circuit are the usual cures.

Should hum disappear on the application of test No. 2, only to reappear after removing the short-circuit, the detector valve or its anode circuit are to be suspected, and here again the decoupling condenser and resistance should be checked. There is a possibility, however, that the voltages causing the hum are being induced into the grid circuit, and this is particularly likely to be the fact if the interference is high-pitched in tone. In such cases it is often beneficial to enclose the valve itself in a metal shield.

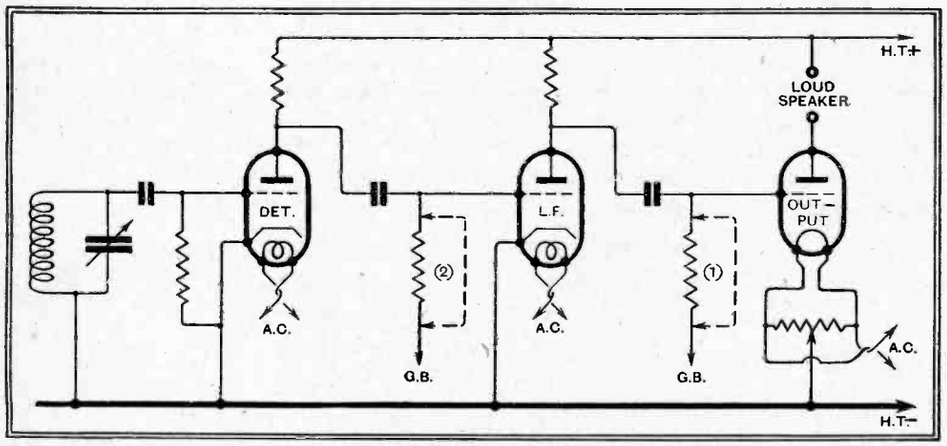


Fig. 1.—Tracking down the source of hum in a resistance-coupled amplifier. The grid leaks should be temporarily short-circuited in the order shown.

A Quieter Background

SO far as sets with a modern volume control system—and particularly super-heterodynes—are concerned, it may be stated definitely that anything which tends to reduce overall sensitivity will inevitably tend to accentuate "valve hiss."

An inefficient aerial is only one of the possible causes of low sensitivity, but it is quite a serious one, and those readers who have recently written to us on the subject are strongly advised to make an effort to improve matters in this direction.

Although an up-to-date superheterodyne can receive most European stations with a ridiculously inefficient aerial, it must generally be operated at full sensitivity to do so, and hiss is then likely to be in evidence. As the amount of amplification needed for a given strength is reduced the ratio between signal and background noises is bound to become more favourable to quiet reception.

Admittedly, users of even the best superheterodynes who live in the immediate vicinity of a powerful station have some excuse for using inefficient aerials; experiments show that the first detector may be overloaded by the local station even when the tuned circuits are adjusted to 40 or 50 kilocycles "off tune." This is probably the cause of the excessive number of whistles of which another correspondent complains. Even here we suggest that it would be better to make provision for coupling the aerial more loosely to the tuned input circuit rather than to reduce its length.

Home-made Delay Switch

A CORRESPONDENT asks whether an electric bell mechanism could be converted into a delay-action switch; his object is to prevent the application of excessive voltage from the H.T. rectifier to the condensers, etc., of the receiver and smoothing equipment during the warming-up period. His query relates, of course, to an A.C. mains set.

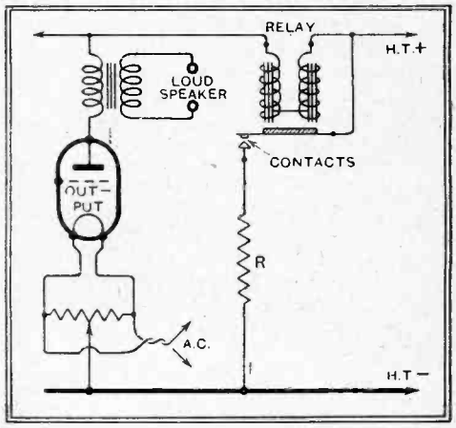


Fig. 2.—Preventing voltage rise; the artificial load resistance, R, remains connected across the H.T. supply until the valves begin to pass anode current.

This subject was dealt with in *The Wireless World* some time ago; as stated then, a fairly satisfactory protective device may be made in this way, but the improvised article can hardly be so effective as a proper thermal-action switch.

From Fig. 2 it will be seen that the bell is converted into a relay, its windings being inserted in the H.T. circuit. Until the valves warm up, no current passes through the windings, and so the armature is not attracted, and the contacts remain closed. In this position, the resistance R is connected across the output from the H.T. supply equipment, and provides an artificial load during the warming-up period.

As soon as the valve has attained a normal working temperature, the loading circuit will be interrupted by the relay and operating conditions will be normal. It will almost invariably be necessary to rewind the bell magnets with finer wire in order to obtain sufficient magnetising force to attract the armature. The resistance R should be of such a value that it passes about one-half to one-third of the current normally consumed in the anode circuits.

The Wireless World INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

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CONTENTS

EDITORIAL COMMENT

Wireless and Thunderstorms

A Negligible Risk

EVERY year as the season of thunderstorms comes round the lay Press appears to delight in headlines of a sensational character associating storm damage to buildings with wireless receivers, and it is curious to note to what an extent an early impression of wireless can persist and crop up year after year in this way. If we trace the history of this association of the wireless set with thunderstorms, we find that it all originates with the early wireless stations, especially transmitting stations, where a site was invariably chosen on high ground as remote as possible from any tall buildings or other obstacles which might impede the progress of the radiated waves. Aerials were elevated as high as possible and frequently supported between masts of metal construction. It was not unusual, as might readily be expected, for wireless stations of this character to provide a path for lightning discharges, and the designers of such stations took every possible precaution to meet this kind of risk.

Quite naturally, therefore, a wireless station came to be regarded in the lay mind as a sort of "trap" for lightning, but the position with broadcast receiving stations is entirely different and, except in such cases where these stations may be in isolated and elevated locations, there is very little reason to imagine that the addition of an aerial connection to a set enhances risks from lightning in any way. If a house is struck by lightning it may be expected that a considerable proportion of the discharge will travel down the aerial to earth as being a convenient path, but there is little evidence to show that the presence of an aerial has ever been directly responsible for a house being struck. In fact, in such cases, much greater damage might have been done if there had been no aerial present to assist in the passage of the discharge to earth.

The only precaution which we feel would be justified is to avoid using the set or sitting in the immediate vicinity of the down lead whilst a storm is active overhead.

There still seems to be a need to get out of the heads of non-technical people the idea that wireless attracts lightning; it does nothing of the kind. It is unfortunate that this type of scare should still be seized upon by the lay Press as sensational news, and still more is it to be regretted that manufacturers of aerial equipment should make use of sensational newspaper quotations associating wireless with storm damage as a means of advertising their wares.

Subdivision

The New Trend in Portables

COMPACT as it is, the average portable set can seldom be stowed away comfortably in car, yacht, motor-boat, caravan, or, indeed, any other normal kind of conveyance. How true it is, though, that two small articles can be accommodated more easily than one of the same cubic content; it is this truth which has inspired the design of the "Two Unit Portable" described in this issue.

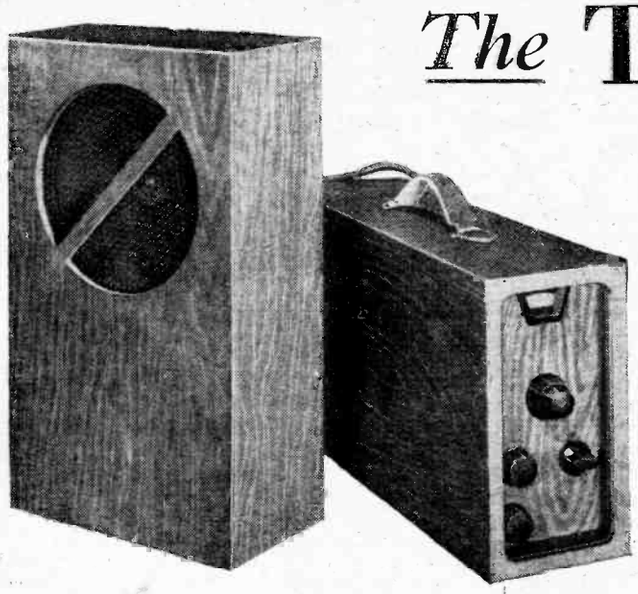
The two-unit principle removes various constructional difficulties, and simplifies the introduction of a moving-coil speaker which in this case is fed by a Class "B" amplifier.

In other details the set is well abreast of modern receiver design; it includes a short-base H.F. valve and new types of iron-cored tuning coils.

The Two-Unit Portable

Latest Technique Ensures Exceptional Quality, Volume, and Range

By H. F. SMITH



A SELF-CONTAINED set in which extreme portability and easy stowage have been secured, not by sacrificing performance but by dividing the weight and bulk into separate units, which may be interconnected in a moment. One of the containers accommodates the receiver proper and the L.T. battery, while in the other is mounted a permanent-magnet moving-coil loud speaker and H.T. battery. The set is especially intended for transport in cars, caravans, motor boats, and yachts, and is proved to be much more convenient than the ordinary portable.

SOONER or later occasion always seems to arise for carrying a portable set in a car; in spite of the compactness and lightness of the average present-day receiver of this type, it is surprisingly difficult to find room for it comfortably, especially in a "baby" or medium-powered vehicle. The average set is just too big to be stowed away without sacrificing a passenger's seat, or, alternatively, it occupies space in the luggage locker which is probably required for other purposes.

In a caravan, similar objections apply, but perhaps with less force; it is also rather difficult to find a place where the set can be mounted as a semi-permanent fitting.

On board small yachts and motor boats, again, it is generally found that the ordinary type of portable gets in the way, and, moreover, its frame aerial is anything but a blessing, due partly to the fact that enough space for swinging the set is seldom available.

This brings us to the question of aerials, and partly explains why in an all-purpose design it has been considered better to avoid a frame and, instead, to make provision for a short "open" aerial. On the score of sensitivity there will, more often than not, be an actual gain by adopting this course; as for selectivity, the new high-efficiency coils, with iron-powder cores, help very considerably towards a satisfactory solution of the problem.

To revert to the advantages of the two-unit principle of construction, it will be obvious that each of the units can be made considerably smaller and lighter than a complete "one-piece" set with anything approaching the same performance. Admittedly, the total cubic content and weight is quite as high, but, on balance, the gain is considerable. For instance, in a small car where it was found to be quite impossible to accommodate a conventional portable when four passengers were carried, the present set was easily packed away. One unit was used as an arm-rest between the occupants of the rear seats, while the other was stowed on the floor under the knees of the front passenger.

Latest Circuit Features

It will be seen from the circuit diagram reproduced in Fig. 1 that two tuned circuits only are employed, and that, instead of a band-pass input filter, the aerial circuit is of the single-tuned variety. This plan would be open to adverse criticism in a "fixed" receiver intended for operation with a full-sized aerial, but, as already indicated, the selectivity of the present arrangement is quite sufficient when the set is connected to a short and more or less improvised aerial. The types of aerial that the designer had in view were, for a motor car, an arrangement of parallel wires or wire netting in the roof; a gauze disc under the spare-wheel cover also makes a surprisingly effective collector. As for the caravan, similar arrangements can be devised, but even more easily, and on board the small yacht one of the wire-rope shrouds is generally satisfactory. The set is sensitive enough to work with very inefficient aerials, and

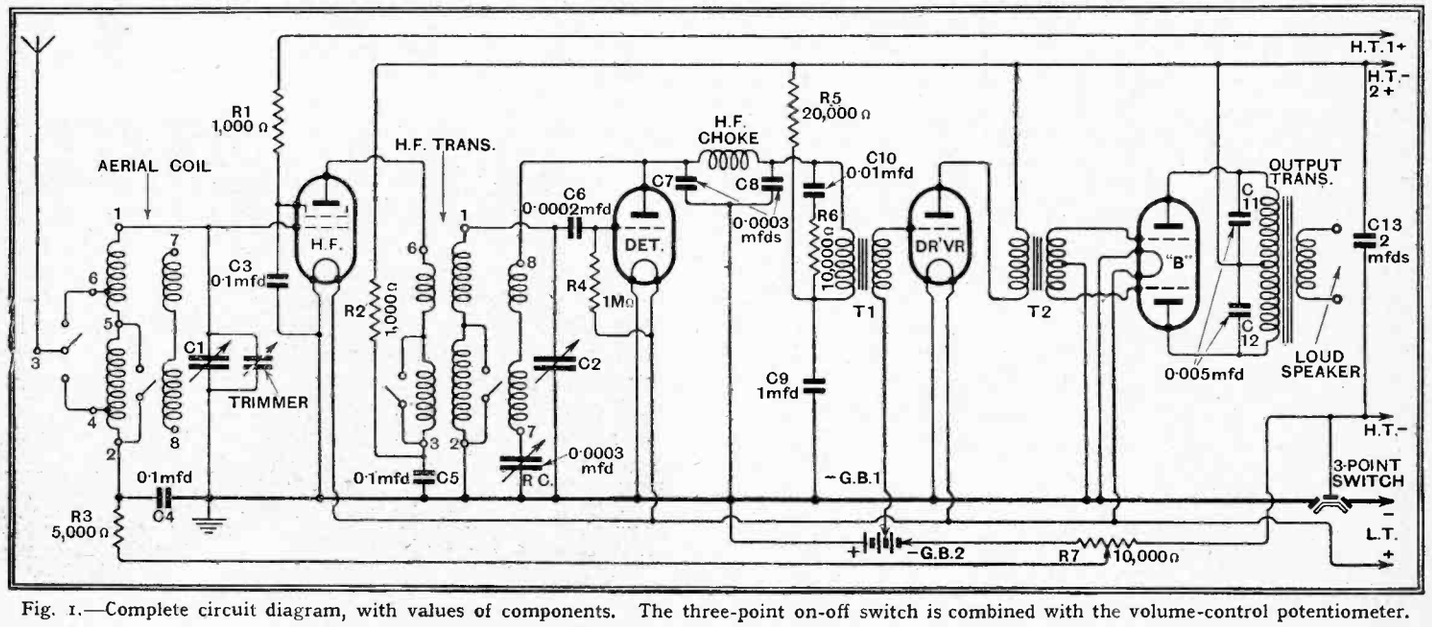


Fig. 1.—Complete circuit diagram, with values of components. The three-point on-off switch is combined with the volume-control potentiometer.

The Two-Unit Portable—

considerable liberties may be taken in this direction.

Although the receiver was not designed for operation on cars in motion, it is a matter of some interest that it has been found to give a good account of itself when used in this way. Strictly speaking, however, a more ambitious arrangement, of even greater sensitivity and with automatic volume control, is advisable.

Side view, showing the L.T. accumulator compartment and position of the bias battery. The detector and output valves have been removed to show more clearly the position of the H.F. and driver valves.

Except for the use of high-efficiency tuning coils, the arrangement of the H.F. and detector stages are conventional, although it should be noted that the new Mullard "short-base" variable-mu H.F. valve which was used in the original model is especially suitable for a portable set. With this type of valve, a comparatively small increase in negative grid voltage has a very marked effect in reducing the mutual conductance of the valve, and so in controlling the sensitivity of the H.F. stage. This means in practice that a low-voltage grid bias battery may be employed, and in this way a saving in weight and bulk is effected.

Thanks to the use of Class "B" amplification, quiescent anode current has been kept down to the very reasonable figure of 8 or 9 milliamps, and in order to ensure that the average working current shall also be as low as possible the necessary tone control is effected at an early stage in the L.F. amplifier. Actually, correction is introduced by a condenser-resistance combination shunted across the primary winding of the L.F. transformer which links the detector to the driver valve. The attenuation of high notes brought about in this way is by no means drastic, mainly for the reason that a good deal of automatic correction takes place in the tuned circuits, which, as already stated, are of high efficiency, and are not of the band-pass type. Further, the view may be expressed that the reproduction of a portable set is all the better for being slightly on the "bright" side; but those who hold contrary opinions may adjust matters to their own taste by using a larger condenser (C_{10}), or a smaller resistance (R_6).

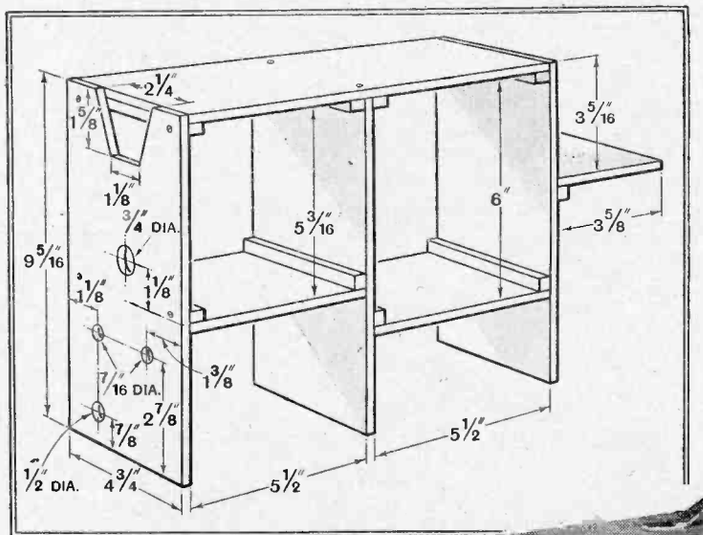


Fig. 2.—Dimensioned drawing of the removable internal wooden frame on which the components are mounted. It is constructed of plywood, ¼in. thick.

Like the H.F. amplifier, the Class "B" output valve specified is also particularly suitable for a portable, for the reason that its filament consumption is low, and so an L.T. battery of the capacity used will not need frequent recharging.

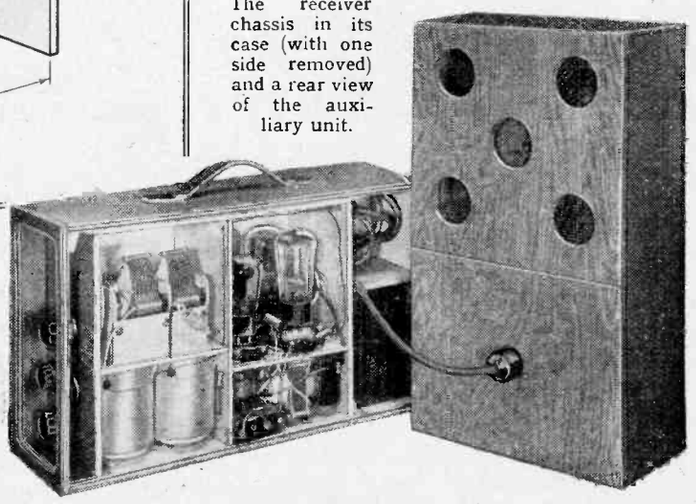
It will be observed that, in the "List of Parts," the usual alternative makes of components are not specified. This does not mean that the makes used in the original model are irreplaceable, but in a compact set it is obviously necessary to work within much closer limits than usual, and the inexperienced constructor might find himself in difficulties if substitutions were made. In many instances, however, it is possible to employ different components, especially when modifications as to dimensions and positions are to be made.

Removable Wooden Frame

All the components are secured on a wooden framework, of which the essential dimensions are given in Fig. 2. It is intended that this framework should fit closely inside a wooden container, matters being arranged so that the control knobs are set back far enough to be protected against risk of damage in transport. It seems desirable that there should be no external projections whatever, and that the case should be strong enough to withstand rough handling. The container for the loud speaker and H.T. battery is of similar dimensions and construction; for the convenience of readers, arrangements have been made for the Carrington Manufacturing Co. to produce both the cases and the frame.

Positions of components above and below the platform are shown in Figs. 4 and 5, except that it should be noted that the 0.1 mfd. by-pass condensers, C_4 and C_5, are not visible, as they are accommodated respectively under the screening cans of the aerial coil and H.F. transformer. These condensers, as well as all the others except C_9 and C_{13}, are of a type which can be suspended in the wiring. The same applies to the fixed resistors; by using these components a good deal of baseboard space is saved.

It should be noted that when mounting the tuning condenser and tuning coils,



The receiver chassis in its case (with one side removed) and a rear view of the auxiliary unit.

HOW TO WIRE THE TWO UNITS

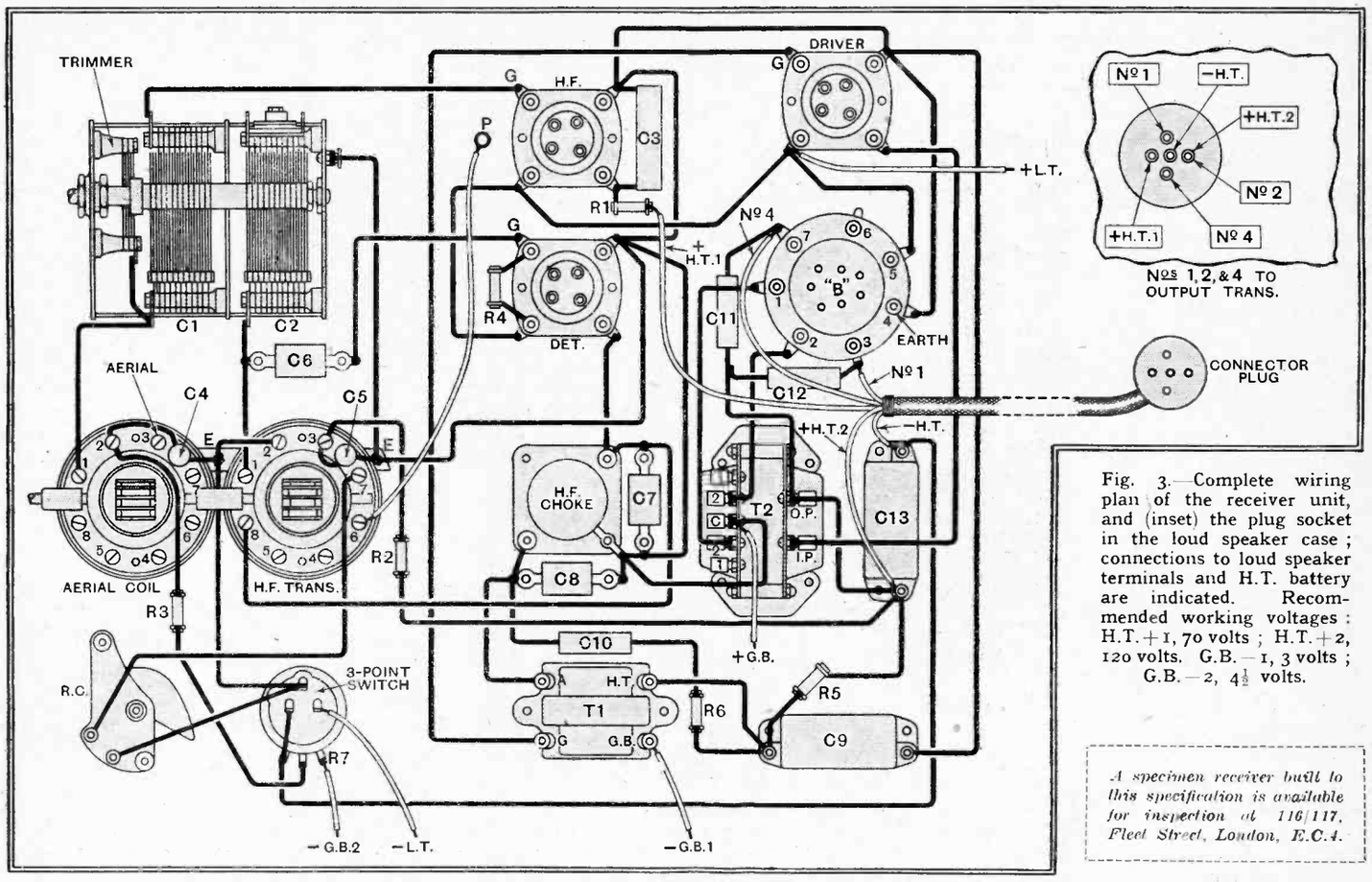


Fig. 3.—Complete wiring plan of the receiver unit, and (inset) the plug socket in the loud speaker case; connections to loud speaker terminals and H.T. battery are indicated. Recommended working voltages: H.T.+1, 70 volts; H.T.+2, 120 volts. G.B.—1, 3 volts; G.B.—2, 4½ volts.

A specimen receiver built to this specification is available for inspection at 116/117, Fleet Street, London, E.C.4.

etc., the front panel must be temporarily removed, and also that the condenser should be mounted first, as it is secured in position by screws passing up through the platform; the heads of these screws will later be covered by the tuning coils. In mounting these coils, reasonable care should be taken in aligning the switch-operating rods, and the insulated connecting link should be reduced in length so that two screening covers may be mounted close to each other. An earthing strip of copper or other metal is placed between the coils and the platform, and

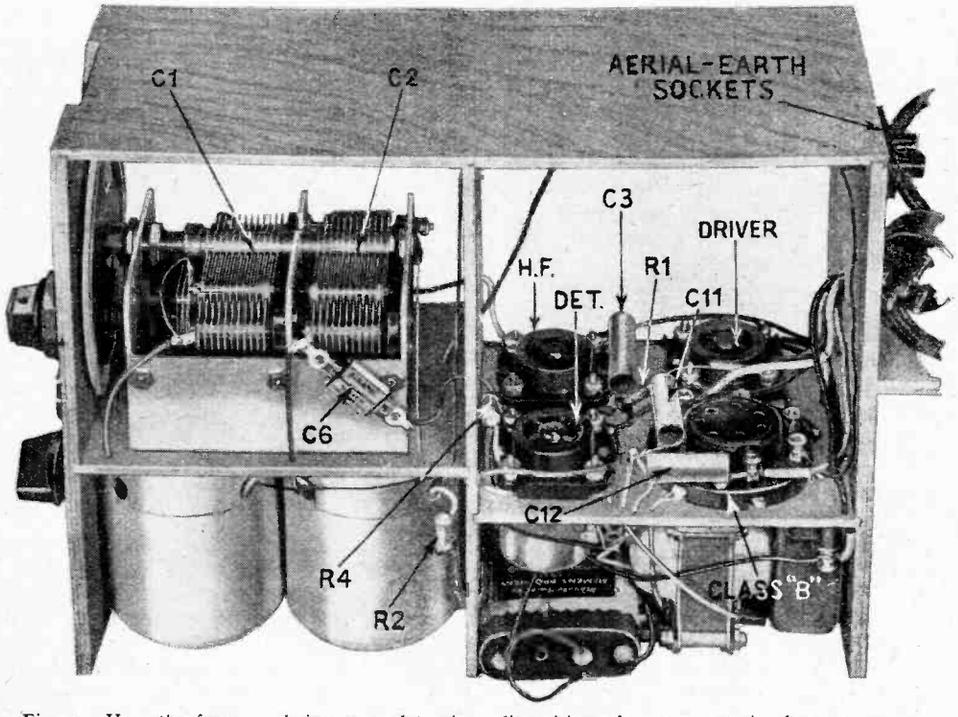


Fig. 4.—Here the framework is removed to show disposition of components in the upper compartments. Positions of the four valves are indicated.

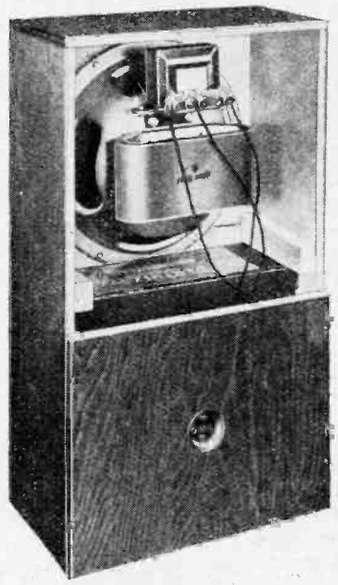
LIST OF PARTS

1 2-gang condenser, 0.0005 mfd., with air-dielectric trimmer C1, C2 (Utility Type W.312)
1 Set of 2 coils (aerial and H.F. transformer) (Varley "Nicore")
3 4-pin valve holders, anti-microphonic (Benjamin "Vibrolder")
1 7-pin valve holder, Class "B" (Benjamin)
1 Variable condenser, bakelite dielectric, 0.0003 mfd. R.C (Burton)
1 Fixed condenser, 2 mfds. C13 (Igranic No. 2231/70)
1 Fixed condenser, 1 mfd. C9 (Igranic No. 2231/69)
1 Fixed condenser, 0.01 mfd., tubular, C10 (British Radiophone)
3 Fixed condensers, 0.1 mfd., tubular, C3, C4, C5 (British Radiophone)
2 Fixed condensers, 0.005 mfd., tubular, C11, C12 (British Radiophone)
1 Fixed condenser, 0.0002 mfd., tag type, C6 (Igranic)
2 Fixed condensers, 0.0003 mfd., tag type, C7, C8 (Igranic)
1 Potentiometer, 10,000 ohms, with 3-point switch, R7 (British Radiophone Type No. 484)
1 L.F. transformer, 3½ : 1, T1 (Ormond Type 531)
1 L.F. transformer, Class "B," T2 (Wearite)
1 H.F. choke, screened (Graham Farish Type H.M.S.)
1 Fixed resistor, 1 megohm ¼ watt, R4 (Erie)
2 Fixed resistors, 1,000 ohms ¼ watt, R1, R2 (Erie)
1 Fixed resistor, 5,000 ohms ¼ watt, R3 (Erie)
1 Fixed resistor, 10,000 ohms ¼ watt, R6 (Erie)
1 Fixed resistor, 20,000 ohms ¼ watt, R5 (Erie)
2 yd. 5-way cable (Goltone No. R.39/5 MR)
2 Cases and frame ("Camco")
1 5-pin adaptor plug (Bulgin Type P.3)
1 Valve holder, 5-pin, chassis mounting type (Clix)
2 Plugs (Clix No. 10)
2 Insulated sockets (Clix No. 11)
2 ozs. No. 20 tinned copper wire, 6 lengths Systoflex, etc.
Screws: 24 ¼in. No. 4 R/hd.; 4 ⅜in. No. 4 R/hd.; 4 ⅜in. No. 4 R/hd.; 6 ½in. No. 6 R/hd.
1 L.T. accumulator cell, unspillable (Oldham PZV3)
1 H.T. battery, 130 volts (Pertrix No. 312)
1 Bias battery, 4½ volts (Siemens Size G.1)
1 Loud speaker, permanent magnet, Class "B" type (Blue Spot No. 29 P.M.)
Valves: Mullard PM12M, metallised, Mullard PM1HL, Mazda L2, Mazda PD220.

The Two-Unit Portable—

serves as a point of attachment for various earth leads.

With regard to the second case, which accommodates the loud speaker and H.T. battery, it is wise to fit wooden battens to prevent movement of the battery. Incidentally, the consumption of the set is quite low enough to make it possible to use the standard-capacity 120-volt battery, but as there is sufficient room, a somewhat larger battery, with a small reserve of voltage, was fitted in the original receiver. A five-pin valve socket is mounted on this unit, and through it the output from the valve in the receiver unit is passed to the loud speaker; H.T. current for the valves is fed to the set through the remaining connections.



Details of the H.T. battery-loud speaker container.

A practical wiring plan is given in Fig. 3; here the components are arranged as nearly as possible in their relative positions, and, with the help of the layout diagrams, no difficulty should be experienced in wiring the set. It should be observed that the same reference lettering for the components is adhered to in all diagrams, and also in the List of Parts.

a short-circuit across the H.T. battery.

The multiple interconnecting cable may be of any reasonable length, although it will seldom be necessary to make it longer than a yard or two, except when it is desired to mount the two units at a considerable distance from each other. It might prove convenient to do this, for instance, on board a yacht, where the receiver unit would be mounted flat against the cabin bulkhead, in such a position that the controls are get-at-able.

To economise in space, the three-point switch which interrupts both the L.T. and G.B. battery circuits is combined with the volume-control potentiometer. For maximum sensitivity this control must be rotated fully in a clockwise direction.

Preliminary adjustments are simple, and the writer has never encountered a more docile and manageable set; from the start, instability of any kind was totally absent, and, indeed, it was found difficult to provoke it artificially. The operation of ganging is carried out by first setting the air-dielectric trimmer to half-capacity, and then adjusting the semi-variable condenser across C2 for maximum response to a signal of short wavelength. Any subsequent adjustment that may be necessary is carried out by rotating the concentric air-trimmer control knob.

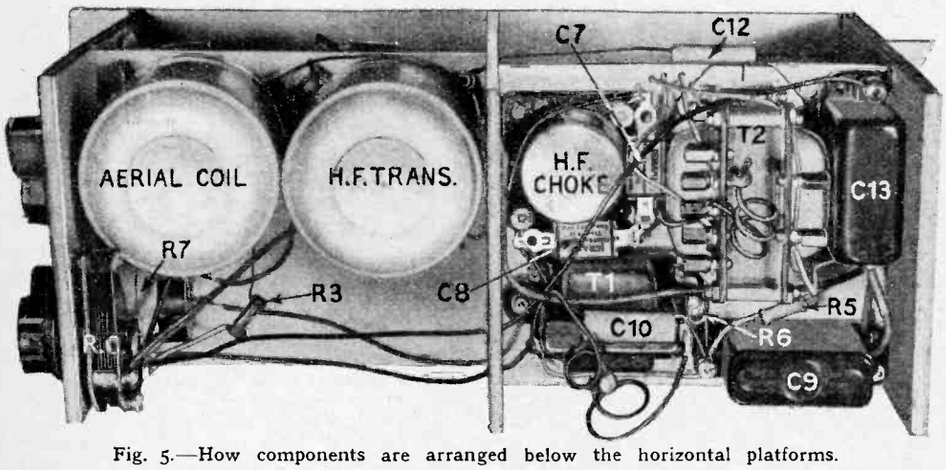


Fig. 5.—How components are arranged below the horizontal platforms.

It will be observed that, in the practical wiring plan, external connections to aerial and earth are indicated, but unless the set is to be used with a permanent aerial, it will be preferable to wire these points to a pair of sockets which may be mounted in the compartment which serves to house the connector cable and plug, and also the aerial and earth wires. For this purpose a pair of Clix sockets or a Belling-Lee double socket connector strip is convenient, and they may be fitted as shown in the illustration on page 441.

In wiring the receiver, it is as well to make sure that the moving vanes of the reaction condenser are earthed, and thus to avoid the risk of introducing

DISTANT RECEPTION NOTES.

LONG-DISTANCE listening is full of surprises at the moment, for you may come across at various times stations conducting transmissions on wavelengths very far from those assigned to them in the current lists. These transmissions are chiefly tests made with a view to ascertaining the effects of adopting the alterations suggested at the Lucerne Conference.

It is, for instance, almost a shock to come across a Swiss station at work on the long waves. The other day I was very puzzled at hearing speech in German almost on the Eiffel Tower's wavelength. The station turned out to be Beromünster. Both Beromünster and Monte Ceneri have been conducting tests, usually outside programme hours, on wavelengths well above 1,000 metres. I understand that the results of these tests showed that in Switzerland's mountainous country the use of a long wave enormously increased the service area. Beromünster's strength was certainly magnificent when I picked up its transmission.

Both Vienna and Hilversum are using much greater power in the evenings than they do during the daytime. Hilversum goes up from 7 to 20 kilowatts at 4.40 p.m., while Bisamberg is not able to use very high power in the daytime, since workmen are still engaged on the aerial. This station, by the way, does not seem yet to be radiating at full power even after dusk on most days of the week. I mentioned recently that Saturday had been its best night for some little time, and this still seems to be the case.

Amazing Kilowatts

I cannot believe that Hamburg has been using for the last fortnight no more than the 1.5 kilowatts shown in the lists. The new dispensation in Germany is making a great deal of use of the broadcasting stations, and it seems probable that steps are being taken to effect temporarily an increase in Hamburg's power until the new transmitter comes into operation. In any case, Hamburg is now as strongly and as easily received as Langenberg, whose official rating is forty times as great!

There is still no official news concerning Lyons Doua, another alleged 1.5-kilowatt station, to whose amazing performances I have referred before. In winter, when reception conditions were at their best, Lyons was rarely heard at any great strength. Now, at the height of summer, Lyons is amongst the most strongly received of Continental stations. If their number really is only 1.5 they must be astonishing kilowatts!

American stations, particularly the South American, have been wonderfully well heard on certain nights of late. The chief reason probably why more has not been heard of transatlantic reception this summer is that the best time for listening is between three and four o'clock in the morning, when few of us are able (or willing) to be at the control knobs of the receiving set. Any enthusiast who happens to be up and about between those hours may find it well worth while to try the small band between 200 and 250 metres, which is the most fruitful of results just now.

Daylight reception on the medium band, though not quite so good at the moment as it was a week or so ago, is still rather remarkable. Langenberg is nearly always to be received, whilst Trieste, Turin, Brussels No. 2, Hilversum (a pity that the 20-kilowatt plant cannot come into operation earlier), Nürnberg, and Fécamp are generally to be found when required.

Besides those mentioned, the best medium-wave stations from about 8 p.m. onwards are Rome, Leipzig, Strasbourg, the Poste Parisien, Breslau, Gleiwitz, Heilsberg, Bordeaux, Göteborg, Milan, and Florence. I would include Prague, but that this transmission is given to occasional periods of signal weakness at the present time.

D. EXER.

UNBIASED
BY FREE GRID

Plays both sides of the record.

Looking-in on the Radiogram

I SEE a radio savant writing in one of our popular evening papers wants the B.B.C. to save all the money they spend on radio drama and use it for television research. So far as I can gather, he makes this appeal simply because he finds listening to plays rather a bore. Possibly he lacks sufficient visual imagination.

While admitting that there is room for improvement in radio drama, I frankly cannot see why your hard-earned money and mine should be wilfully wasted in the manner suggested.

Since it has been demonstrated that television can be recorded on gramophone discs, I suggest that the play first be enacted before a suitable recording apparatus and the television discs sold at a high price to unimaginative people, who would, of course, have to supply their own turntable, screen and optical apparatus, and, incidentally, do their own synchronising by hand-adjustment of the speed of the gramophone turntable. But it would serve them right.

Perhaps, after all, it would be best to supply them with a complete talkie film of the play, and then they needn't bother to listen in at all.

For the Poor Man

I WONDER if the powers-that-be in the radiogramophone world are going to give us any improvement in automatic record changers at this year's exhibition? Judging by what I have seen already I rather think not, but it may just be possible that the manufacturers have something up their sleeves which has so far escaped me.

It is, of course, quite hopeless to expect them to give us anything in the nature of an instrument which plays both sides of the record, for, as I have already mentioned in these columns, they have turned a deaf ear to all my appeals. There is, however, one little improvement which we might expect from them, and it is one concerning which I have had several moans from readers who already own automatic record changers.

The moan is that when setting the lever provided for throwing the automatic mechanism "out of circuit" so that the gramophone can be used in the ordinary manner for hand-playing, users are deprived of an automatic stop. It may well be asked what is the object of such a stop, since if a person desires to play one record only and wishes the machine to switch itself off afterwards he can use the automatic record changer, which will deal with one record as well as with eight.

This is all very well for the plutocrats who confine themselves to standard twelve- and ten-inch records, but many of my readers are not very far from the bread line, having spent nearly all that they had in acquiring the machine, and so they are forced to go in for the cheap eight-inch records at the sixpenny stores. Of course, the record changer will not accept these.

There are those even poorer who cannot even afford the luxury of an eight-inch record, and have perforce to buy a home recorder and make their own. I trust that this appeal will catch the eye of one of our big manufacturers and cause a suitable contusion.

Flying Low in Scotland

STRANGE things are happening in the lonely wastes of Scotland, according to a correspondent of mine in that area. It appears that our old friend the Post Office van is actively engaged up there in the thankless task of chasing the hardy Scots to their lairs amid Killarney's lakes and fells, as the song has it, and, incidentally, attempting to separate them from their money.

The officials have been seriously obstructed in their work, however, by mysterious aeroplanes fitted with what my correspondent calls "powerful unlicensed transmitters." I feel, however, that no words of mine would be adequate to describe the strange deeds that are going on up there, and I must, therefore, fall back on my friend's own words.

"So powerful are these transmitters that as the aeroplanes fly in the vicinity of a van the frame aerial on its roof is caught up by the magnetic component of the transmitted wave, and, despite the efforts of the P.O. engineers to hold it steady, it is wrenched round until it is in alignment with the wireless transmitter on the aeroplane, and all efforts at detecting unlicensed receivers are thus set at naught. In some cases where aeroplanes have flown rather low the strength of the magnetic field has been so strong that the frame aerial has been torn off the roof of the van."

I feel that comment would not serve any useful purpose, and I will, therefore, content myself with remarking that the above extract is given exactly as it was in the original, except, of course, that I have been compelled, for the benefit of my southern readers, to deal drastically with one or two idiomatic phrases.

Me and My Midget

I HAVE often railed against the mellow bellow which is the hallmark of certain types of American receivers, and which the more ignorant of our manufacturers strive very successfully to copy under the mistaken impression that it constitutes good quality.

Its truly devastating effects were strikingly brought home to me the other day when I dropped into a London store to listen to an important outside broadcast, the exact nature of which the Editor tells me I must not disclose.

Having elbowed my way successfully through the crowd, I found myself confronted by one of the most notorious of American bass resonators. I endured the terrible racket almost up to the "off," when, unable to stand it any longer, I hastily donned the 'phones of my vest-pocket midget and prepared to enjoy the race in comfort.

Owing to the necessity of haste in tuning I unfortunately made one or two "tweets," which were reflected in the black looks given me by the crowd. Reception was none too clear, and, thinking that this was caused by my pressing reaction too closely, I at once proceeded to mend matters.

I can only explain subsequent kaleidoscopic happenings by supposing that, owing to my cramped surroundings, my elbow must have been jogged by some ill-mannered lout in the mob, so causing me to turn the vital knob the wrong way at a critical moment in the race; at any rate, I was suddenly seized from behind and violently propelled out of the crowd, with my portable flung after me.

Me and my midget.

I was rescued from my undignified position by the departmental manager, who made it quite clear that I was no longer *persona grata* so far as he was concerned, as in the disturbance two or three members of the audience had got away with models of American midget sets.

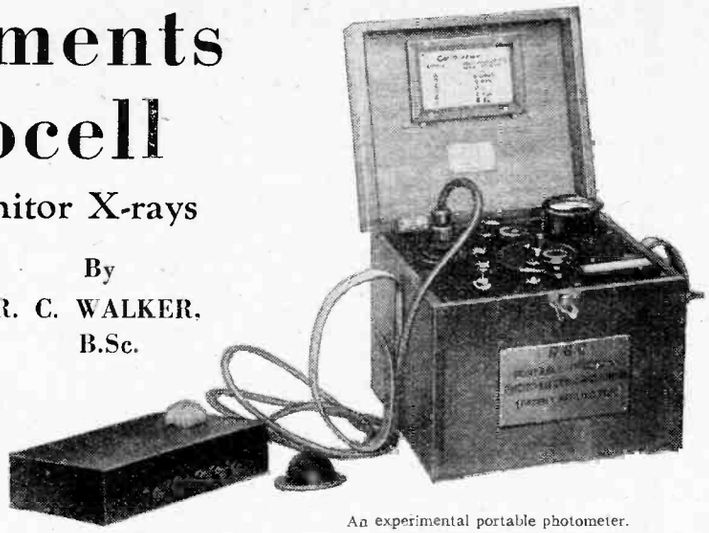
May static be their portion!

Making Measurements with the Photocell

How the Electrometer Triode can Monitor X-rays

TO achieve anything approaching accuracy in the measurement of light calls for something more elaborate than the ordinary photocell arrangement for detecting light rays. This article outlines the circuits used in colorimeters, optical density meters and similar devices, and describes the Electrometer Triode—a unique and interesting valve specially designed for the measurement of feeble currents.

By
R. C. WALKER, B.Sc.



An experimental portable photometer.

THE use of the photocell for quantitative measurements is not as simple as mere detection of light or darkness, where it is simply required to actuate a relay to switch in or out some external mechanism with pronounced changes in light intensity. Simple circuits involving trigger action, which are so useful in such cases, can be modified in certain instances for the purpose of making rough measurements, but considerable elaboration is necessary if a high degree of accuracy is demanded, and

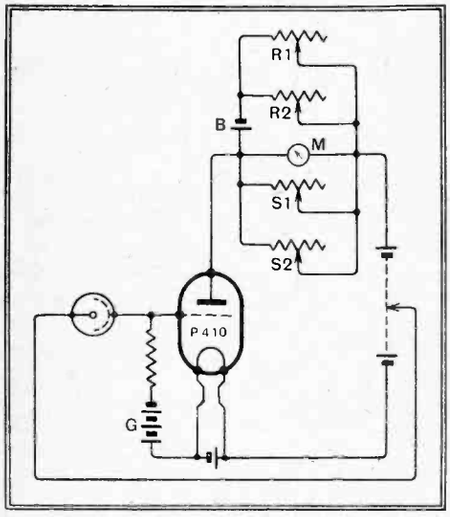


Fig. 1.—A simple photocell circuit used for colour measurements in industrial processes.

in their simplest form such circuits are often unstable. There are numerous reasons for this, and the purpose of this article will be to enumerate the methods which have been successfully used in overcoming these difficulties.

Provided that sufficient light is available, the straightforward circuit, in which the photocell is connected directly in series with a battery and galvanometer, is often the best, since the relation between light and photoelectric current is linear and a measurable deflection can be obtained with a high-grade instrument for very small currents. The obvious objection is the use of an essentially delicate indicating instrument, which, of course, limits the application of the method. If a robust instrument is substituted the employment of some form of amplification becomes necessary.

The circuit of Fig. 1 has been applied to various forms of colorimeters and optical density meters, and while it is capable of no great accuracy it has been found sufficiently good to warrant its use in industry. The range over which the relation between light and current in the valve anode circuit is linear is comparatively small, though that range is adjustable by varying the components of the circuit. The photocell is the Osram type K.M.V.6, and has an appreciable response throughout the whole of the visible spectrum, and although it has lower sensitivity to white light than the caesium type of cell it is also free from the comparatively large dark current which is frequently found in the latter type. The valve in Fig. 1 may conveniently be of the P.410 or L.P.2 type, carefully aged and tested for low grid current and high insulation resistance. M is a Ferranti 0-1 milliammeter with 200-ohm adjustable shunt S1 and 25-ohm vernier shunt S2, capable of permitting readings to be taken over a comparatively wide range. By means of the grid bias battery G the anode current should be reduced to a low value when the photocell is dark, and the milliammeter reading then reduced to zero by adjusting the resistance R1, and the vernier resistance R2 in the circuit of the auxiliary battery B. It is convenient to test the scale relation of the meter for light incident on the cell by arranging the meter to read 100 at full illumination and then interposing screens of known absorption at two or three parts of the scale. No attempt should, of course, be made to operate the circuit from supply mains.

Avoiding Insulation Leakage

It must be remembered that the current amplification is high, and, consequently, it is obvious that, unless special precautions are taken to avoid insulation leakage, small changes in valve characteristics may take place and difficulty will be experienced in repeating observations to within 5 per cent. Resistance coupling of several stages can be used as an alternative, but this necessitates a means of interrupting the light on the photocell at a frequency suitable for amplification in order to produce A.C. pulses on the input grid.

Thoriated Tungsten Filaments

Considerable improvement on the circuit shown in Fig. 1 can be obtained by what is termed a "null deflection method," using two valves connected in a bridge circuit as illustrated in Fig. 2. This arrangement is useful in cases where the photoelectric current is small compared with the backlash of the valve. In order to avoid extraneous disturbances the entire circuit, including batteries, should be housed in an earthed metal case, and the batteries kept permanently in circuit so that the valve may settle down to a steady state. Valves with thoriated tungsten filaments of the type

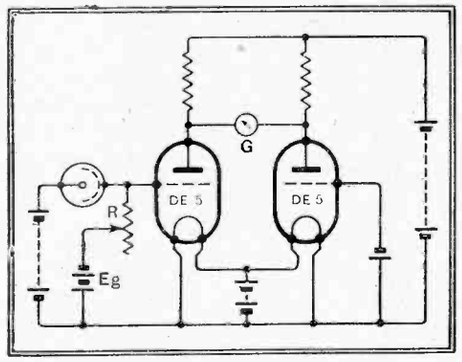


Fig. 2.—An improved arrangement in which two valves are connected in a bridge circuit.

D.E.5 are most suitable. In using this circuit it is best to employ a plain indicator G and balance its reading to zero by adjusting the grid bias Eg. A change in this grid bias Eg corresponds to a change in photoelectric current equal to

$$\frac{Eg}{R}$$

so that if the cell has a linear relation between light and photoelectric current, the adjustable resistance, which should not be greater than 10 megohms, may be calibrated to read directly. Elaborations of

Making Measurements with the Photocell— this circuit have been used in the measurement of colour temperature and light output of electric lamps, and have been standardised for precision measurements of this kind. A portable photometer of an experimental type, involving an arrangement on the lines of that shown in Fig. 2, is illustrated at the head of the article.

It may be interesting to consider more closely the reasons for lack of uniformity in valve circuits for making direct measurements. Poor insulation and grid current are the chief factors. The contributory causes of grid current are: (1) *Positive ions from the filament, from the anode, or from the residual gas produced by electronic bombardment.* Positive ions from the filament are avoided by the use of a low-temperature filament of the oxide-coated type, and from the residual gas by a low plate voltage, i.e., less than the ionising potential of the gas. The latter condition also eliminates the possibility of positive ions from the anode. (2) *Electrons reaching the grid from the filament.* This trouble can be reduced by operating the grid at a sufficiently high negative potential. (3) *Photo-electric emission from the grid itself.* The use of a dull emitting filament and operating in complete darkness will eliminate this factor. Poor insulation may give rise to surface leakage over the internal or external surface of the glass, and the presence of "getter" on the "pinch" of the valve will provide a further contributory cause of grid current. It is clear, therefore, that grid current may be in either direction, according to the magnitude of the factors mentioned, and the uncertainty of the value of this current is a great inconvenience in the measurement of small currents.

Fig. 3.—The electrometer triode, developed by the General Electric Co., Ltd., for measuring feeble currents.

In order to facilitate the measurement of feeble currents, a valve of special design has been developed, and is known as the electrometer triode. Incidentally, this valve is suitable in nearly all cases as a substitute for an electrometer, i.e., for measurement of hydrogen ion concentration, X-rays, α particles, etc., and therefore offers a wide field of application in applied physics and electromedical investigations. Fig. 3 shows the external appearance of the type made by the General Electric Co., Ltd., and Fig. 4 the electrode assembly, the arrangement of which is unusual. The anode consists of a nickel plate mounted horizontally above the pinch, and supported by two nickel wires, one of which forms the lead-in. The filament is of the single V type and mounted horizontally above the anode. The grid is supported parallel to and above the anode by a nickel wire insulated from the pinch support wire by an elongated bead of hard glass. The valve is fitted with a standard base, the filament and anode being brought out to the pins, to which they are connected in a normal triode, while the lead from the nickel band on the pinch which forms an internal guard ring is brought out to what is usually the grid pin. A number of turns of tinned copper wire are wrapped round the wall of the valve immediately above the base, and are fixed in position with solder. One end of this coil, which forms the external guard ring, is connected to the same pin as the internal guard ring. The grid of the triode is taken out at the opposite end of the bulb, which has an extended neck and is fitted with a screw cap. The following are the characteristics of the Osram type:—

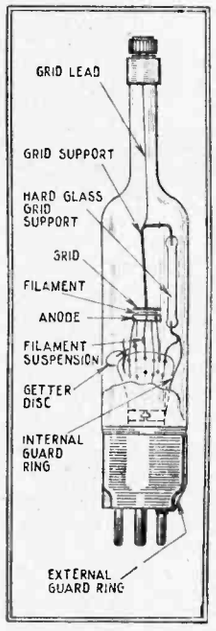


Fig. 4.—The electrode assembly in the electrometer triode.

Filament	1.0 volts, 0.1 amp.
Anode	4-10 volts.
Mutual conductance	with grid −1.5 volts and anode 2 volts = 0.04 mA./volt.
Mutual conductance	with grid −1.5 volts and anode 10 volts = 0.16 mA./volt.
Insulation between grid and other electrodes	10^{14} ohms.
Interelectrode capacity	1.6 $\mu\mu$f.

Grid potential should be greater than −1.0 volt, with respect to negative end of filament.

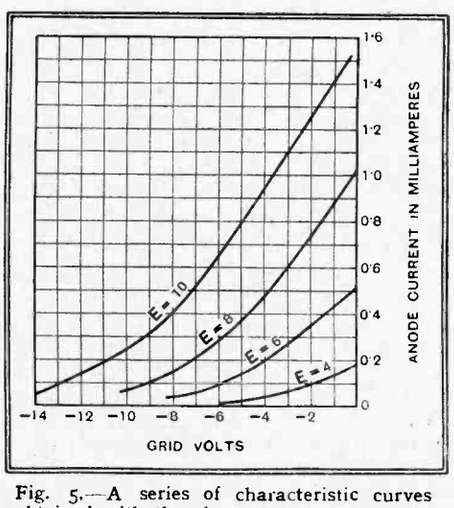


Fig. 5.—A series of characteristic curves obtained with the electrometer triode under varying conditions of anode voltage.

The surface of the bulb should be kept clean and dry, and the triode may with advantage be kept in an enclosure with a suitable dehydrating agent such as calcium chloride.

Fig. 5 shows a series of characteristic curves taken under varying conditions of anode voltage, and Fig. 6 a typical amplifier circuit. One of the most recent developments in the use of this triode consists of the combination of this valve and a photocell together in a third exhausted envelope, an arrangement which will probably go a long way towards overcoming the inherent difficulties of highly accurate amplifier circuits. The idea is not entirely new, since considerable work has been done on the development of phototubes in America, these units consisting of a photocell and thermionic electrodes in one and the same evacuated bulb. The method of combining the photocell and electrometer triode appears to have great possibilities for the future in the field of quantitative measurements.

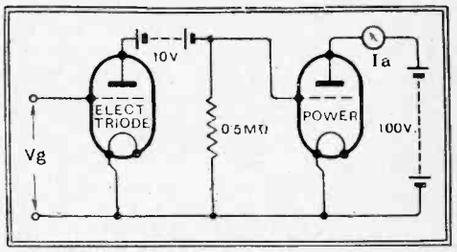


Fig. 6.—A typical amplifier circuit.

FOREIGN BROADCAST GUIDE

BERLIN-WITZLEBEN

(Germany).

Geographical position: 52° 32′ N.; 13° 25″ E.

Approximate air line from London: 583 miles.

Wavelength: 419.5 m. Frequency: 715.5 kc/s. Power: 1.5 kW.

Standard time: Central European (coincides with B.S.T.)

Standard Daily Transmissions.

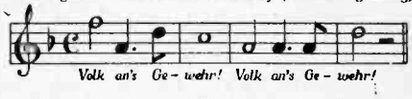
06.15 B.S.T., Physical exercises; talk; morning concert; 08.15, physical exercises; 08.55, sacred service (Sundays), then continuous broadcast until 18.00, concert, talks; 19.00, National transmission relayed to all German stations.

Announcers: Male.

Call: *Achtung! Achtung! Hier Berlin* (followed by the names of other stations taking same programme). When National transmission is given: *Hier Stunde der Nation.*

Official time signal: 12.55.

Interval signal: Musical-box melody (Marching Song).



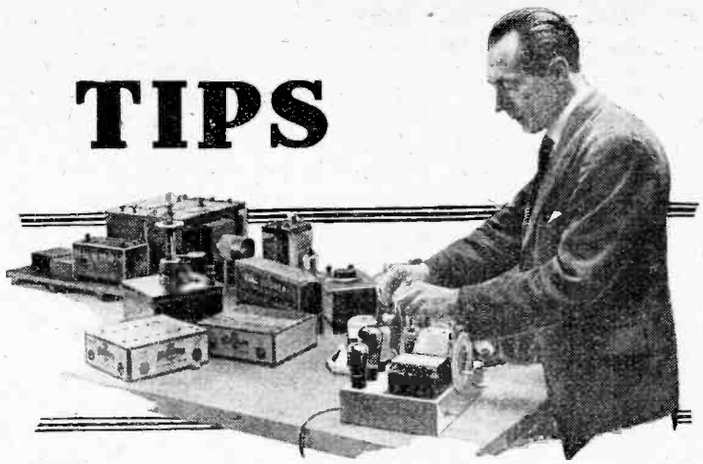
Closes down with the usual German good-night greetings: *Gute nacht meine Damen und Herren,* and the *Horst-Wessel Lied* of which the first few notes are here given

followed by the German National Anthem (*Deutschland ueber Alles*), played to the melody of Haydn's Hymn (Austria).

Relays: Berlin, Stettin, Magdeburg, 283 m. (1,058 kc/s); Koenigswusterhausen, 1,635 m. (183.5 kc/s) and Zeesen, occasionally, on 31.38 m. (9,560 kc/s) and 49.83 m. (6,020 kc/s).

Practical HINTS and TIPS

AIDS TO BETTER RECEPTION



WAVE-RANGE switches are often fitted with control knobs which bear no indication of the appropriate positions for medium or long wavebands. When handling a set with which one is unfamiliar, and which is not fitted with a marked switch, it may be remembered that, nine times out of ten, an appreciable resistance to rotation is encountered when turning the switch to the *medium-wave* position. The reason for this is that, almost invariably, the switch blades must be forced into contact in order to impose a short-circuit across the long-wave coils, and so permit of reception being carried out on the medium band.

The Right Direction

THE average D.C. mains receiver includes a condenser in the earth lead, which is intended to prevent a "double earth," or, where the positive side of the mains is earthed, to obviate a more or less direct short-circuit. Sets operated with a D.C. eliminator also embody what amounts to the same thing; it is generally arranged that the set shall be earthed through a condenser which is actually built into the eliminator unit.

D.C. Mains Short-circuits

When this type of protective device is employed it should be remembered that an accidental reversal of the aerial and earth connections to the set may be harmful, as, in the absence of a series aerial condenser, the earth condenser will be virtually short-circuited by the aerial coil. If the mains happen to be positively earthed, as shown in Fig. 1, they will be short-circuited through earth by making the connection shown in dotted lines.

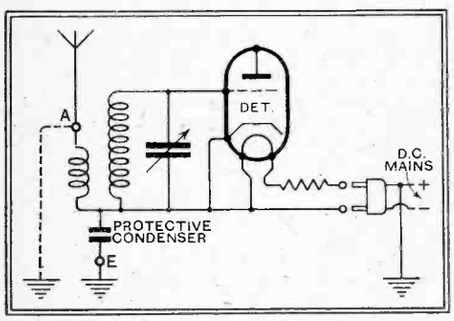


Fig. 1.—Skeleton diagram showing the need for complete isolation of the aerial-earth circuit in a D.C. set.

Even where negatively earthed mains are employed trouble may occur if it happens that the mains plug is accidentally reversed at the same time as the aerial-earth connections. Although the possibility of two reversals taking place simultaneously would appear to be remote, a correspondent, whose business activities are connected with insurance, tells us that such occurrences are by no means unknown.

The moral of this is that, in a D.C. set, the external aerial-earth circuit (and not only the earth connection) should be metallically isolated from any part of the wiring which is connected to the mains. This isolation is usually afforded by condensers, but a completely separate aerial winding on the input tuning coil serves the same purpose.

WHEN working on short—and particularly on ultra-short—wavelengths, it is often found that noises which are akin to those caused by atmospherics, electrical interference, or by a loose internal connection, may be produced in a way that is seldom suspected by the average user. Severe interference can be set up by loose metal objects in contact, such as tools, etc., in the immediate vicinity of the receiver.

Noisy Short-wave Sets

This trouble, in a particularly aggravated form, was recently traced to the fact that a drawer under the table on which a newly built set was being tested was used for storing tools and various pieces of metal; on removing the drawer to a distance the interference ceased entirely.

THE absolute inter-dependence of voltage, current and resistance in an electrical circuit should always be borne in mind. With a fair working knowledge of the relationship existing between these quantities, satisfactory test can be made with fewer measuring instruments than would otherwise be needed.

Volts and Amps.

The natural thing to do when testing a receiver is to attempt to measure the voltage of the various sources of supply on which its operation depends; this is because voltage is, so to speak, the primary effect which causes current to flow through a resistance. But when a voltmeter is not available it is quite possible that an ammeter or milliammeter, which measures current instead of pressure, will give equally informative results. Take the simple circuit of Fig. 2 (a), which represents a battery in series with a resistance: to ascertain the condition of the battery, a voltmeter would generally be connected across it. Instead of relying on a voltage measurement, however, we can be fairly confident that the battery is in order if an ammeter connected in series with it and the load resistance shows a normal reading. In this simple case, it would only be possible to be misled if the resistance, for some unknown reason, had undergone a change in value.

In other words, if current is right, we have strong presumptive evidence that the voltage which gives rise to that current is also right.

All this is applicable, of course, to a wireless receiver, and the more familiar circuit of Fig. 2 (b) represents what is basically the same, from the point of view of current and voltage measurement, as the circuit of diagram (a). If either the H.T. voltage or anode current of a valve are found to be normal, it is extremely unlikely in practice that there will be anything wrong with the particular circuit in which operating conditions are being measured.

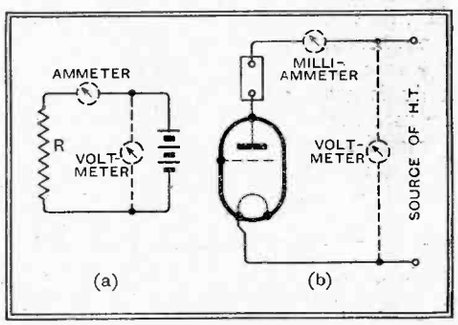


Fig. 2.—If current is normal, battery voltage must also be normal unless the resistance R in diagram (a) has undergone a change. The same reasoning may be applied to the valve circuit (b).

It is often advised that the anode currents of all the valves of a new receiver should be measured and recorded, in order that defects and failures in valve emission may be traced more easily. This is excellent advice, but it may be supplemented by saying that readings of voltage are rather more easily taken, and are in many cases almost equally informative. When a valve begins to lose emission the voltage on its anode will rise, due to the reduced voltage drop across the various resistances included in the anode circuit.

How the Superhet Works. 5.

THE FIRST DETECTOR

Choosing a Square-Law Valve

By W. T. COCKING

IN this article, which is the fifth of the series, the first detector is discussed. It is probably not generally realised how widely this detector differs in its action from the type used in a straight set. As the input consists of both the signal and oscillator voltages the principle of demodulation arises and plays an important part.

THE chief operating principles of the superheterodyne will now be apparent, and we can turn our attention to the details of design upon which so much depends. Let us return first to the frequency changer. The necessity for using a diode or power grid detector for high-quality reproduction has been so often stressed in the pages of this journal that a lack of confidence in the ability of the superheterodyne to deliver an output free from distortion is often expressed, since anode bend rectification is almost invariably used for the first detector. It is not generally realised, however, that the operating conditions of the first and second detectors are in no way parallel. So far from an anode bend first detector introducing distortion, it is probably the only rectifier which will permit distortionless frequency changing.

The ordinary detector is usually considered to have an input from the desired station, that is, a single modulated carrier, and no account is taken of interference. In this case, a linear rectifier is essential if the modulation is not to suffer amplitude distortion. A rectification characteristic which is linear for a single applied voltage, however, is not necessarily linear when two or more voltages of different frequency are simultaneously applied to the rectifier. It has, in fact, been pointed out by F. M. Colebrook[1] that when two signals are applied to a linear detector the effective rectification characteristic is profoundly modified; the characteristic becomes non-linear. If the two signals are of different amplitudes, the rectification characteristic for the weaker of the two departs considerably from the original straight line and the efficiency of rectification is greatly reduced. As far as the stronger signal is concerned, the characteristic is much less affected, and the efficiency and linearity are only slightly reduced.

The effect is, perhaps, best illustrated by the curves of Fig. 1, in which curve A shows the rectification characteristic, that is, the detector output plotted against the input, for a perfect rectifier operating with a single input voltage. When two different inputs are simultaneously applied, the characteristic is modified, and takes the form shown by curves B and C. If one signal be much stronger than the other, the characteristic for the strong signal is very little affected by the presence of the weaker, and is similar to curve B. The response of the detector to a weak signal in the presence of a stronger, however, is shown by curve C, and it is evident that the characteristic has been very greatly modified. The slope of the curve is greatly reduced, indicating poor efficiency, and it is far from the ideal straight line. The effect is the well-known apparent demodulation of a weak signal by a strong.

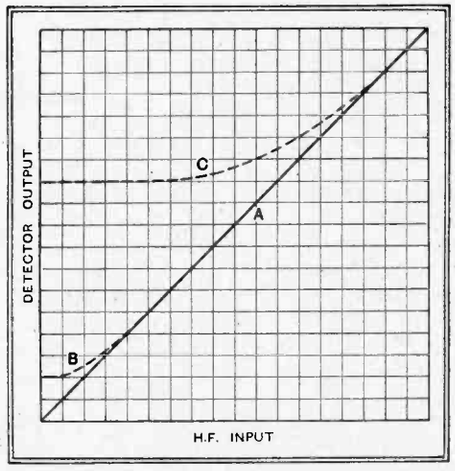
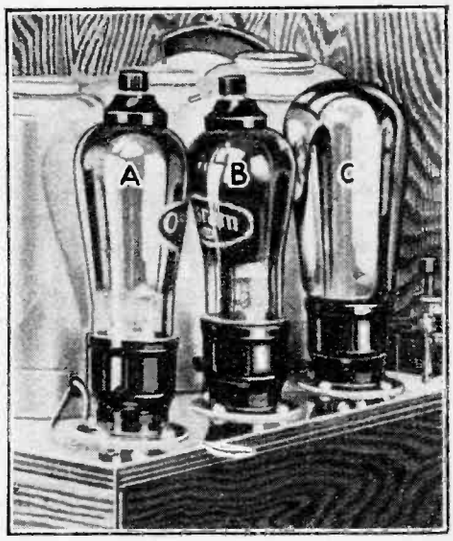


Fig. 1.—Rectification characteristics (A) for a perfect detector with a single input voltage, (B) for the same detector to the stronger of two simultaneously applied voltages, and (C) to the weaker of two applied voltages. The large change in the last case should be noted.

Now the first detector of a superheterodyne never operates on a single input, the ideal case for the second detector, for there is always one voltage due to the signal and another from the local oscillator. Under normal conditions the voltage from the oscillator is stronger than that caused by the incoming signal. If we use a linear first detector, therefore, the effective rectification characteristic to the signal will be similar to curve C of Fig. 1; it will be very far from linear. The process of frequency changing, therefore, will not only be inefficient, but it will introduce distortion and may also be responsible for whistle interference.



The first detector (B) is here shown mounted between the H.F. valve (A) and the oscillator (C).

Suppose, however, that instead of using a linear detector we employ one of the square-law type. For a single input the characteristic will then be a curve such as A of Fig. 2, and at first sight it appears to be quite unsuitable. In the presence of the local oscillator, however, it takes a different form. Just as the characteristic of a linear detector becomes non-linear in the presence of the oscillator, so the response of a square-law detector becomes linear to the weaker of two simultaneously applied voltages, as shown by curve B.

Detector Overload

In practice, valve curves do not follow a square law over the whole of their range, and, as the input voltage increases, they approach more closely to a straight line. This is shown by curve A of Fig. 2, which follows a square law only for small input voltages. As a result, the effective rectification characteristic of a practical first detector is only linear as long as the input does not exceed a certain value. For large inputs, when the valve curve is approaching linearity, the effective characteristic begins to droop and becomes non-linear. This is brought out by the bend in curve B of Fig. 2.

In designing a superheterodyne, therefore, we must always keep the first detector input below the value at which non-linearity commences. Quite a large lati-

[1] "A Little Known Fact about Interference," *The Wireless World*, May 27th, 1931.

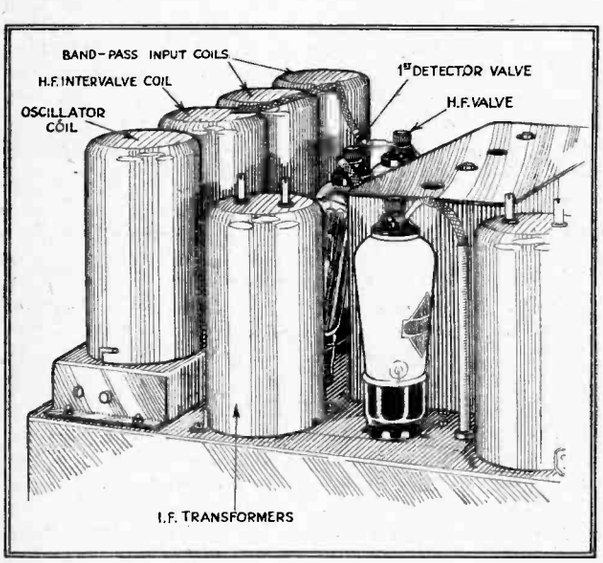
How the Superhet Works—

tude is permissible, and in a receiver of the type which we are discussing the second detector will normally overload long before the first detector approaches non-linearity.

The conditions which we have discussed, however, are only those of the reception of a single station with the sensitivity of the set adjusted appropriately to its strength by the volume control. Practical conditions will often be much more severe, and the first detector input will certainly not be confined to voltages from two sources only—the desired station and the local oscillator. Suppose that we are trying to receive a weak signal spaced by only 20 kc/s from a powerful local, and for the reception of this weak signal the set must be working at its maximum sensitivity. With an efficient aerial the local station may set up as much as 7 volts peak across the aerial tuning condenser (see C1, Fig. 1, in the first article of this series) when this circuit is tuned to resonance. Even if the aerial tuned circuit be efficient, there is unlikely to be less than 1 volt peak applied to the grid of the H.F. valve when this circuit is mistuned from the local by only 20 kc/s.

Volts from the Local Station

If the intervalve tuned circuit is of similar efficiency, and the stage gain at resonance be 100 times, the amplification of the local station will be 15 times, so that there will be 15 volts peak due to the local applied to the first detector grid in addition to the minute potential from the wanted station and the oscillator voltage. During deep modulation the peak voltage from the local station may rise to nearly double this value. The oscillator voltage should always be stronger than any other potential applied to the first detector, so that for this condition the first detector should be biased to not less than 60 volts negative, if grid current and consequent damping of the tuned circuit and overload distortion are to be avoided.



Typical arrangement of components associated with the signal frequency and oscillator voltages, which together must be applied to the first detector.

This condition, of course, is absurd, for it would necessitate the use of a large output valve for the first detector. This is impracticable, but it would theoretically be necessary under the conditions laid down. These conditions, however, are unnecessarily severe, for if the wanted signal were so weak that the full amplification of the set were necessary with a good aerial it would be weaker than the generally prevailing level of background noise due to atmospherics, and so be of little use. In general, the wanted signal will be much stronger, so that the full amplification is not needed with a good aerial.

Suppose that the station has a strength such that an amplification of only 25 times is needed from the H.F. valve, or only one-quarter of the maximum value. The maximum peak input to the first detector on deep modulation from the local station will then be no more than 7½ volts, and the bias can be some 15 volts only. This is quite a possible case, but not one which is often encountered in these days of powerful transmitters, for a bias of some 6 to 10 volts is usually sufficient. These examples, however, show the need for care in selecting the operating conditions of the first detector, and it is evident that this valve should be operated with as small a signal input as possible. We have the question of background hiss to consider, however.

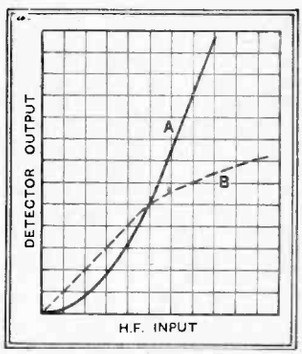


Fig. 2.—The square-law detector has a curve such as (A) for a single applied voltage, but to the weaker of two simultaneously applied voltages it takes the form of (B). Under the correct condition, the first detector is thus linear.

It is well known that a hissing sound is evident when an ordinary reacting detector is oscillating, and the same effect sometimes occurs in a superheterodyne. The output of an oscillator is not a pure H.F. current, for it carries a slight modulation due to imperfections in the circuit and valve. The amount of such modulation is very small, and very high amplification is necessary before it becomes audible. Nevertheless, it places a definite limit to the amount of useful amplification which can be used following the first detector of a superheterodyne. A slight hiss during pauses in the wanted modulation may be unobjectionable, but when it is evident at a strength comparable with that of the programme it is intolerable.

The amount of I.F. amplification which can be usefully employed is at present open to doubt. It depends largely upon the purity of the oscillator output as regards the unwanted hiss modulation, but also upon the amount of L.F. amplification used, the volume level desired, and the degree to which high-audible frequencies are retained. In general, more than a single I.F. valve leads to excessive background, but if the L.F. amplification and the maximum volume be moderate, two I.F. stages may be permissible. This applies, of course, to stages used to provide their maximum amplification, for two low-efficiency I.F. stages may lead to no more hiss than a single high-efficiency stage.

Since the I.F. amplification is limited, the sensitivity also is limited, unless H.F. amplification be employed. It will be seen, therefore, that the H.F. stage of a modern superheterodyne is used largely to obtain freedom from background hiss while keeping the sensitivity at a high level. If it were not for background hiss it would be simpler to provide the requisite amplification at the intermediate frequency.

The use of an H.F. stage is by no means universal, however, and very many sets without it are to be found. In general, a superheterodyne without an H.F. stage is less sensitive than one employing signal-frequency amplification, and in the reception of any given station it will tend to give more background hiss. This does not necessarily mean that the hiss will be audible, however, for that depends on the signal strength and upon the aerial employed. With a good aerial it is quite possible to obtain hiss-free reception of the stronger distant stations without using an H.F. stage, but a set which does include such a stage will permit better reception of weaker stations, or as good reception of the same stations with a poorer aerial.

Reducing Input

We must now leave the first detector for the time being, but before doing so it is as well to emphasise that this valve must always be operated in a linear condition. As a result, either the valve must be of a type which will accept a large bias and still have a square-law characteristic, so that grid current does not flow when receiving a station nearby the local, or some means must be provided for reducing the input from the local station below the value which has so far been assumed to be a minimum in this article.

Previous articles of this series have dealt with the following stages of the superheterodyne receiver:—(1) The signal frequency stage; (2) the H.F. stage and the oscillator; (3) the frequency changer and the I.F. amplifier; (4) the second detector.

The New Wavelengths

Lucerne Plan Accepted

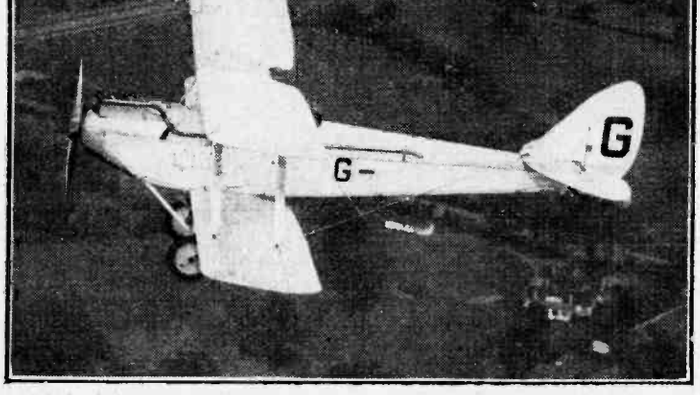
TWENTY-SEVEN countries signed the "Plan de Lucerne" on Monday last, while seven delayed their decision, these being Holland, Sweden, Finland, Poland, Luxembourg, Lithuania, and Greece, all of which have an opportunity to sign before January 15th, 1934, when, at one minute past midnight (G.M.T.), the "Plan" comes into force. By special arrangement, we are able to print this "Plan Définitif" in full, incorporating last-minute alterations, telephoned before the delegates' signatures were dry.

The "Plan" is based on theory rather than on practice. In most cases the 9 kc/s separation continues; where the "Plan" differs from its predecessors is in the widespread sharing of wavelengths, the choice being based on questions of power, distance, and area of country covered.

The power of stations working on waves greater than 1,000 metres will be limited to 150 kW., with the exception of Moscow No. 1. For stations working between 549.4 and 272.7 metres the power will be limited to 100 kW., with the exception of Budapest, Leipzig, Prague I, Rennes PTT, Toulouse PTT, and Vienna, each of which is allowed 120 kW. Between 272.7 and 240 metres the power of 60 kW. must not be exceeded, while between 240 and 200 metres the maximum permissible is 30 kW. Stations working on international common waves (non-synchronised) are limited to 0.2 kW.; those on international common waves (synchronised) are permitted 2 kW.; those on national common waves (synchronised) may use 5 kW.

Metres	Stations
1875	Brasov, Roumania
1796.4	Radio-Paris, Syria
1714.3	Moscow I, URSS
1639.3	Madrid I, Ankara, Kaunas, Reykjavik
1570.7	Zeesen
1500	Daventry
1442.3	Minsk, URSS
1388.9	Motala
1345.3	Huizen, Kharkov
1304.3	Warsaw
1260.5	Kalundborg, Portugal Nord (I)
1224.5	Leningrad
1185.8	Oslo*
1145	Lahtit
1107	Moscow II
845	Rostov s/ Don URSS, Finmark, Finland
824.2	Smolensk
65.3	Slovaquie, Ostersund
748.1	Moscow III. Genève**
725.5	Voronej, Boden
696	Oulu*
578	Hamar, Innsbruck
569.2	Ljubljana, Tampere, N.C.W. Finland
559.7	Wilno. Bolzano
549.4	Budapest
539.6	Beromünster
531	Athlone, Palermo, N.C.W. Sicily
522.6	Mühlacker
514.6	Madona (Latvia), Tunis
506.7	Vienna
499.2	Sundsvall, Athèns, Radio-Maroc
491.8	Florence, Mourmansk
483.9	Brussels I, Cairo
476.9	Trondheim, Lisbon, Skoplje (S. Serbia
470.2	Prague I
468	Lyons PTT, Petrozavodsk
455.9	Langenberg
449.1	North Regional, Jerusalem
443.1	Sottens
437.3	Beograd
431.7	Paris Ptt
426.1	Stockholm
420.8	Rome
415.5	Kiev
410.4	Tallinn, Seville
405.4	Munich
400.5	Marseilles PTT, Viipuri (Finland)
395.8	Kattowice
391.1	Midland Regional (later Scottish Regional)
386.6	Toulouse PTT, Stalino
382.2	Leipzig
377.4	Lwov, Coruna (Santiago, Spain)
373.1	Scottish Regional (later West Reg.) Salonica
368.6	Milan
364.5	Roumania
360.6	Moscow IV
356.7	Berlin
352.9	Bergen, N.C.W. Norway, Sofia, Valencia
349.2	Strasbourg, Simferopol
345.6	Poznan, Marakesch
342.1	London Regional
338.6	Graz
335.2	Helsinki, France (Pyréné Sud)
331.9	Hamburg, Maroc Espagnol (Dir. Aer.)
328.6	Limoges PTT, Dnepropetrovsk
325.4	Brno
321.9	Brussels
318.8	Algeria, Göteborg
315.8	Breslau
312.8	France (Paris), Gomel
309.9	Vinnitsa, Grenoble
307.1	West Regional (later North Ireland Reg.) Haifa
304.3	Genoa, Torun or Cracow
301.5	Hilversum
298.8	Bratislava
296.2	North National (later Midland Reg.) Tchernigov
293.5	Madrid II
291	Heilsberg, Portugal du Sud
288.6	Rennes PTT, Syrle, Leningrad II
285.7	Scottish National, Bournemouth (later North-East Reg.) and Krasnodar
283.3	Bari
280.9	Tiraspol
278.6	Bordeaux PTT
276.2	Zagreb, Falun
274	Venice, Barcelona
271.7	Naples, Kuldiga
269.5	Kosice, Oran
267.4	Belfast (later North Scotch Regional), Alexandria
265.3	Hörby (Dir. Aer. if over 60 kW.)
263.2	Turin
261.1	London National, West National (later Scot. Nat.), Turkey
259.1	Moravská-Ostrava
257.1	Monte Ceneri
255.1	Copenhagen and Malta
253.2	Nice-Corse, PTT, Kharkov II
251	Frankfurt a. Germ. N.C.W.
249.2	Prague II, N.C.W. Czecho-Slovakia
247.3	Lille PTT
245.5	Trieste
243.7	Gleiwitz, Germ. N.C.W.
241.9	Yugoslavia
240.2	Luxembourg
238.5	San Sebastian, Riga, Roma II
236.8	German National Common Wave
235.1	Norw. N.C.W. and Varna (Bulgaria)
233.5	Belgium, South Greece
231.8	Linz, Salzburg
230.2	Danzig, Sombor (Yugoslavia).
228.7	Swedish N.C.W.
227.1	Budapest II
225.6	North German N.C.W.
224	Pinsk (Poland), N.C.W. Poland, Montpellier PTT
222.6	I.N. Common Wave, 10 cycles exact; 13 stations, Aberdeen, Königsberg, Dublin, etc.
221.1	Norwegian N.C.W., Italian N.C.W.
219.6	Krakov or Torun
218.2	Swiss N.C.W.
216.8	Warsaw II, Albania
215.4	France (Centre), and French N.C.W.
214	Swedish N.C.W., and Bulgaria
212.6	Roumanian N.C.W. and N.C.W. of Portugal
211.3	Finnish and Yougoslav N.C.W.
209.9	International C.W., 10 cycles exact; 9 stations. Newcastle, Cork, Klagenfurt, etc.
208.6	Hungarian N.C.W., 4 stations
207.3	Spanish N.C.W. and Siauliai, Lithuania
206	French N.C.W.
204.8	German N.C.W.
203.5	British N.C.W. wave and Plymouth
202.3	URSS N.C.W.
201.1	International C.W., 50 cycles exact
200	International C.W., 50 cycles exact

N.C.W. = National Common Wave, Nationale Gleichwelle.
*Directional Aerial.
†Power Reduction one hour after Sundown or Directional Aerial.
**If it does not interfere with public services.



5-METRE 'PLANE TESTS. A Puss-Moth machine of the type to be used for G6SM's experiment on Sunday. The aerial will be slung in the manner shown.

Dissecting the New Plan

Shared Wavelengths for Many Stations

By Our Lucerne Representative

THE wavelength plan coming into operation on January 15th, 1934, will have an effective life of two years, for on January 15th, 1936, a new Conference is to be called using the new Lucerne Plan as a theoretical basis for a more practical scheme.

The Plan covers the "European zone," which comprises the whole of Europe as we know it from our geography lessons, plus Russia to the 40th meridian east of Greenwich, plus the following countries situated on the shores of the Mediterranean belonging geographically to Asia, but whose radio services are susceptible to interference of European stations. These countries are:—Turkey, Tunis, Syria, Egypt, Spanish Morocco, Morocco, Palestine, and the Italian colonies, Tripoli and Cyrenaique.

And what does the "Plan de Lucerne" mean to the ordinary man? Primarily, he may look upon it as a plan for the local listener. It is primarily designed to enable him to pick up his national transmitters; if, having achieved that, he spares time to listen to foreigners, he may find certain clashes which did not trouble him before.

The Plan provides for eleven long-wave channels, divided among no fewer than seventeen stations, four of which have to work on one wavelength and six of which share a wavelength with another transmitter. There are also four channels which are shared with certain non-public services. Where broadcasting shares a wavelength with shipping the latter is the prime owner, and can have any interfering broadcasting station removed. There are six such channels used by ten stations, all of which are Russian.

In the medium band there are 173 stations using 105 channels, plus twenty-two stations on four international common waves. Above 300 metres there are fifty-three channels used by eighty-six countries; below 300 metres there are eighty-seven countries (i.e., stations) on fifty-three channels. If one adds up the actual exclusive waves one finds seven long waves exclusively devoted to broadcasting, two used for shipping and four for non-public services. There are thirty-seven medium exclusive waves, in addition to which are the fifteen exclusive waves listed as national common waves.

The following countries have exclusive waves:—Russia, four long waves, four medium waves; France, four medium waves; Germany, one long wave, eleven medium waves; Italy, four medium waves; Great Britain, one long wave, two medium waves, and one exclusive national common wave.

At the request of one or more Governments a new European Wavelength Conference may be called if at least a third of the signatories to the "Plan de Lucerne" are agreeable.

Any proposed changes in wavelength or power have to be notified to all administrations concerned. If no protest is lodged within six weeks from the date of reception of the notification the change may be made.

The Five-Metre 'Plane Tests

G6SM's National Effort on Sunday Next

AT THE RECEIVING END. A good vantage point for reception over optical ranges. The set in use is *The Wireless World* Ultra Short-wave Two described in our last issue.

BY the time these lines are read the stage should be set for the first British tests in ultra-short-wave transmission from a 'plane. It is hoped that many readers will be able to get "on the air" with 5-metres receivers by 10 a.m. on Sunday next, when Mr. S. G. Morgan (G6SM) will begin his flight from Croydon and proceed to Liverpool, transmitting speech throughout the journey.

The 'plane will cruise at about 75 miles per hour so that the approximate localities and times on the outward journey will be as follows:—

London	10.0 a.m.
Aylesbury ..	10.30 a.m.
Daventry	11.0 a.m.
Birmingham ..	11.20 a.m.
Stafford	11.40 a.m.
Stoke	11.50 a.m.
Liverpool ..	12.15 p.m.

A special transmission giving final details will be given by 5BY (Croydon) at 7.45 a.m. on 40 metres and at 8.0 a.m. on 80 metres.

Although listeners within clear visual range of the machine may have the best opportunity to pick up the signals, powerful reception should be possible more than a hundred miles away, and no one in the British Isles can confidently declare that he is outside the orbit; in fact, several Continental amateurs will also be participating.

6SM, who will be operating the 'plane set, will transmit on exactly 5 metres (60 megacycles). Attempts will be made to maintain constant touch with two stations on the ground, G5BY and G6VH, throughout the flight, but as many other amateur stations as possible will be worked *en route*. Radiotelephony will be mainly used, but at intervals the call sign G6SM and the 'plane's registration letters, G-ACCY, will be radiated in Morse.

On the return journey which, weather permitting, will include the Hull area, the approximate localities and times should be as follows:—

Liverpool ..	3.0 p.m.
Manchester ..	3.30 p.m.
Leeds	3.50 p.m.
Hull	4.30 p.m.
Lincoln	4.55 p.m.
Stamford ..	5.30 p.m.
Bedford	6.0 p.m.
London	6.30 p.m.

The flight will furnish listeners all over the Kingdom with an unprecedented opportunity for rendering valuable assistance in investigating the possibilities of the ultra-high frequencies, particularly as regards their behaviour over long distances.

Reports, which will be warmly welcomed from any district, should be in log form, mentioning time and nature of reception, signal strength, quality, presence or absence of fading, etc., etc.

All communications should be addressed either to Mr. S. G. Morgan (G6SM), 3, High Street, Croydon, Surrey, or to The Editor, *The Wireless World*, Dorset House, Stamford Street, London, S.E.1.

As soon as possible after the collation of reports *The Wireless World* will publish a description of the test and the results achieved.

News *of the* Week

Current Events in Brief Review

Roumanian Radio Ban

ROUMANIA, it seems, is the only country in Europe where the importation of wireless receivers is completely forbidden. The rule is not relaxed in the case of travellers passing through the country.

Short Waves from Portugal

WE learn that the Portuguese Government is contemplating the erection of a 10 kW. short-wave station to cover the Portuguese colonies in Africa, India and Timor.

A "Record" Record

THE King has consented to accept a copy of the special H.M.V. record of His Majesty's speech at the opening of the World Economic Conference. The disc—a double-sided 10in.—is now available to the public and has a special royal label of blue, gold and scarlet bearing the royal arms.

The Royal speech was recorded at the H.M.V. studios at St. John's Wood by private wire from the Conference Hall. The first copies were pressed in the record time of three hours in order that the speech could be broadcast by the B.B.C. during the same evening.

Concert for DX-ers

WE learn that a concert, dedicated to the Anglo-American Radio and Television Society and the International DX-ers Alliance, will be broadcast by Radio Normandy between 1 and 1.30 a.m., on July 2nd next.

Reports of reception should be addressed to 11, Hawthorn Drive, Willowbank, Uxbridge, England.

The Pentagrid Converter

IN view of the considerable attention aroused by the description of the Pentagrid Converter in our issue of May 12th last, readers may be interested to know that additional information regarding this American frequency changer will appear in the July issue of our sister journal, *The Wireless Engineer*.

Palm Goes to Italy

ITALIAN short-wave stations are the most popular in New Zealand, according to Mr. S. Robson, President of the New Zealand DX Club. Practically without exception, he reports, the Italians reach a high standard of quality and reliability. A Wellington correspondent declares that "Daventry is practically a wash-out."

Portugal's Broadcast Debut

THE new 20 KW. broadcasting station at Lisbon is to open on October 5th, transmitting on about 291 metres. If necessary, the power can be raised to 100 kW.

Radio Smuggling

AFTER radio pirates — radio smugglers. A woman in Co. Donegal found listening with a set which had been brought into the Irish Free State without payment of Customs duty has been fined £100.

Programme Canning on Film

INSTEAD of using the "Blattnerphone," the Australian Broadcasting Commission is now "canning" complete programmes by sound tracks on film. It is claimed (says a Sydney correspondent) that a complete opera or national event can now be recorded and preserved by this method.

Car Radio

THE design of automobile wireless sets cannot yet be said to have reached finality. It is interesting to note in this connection that Captain Duncan Sinclair, the well-known Communications Consultant and part organiser of the A.A. Broadcasting Service, now advises manufacturers and others on the various problems in car radio. His office is Windsor House, Victoria Street, London, S.W.1.

Radio's First Representative at B.I.F.

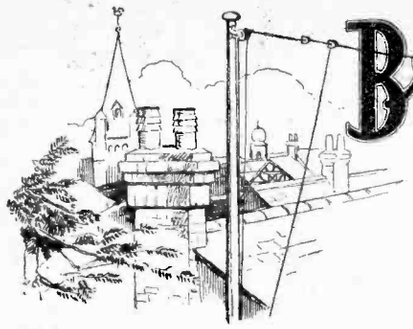
MR. A. E. WATKINS, of Messrs. Watmel Wireless Co., Ltd., has been elected first representative of the radio section on the Exhibitors' Advisory Committee of the British Industries Fair. His election is the result of the increase in the number of radio exhibitors from nineteen to forty-four, as a minimum of twenty-five exhibitors entitles the section to one representative.

Germany's Standard Receiver

AS stated in our issue of May 2nd, the Hitler Government recently ordered the German radio trade to produce cheap standard receivers which would put the programmes of the Ministry of Propaganda within the reach of the masses. We now learn that a standard design has been triumphantly vindicated by Professor Leithäuser of the Heinrich Hertz Institute in a grand listening tour through Germany. The receiver is a two-valve all-mains model (pentode output) with loud speaker, and the retail price complete (including valves) will be exactly 75 marks or £3 16s. at par. An official communiqué states that it has been necessary for all concerned to make large sacrifices to achieve this extremely low price.

A battery set is to be constructed on current-saving lines to a design of Herr Nestel, of the R.R.G. Laboratories.

This standard receiver is to be on sale in time for the autumn radio show. Twenty-eight German firms, forming a new association, will all manufacture it.



Broadcast Brevities

By Our Special Correspondent

Pleasant Sunday Evenings

THE majority of long-distance listeners are averse to the idea of B.B.C. programmes on Sunday evenings between 6.30 and 8 o'clock. Even with the most selective of receivers there is no gainsaying the fact that the local stations do "spread" themselves to a greater or lesser extent, and it has hitherto been during this sacrosanct period that the connoisseur has been able to seize upon those elusive and distant foreigners which are usually eclipsed when the B.B.C. is transmitting.

I am sorry to note a greater willingness at Broadcasting House to consider the question of earlier Sunday evening programmes.

Economy Steps In

A scheme is actually being discussed for continuous Sunday broadcasting from 12.30 p.m. to 10.30 p.m. If it should go through, however, its supporters will have scored a very doubtful victory, for it is quite probable that the extra two hours of broadcasting will be regarded as a suitable excuse for bringing down the economy axe.

No Alternative

"If," say the powers that be, "the public wants continuous broadcasting on the Sabbath, they must pay for it. We will cut down the number of alternative programmes on that day."

In fact, the first three or four hours of Sunday transmissions would consist of one programme only, the alternatives not beginning until later in the afternoon.

No Slow Foxtrots

The composition of these early Sunday evening programmes will not offer any great problem to the B.B.C. I am told that there will be no departure from the ordinary type of Sunday programmes, so woe betide the prophet who suggests that Henry Hall would bring his boys along to play slow foxtrots.

Big Ben

IT seems that there has been a scare over the Big Ben broadcasts. Observant passers-by cannot have failed to notice that the Houses of Parliament are at present submerged under scaffolding; already several anxious enquirers have asked the B.B.C. whether the clock itself is likely to be silenced.

Business as Usual

Apparently such fears are baseless, and Big Ben will continue to be the most regular and the most popular item in broadcast transmission.

I say "most popular" advisedly, for letter after letter coming from the Dominions and Colonies stresses the keen delight with which Big Ben is picked up in the far corners of the Empire.

Canadian Broadcasting Secrets

SOME big surprises may be expected when Mr. Gladstone Murray discloses the contents of the voluminous report he is now preparing on his recent mission to Canada.

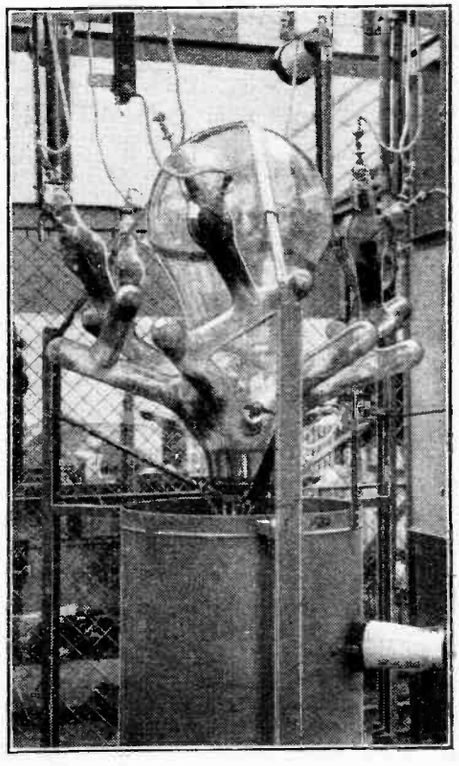
The B.B.C. Publicity Chief, it will be remembered, went over to Canada to help in organising broadcasting in the Dominion on B.B.C. lines, but I believe that before this task could be proceeded with an immense amount of spade work was necessary in order that our cousins in Canada could be made to orientate their views and lose sight of American principles in broadcasting.

Waves Over the Frontier

American influence in the Canadian ether is very strong, which is not surprising considering that no tariff wall can impede the passage of ether waves from those great American networks babbling their sponsored programmes all day long. Mr. Murray's report will make interesting reading—if it is ever published!

A Midget Organ

IF you can tune in Scottish Regional it will be worth listening to the Children's Hour on July 3rd, when a recital will be given on a pipe organ 12in. high, 9in. broad and 4½in. deep. This is the newly installed organ of Titania's Palace, which is being exhibited in Glasgow. This famous palace has been on view in many cities and towns on behalf of well-known charities. The organ is said to be a faithful reproduction of a modern pipe organ, complete in every detail.



ANOTHER NEW VALVE. This striking object is the high tension mercury arc rectifier at the new 100-kw. broadcasting station at Bisamberg, near Vienna.

New Blood in Vaudeville

ONE morning in July next certain broadcast artistes may wake to find themselves famous. A really excellent plan is going forward for a vaudeville hour given by entirely untried performers; each artiste will be making his or her first appearance in a broadcast studio.

The programme is bound to prove interesting, for nearly everybody, I suppose, can attract attention on a first hearing. The programme will offer a real opportunity to some of the younger generation to break the barrier which, unhappily, does seem to hedge the broadcast microphone.

Audition Rules Relaxed?

Naturally each performer will have given a reasonably satisfactory audition, but I believe that to some degree the usual rules will be relaxed, on the principle that not even an audition judge, referee or umpire is infallible.

Jack Payne To-morrow

NO self-respecting dance band "fan" will absent himself from the loud speaker to-morrow evening (Saturday) when Jack Payne and his Band return to the B.B.C. microphone for an hour's broadcast.

Lovers of ballet music will also be catered for, as later in the evening music will be given from the repertoire of the Camargo Ballet Society with the B.B.C. Theatre Orchestra, conducted by Constant Lambert. Two works by the conductor will be included, "Elegia Blues" and two scenes from the "Adam and Eve" ballet.

Why Not An Ultra Short-wave Broadcast?

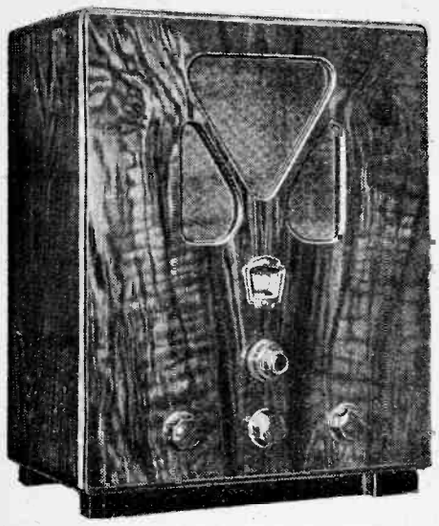
THE ultra short waves seem to have leaped into greater prominence than ever in the last week or two, and it looks as if, this time at any rate, British amateurs are teaching their Yankee cousins a few tricks. The transmission on these waves from an aeroplane on Sunday next is quite an innovation.

It would be a good thing if the B.B.C. could give us a broadcast of a conversation picked up from a 'plane transmitting on the "ultra shorts."

No Technical Obstacle

Very little is being done with the ultra short-wave plant on the roof of Broadcasting House, yet more and more it is coming to be realised that the very high frequencies have practical possibilities, particularly as a means of guaranteeing good quality of reproduction.

There should be no technical obstacle to picking up ultra short waves from the air in the same manner that the B.B.C. engineers receive the short-wave signals from the launch "Magician" on the Thames during the Boat Race.



Sunbeam U35

A Mains Receiver for A.C. or D.C. Supply

WITH electricity undertakings in all parts of the country changing over from D.C. to alternating current, the lot of the prospective purchaser of a mains receiver is one of difficulty and uncertainty. In many cases it is known that a change-over will take place eventually, but the actual date is either some considerable time ahead or cannot be ascertained with certainty.

In the Sunbeam U35 receiver we have a receiver which will function equally well on either type of supply. No change in the circuit is necessary other than the usual adjustment to the mains voltage, and if adjacent A.C. and D.C. power points were available at approximately the same supply voltage the set could be plugged into either with impunity. This was actually done in the course of our tests, and on both types of supply the performance was identical as far as it was possible to judge by ear. The set can, therefore, be purchased for use on D.C. mains with the certain knowledge that there will be no sacrifice of performance if the supply is subsequently changed to A.C. and that there will be no additional outlay.

The indirectly heated Tungsram valves are run in series with the mains through a tapped resistance which is adjusted to the mains voltage by a plug link incorporating a fuse. Actually, the heaters are rated at 0.18 amp. at 20 volts, so that the total consumption of the set, including H.T., is about 50 watts at 240 volts. The H.T. current is rectified direct from the A.C. mains through a Westinghouse half-wave metal rectifier. On D.C. mains the rectifier offers a low resistance in the direction of the flow of the current, and does not drop more than a few volts. A single stage filter is used to smooth the H.T. current, and is quite effective, the mains hum being less than that of many receivers using full-wave rectifiers. The design could be improved by the addition of by-pass condensers to reduce interference such as switch clicks. It is only fair to add, however, that the mains feeders on which the set was tested were more than usually troublesome from this point of view.

As might be expected, having regard to the attractively low price, the radio circuit is simple but efficient. A single tuned circuit precedes the screen grid H.F. valve, which is coupled to the grid detector by a simple tuned anode circuit with reaction. The pentode output valve feeds a permanent magnet Rola loud speaker, the primary of whose output transformer is used as a choke feed for external loud speakers.

A two-gang condenser is used for tuning, and a concentric trimming control is provided to ensure accurate alignment at any part of the tuning scale. When working near the oscillating point the trimming and reaction controls are to a certain extent interdependent, but the tuning process is quite simple if the trimmer is always properly adjusted before increasing the reaction feed.

A short piece of wire inside the cabinet serves as an internal aerial, and with it reliable reception of the B.B.C. regional stations is possible inside a radius of ten or fifteen miles. With a good outdoor aerial several Continental stations were received on medium waves in daylight, but it would be necessary to wait until after sunset before they could be regarded as of sufficient strength for the proper enjoyment of the programmes. After dark a choice of at least fifteen stations should be available even under poor reception conditions.

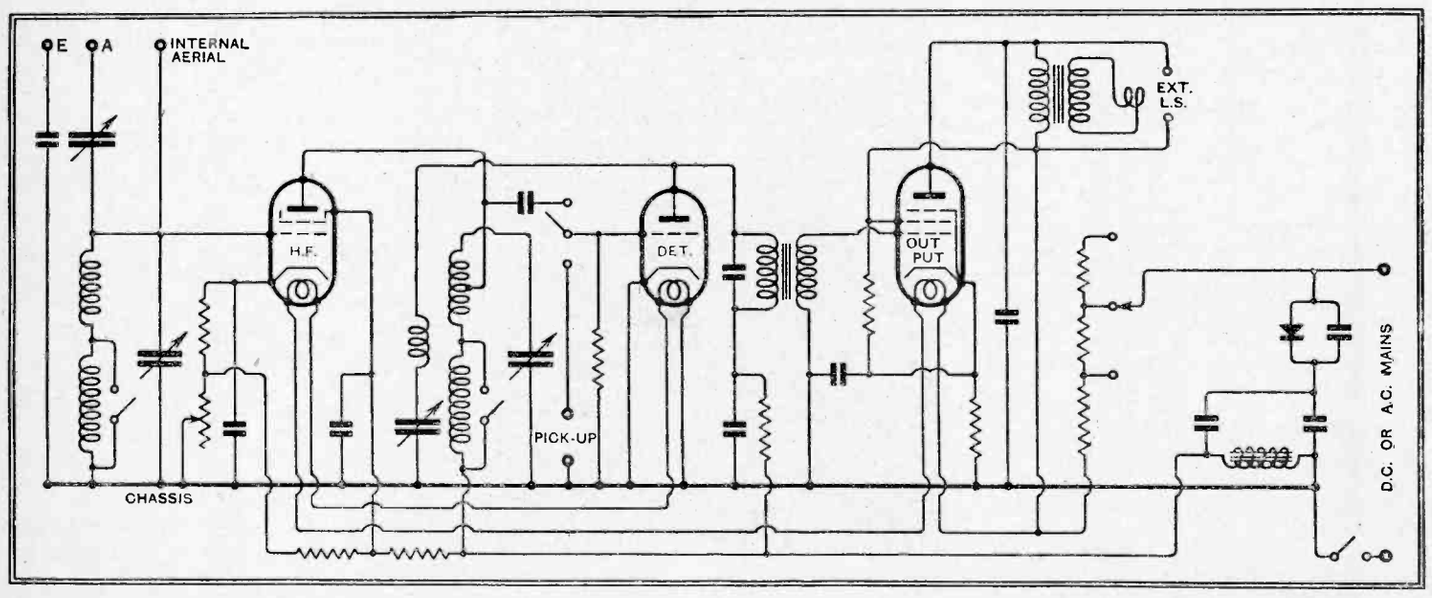
For a straight three-valve receiver without band-pass tuning the medium wave selectivity is very much better than was expected. At a distance of fifteen miles from Brookmans Park, with the set at maximum sensitivity, the National transmitter spread from 240 to 285 metres and the Regional from 320 to 395 metres. On long waves Radio Paris and Daventry are easily separated, but it is difficult to extract Zeesen from between them without a slight background from both stations.

Ample volume—estimated at about 750 milliwatts—is available without overloading, and the quality is clear and well balanced. Reproduction of speech is particularly good.

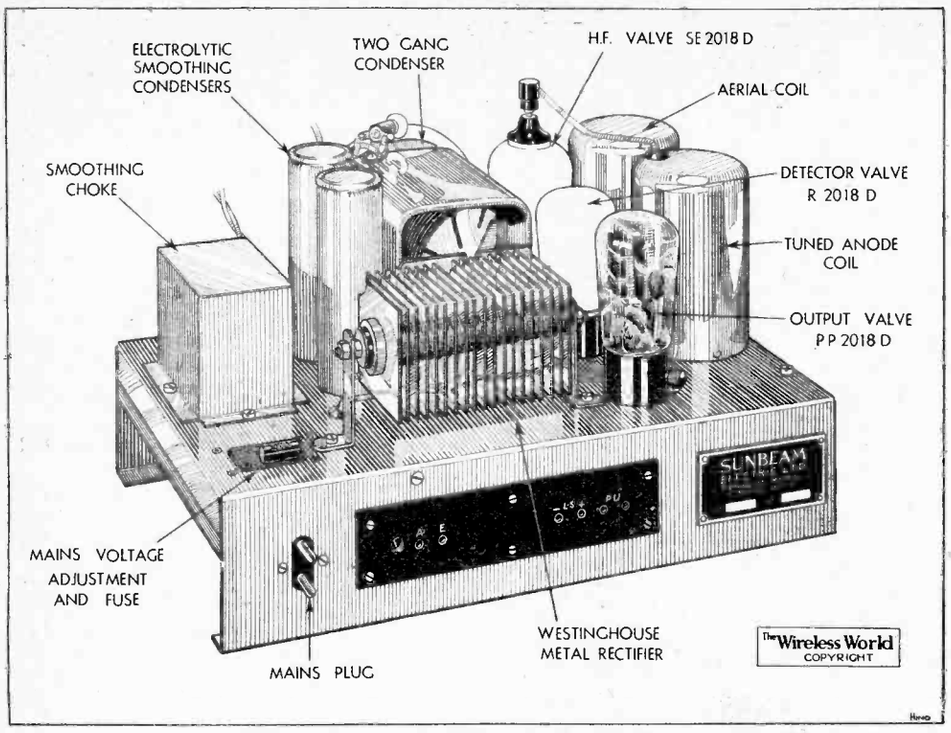
The cabinet is rigidly constructed of solid wood and is well finished. Ventilation holes are cut in the base, and although the edge of the chassis near the filament resistance tends to get rather hot, an extended run proved

FEATURES

Type.—*Straight three-valve with universal power unit for A.C. or D.C. mains. Moving-coil loud speaker. Internal or external aerial. Provision for gramophone pick-up.* ***Circuit.***—*Screen-grid H.F. with tuned anode coupling; grid detector with reaction; pentode output valve. Westinghouse half-wave rectifier.* ***Controls.***—*(1) Illuminated tuning dial calibrated in wavelengths. Two-gang condenser with trimmer. (2) Reaction. (3) Volume and on-off switch. (4) Wave-range.* ***Price.***—*9 gns.* ***Makers.***—*Sunbeam Electric Ltd., Sunbeam Road, North Acton, London, N.W.10.*



Simplicity is the keynote of the Sunbeam U35 circuit. The filament resistance is adjustable for different mains voltages, and the half-wave metal rectifier offers negligible resistance when the set is used on a D.C. supply.



Sunbeam U35 receiver chassis. The filament resistance, which is mounted under the left-hand edge of the base plate, is adjusted by a two-pin plug incorporating a fuse.

that the equilibrium temperature is not unduly high.

For the man whose mains supply is likely to be changed in the near future the Sunbeam U35 is an adequate and inexpensive solution of the problem.

LABORATORY TESTS

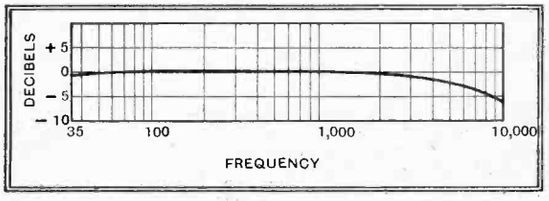
A Review of Manufacturers' New Products

BRYCE OUTPUT TRANSFORMERS

A RANGE of output transformers designed for use with large power valves but equally applicable to any type of output valve used either singly or in push-pull has been introduced by W. Andrew Bryce and Co., Woodfield Works, Bury, Lancs. Each model provides three difference ratios, the AB.OP.1 serving for low-resistance loud speakers and the model AB.OP.2 for those of high resistance. Both models are provided with a centre-tapped primary winding and a core of generous size is used, thereby permitting quite large amounts of D.C. to be handled.

The core is not gapped, and as a consequence the effective inductance changes considerably with D.C. The accompanying table gives the measured inductance of the primary under various working conditions.

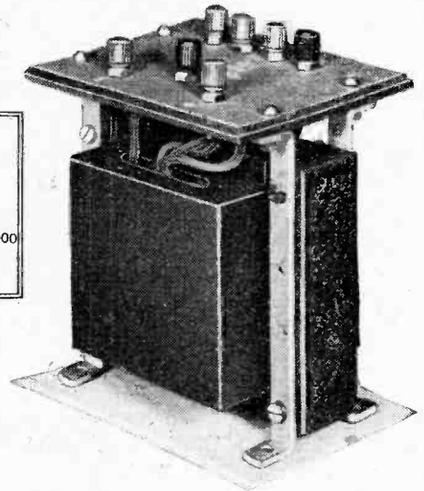
D.C. in mA.	Inductance in Henrys.	D.C. in mA.	Inductance in Henrys.
0	114	60	7.5
10	39	70	6.2
20	25	80	5.8
30	18	90	5.2
40	13	100	5
50	9.5	—	—



Bryce three-ratio output transformer model AB.OP.1, also overall characteristic curve taken with 20 mA. of D.C. flowing through the primary.

The ohmic resistance of the primary winding is 315 ohms.

Tests made with the AB.OP.1 model, an output valve of 3,000 ohms optimum load and a non-inductive 14-ohm resistance across the 1 : 15 step-down terminals enabled an excellent overall characteristic to be obtained, the curve being sensibly flat up to 3,000 c/s and only 3 decibels down at 6,000 c/s. The ratios provided are 1 to 15, 1 to 25, and 1 to 47, which, with an ordinary triode output valve will serve for matching loud speakers of 14-16 ohms, 5-8 ohms, and 1.5-2.5 ohms impedance respectively. The curves obtained with all three ratios were substantially the same. In the case of the AB.OP.2 model, the ratios are 1 to 1, 1 to 1.5, and 1 to 2.7, and the price in each case is 21s.



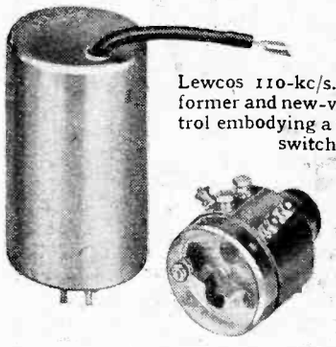
The only criticism we have to make is that since the component is intended to carry large amounts of D.C., a small air gap in the core would enable the primary inductance to be maintained at a more uniform level throughout.

LEWCOS I.F. TRANSFORMERS AND NEW VOLUME CONTROL

LEWCOS superheterodyne I.F. transformers consist of two separate windings loosely coupled and spaced to give a band-pass characteristic. Each coil is tuned to a frequency of 110 kc/s by a fixed condenser of a type which permits very accurate adjustment during the testing process. They are enclosed in copper screening boxes to the base of which is fixed a four-pin valve-type plug so that it can be mounted in an ordinary valve holder. The copper screen is joined to the low potential end of the secondary winding.

Several specimens were tested and in every case the results obtained were identical.

Response curves plotted with two samples taken at random show that the peak separation is approximately five kc/s and that a most satisfactory degree of accuracy in matching is achieved. The curves are not materially altered by using valves of different make, a fact accounted for by the relatively large capacity of the tuning condensers, and small changes in the external capacities have negligible effect on the tuning.



Lewcos 110-kc/s. I.F. transformer and new-volume control embodying a three-point switch.

These transformers are available with or without a pigtail lead for connection to the anode terminal of a screen-grid valve, but the price is the same on either type, namely, 10s. 6d.

A recent addition to the Lewcos range of components is a combined volume control and three-point switch, the component having been developed for use in connection with Q.P.P. and Class "B" amplifiers. The three-point switch can be connected so as to interrupt the grid bias battery circuit in addition to the L.T. supply when in the "off" position. It is available in all the usual values up to 50,000 ohms at the price of 6s. 6d., but resistance values up to 250,000 ohms are made, the prices increasing progressively with the higher values. All resistance elements are wire-wound and the component is perfectly silent in operation.

The makers are the London Electric Wire Co. and Smith's, Ltd., Church Road, Leyton, London, E.10.

The Wireless World

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EDITORIAL COMMENT

An Extra Symbol?

Circuits and Wiring Plans

IN a letter published in this week's issue, a correspondent urges the desirability of standardising a special symbol to represent iron-cored H.F. tuning coils. It is proposed that the new symbol will be used to differentiate between the new coils and the older air-cored types.

When iron-cored H.F. coils were first used in a *Wireless World* constructional receiver, the question of representing them by a distinctive symbol was considered, but was then rejected on the grounds that diagrams tend to become complex, and so all non-essentials should be avoided. After all, a theoretical diagram is intended to illustrate basic principles rather than practical details, and if all these details are shown, it becomes a wiring plan, which is anything but helpful as an aid to a quick and easy appreciation of circuit principles.

Essential Circuit Details at a Glance

In preparing theoretical diagrams it is right and proper that every attempt should be made to give as much essential information as possible, but if these diagrams are to serve their primary purpose, the practical side must not be allowed to intrude unduly. On the other hand, and in support of our correspondent's plea, it would often be helpful to see at a glance (particularly in a set where air- and iron-cored coils are mixed) which types are used in specific positions.

Apart from the question of coil symbols, other minor problems beset the pictorial representation of circuits. Should the H.T. positive line run above the diagram, or, American fashion, below it? Is it more helpful to show the function (*i.e.*, detector, I.F. amplifier, etc.) of a valve, or manufacturers' type designations? Views of readers on these matters would help towards standardisation, which is obviously desirable.

The I.E.E. Anti-Interference Committee

Good News for Harassed Listeners

AS stated elsewhere in this issue, the Institution of Electrical Engineers has now set up a committee "for the purpose of considering and making recommendations on the question of interference with broadcast reception arising from the operation of other electrical plant." It was the original suggestion of *The Wireless World* that the I.E.E. was the appropriate body to bring together the various interested parties, and it is naturally gratifying to know that work has already begun.

Whatever may arise from the committee's deliberations, its constitution is certainly not such as to warrant the criticism that wireless interests are likely to be unduly favoured. Excluding nominees of official and semi-official organisations, only two of the twenty-six members can be considered as directly representing the interests (which are in this matter identical) of the listening public and the wireless industry.

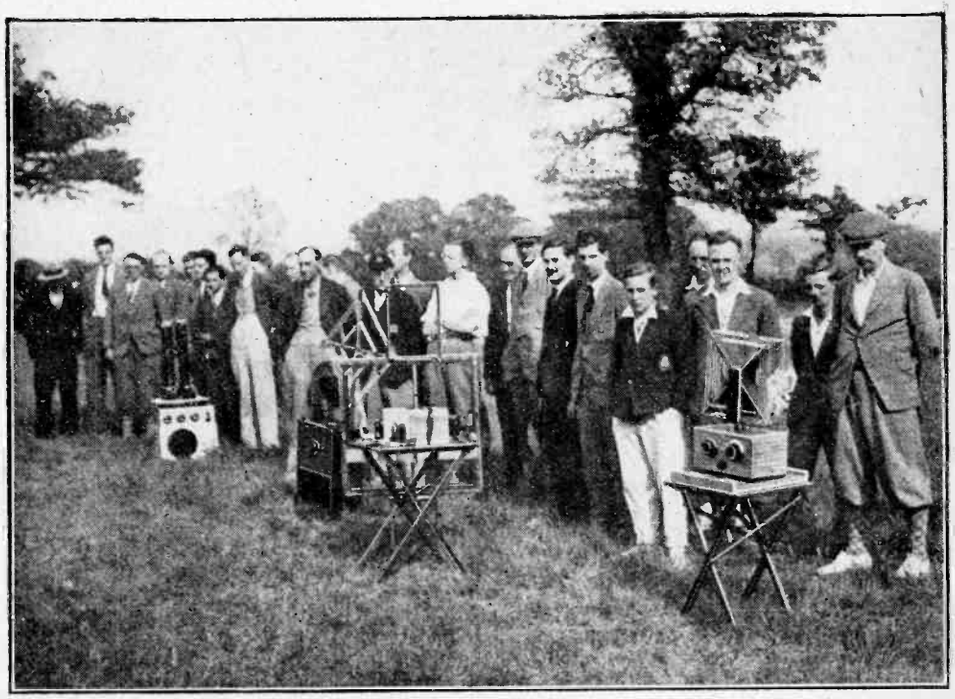
A suggestion for a localised anti-interference effort appears in this issue, and, being put forward at such an opportune moment, cannot fail to provide useful material for all those who are interesting themselves in the problems involved.

Direction Finding for Amateurs

An Inexpensive Hobby: Organising Transmitter "Hunts"

By ALEXANDER BLACK

THE spice of competition enters into Direction Finding as into no other branch of wireless to-day, and those who are seeking an open-air hobby during the summer months cannot do better than join a club which organises "transmitter hunts" and similar events. In this article the author gives some practical advice on D.F. sets.



PRIZE-WINNERS. A "meet" of the Golders Green and Hendon Radio Society last year. The small and compact receivers are those of prize-winning groups in a D.F. competition.

COMPARATIVELY few wireless enthusiasts realise that Direction Finding is a pleasant and cheap hobby. Almost any set is capable of conversion for this class of work, and, alternatively, most amateurs have a collection of spare parts which can be used to build a suitable receiver.

The waveband used is from 150 metres to 170 metres. A description follows of two sets which are very simple to construct and have proved very satisfactory to work. The first is a two-valve set consisting of a leaky grid detector with reaction, transformer-coupled to either a triode or pentode output valve.

In this case the frame aerial should consist of approximately six turns with ½in. spacing between turns, on a frame with 2ft. sides. It should be wound in the form of a solenoid, as this is preferable to a slab, or pancake, form of aerial. As will be seen by reference to the accompanying diagram, the centre tap of the frame is returned to L.T. negative. It is essential that the exact electrical centre of the frame should be taken; this is one reason why a solenoid form is preferable to other types of aerial, as it is easier to get its centre tap accurately. With a centre-tapped frame it is easier to obtain definite minimum positions.

This set should be made inside a metal box for preference, although not essential, as this tends to eliminate direct pick-up of the signals by the wiring of the set.

It might be mentioned here that all direction finding bearings are taken on the minimum signal—i.e., with the plane of the frame aerial at right angles to the transmitting station. The small condenser A is adjusted when the approximate minimum signal is found, until at a certain setting it will be seen that signals disappear at a sharply defined position of the frame.

The frame aerial can be conveniently mounted on a turntable (such as is used for portable sets) on top of the set itself, the leads being brought from the frame aerial through a hole in the top of the set. In order to get the necessary smooth reaction it is sometimes essential to return the detector grid leak to a potentiometer C, 400 ohms, which is connected across the filament circuit.

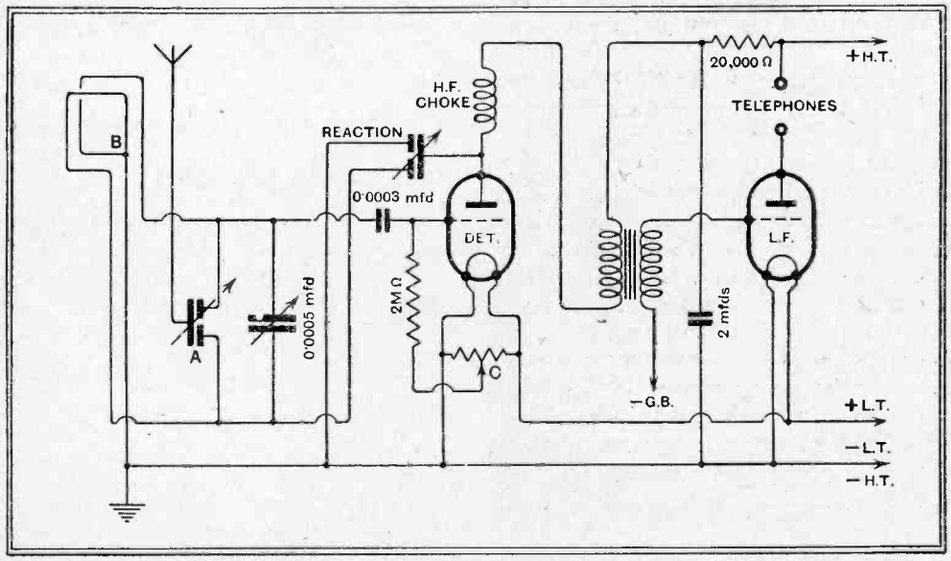


Fig. 1.—Circuit for a simple two-valve set suitable for D.F. work. It comprises a leaky grid detector with reaction, transformer-coupled to the output stage.

Centre-tapped Frame

In the case of the three-valve set a similar frame aerial may be used; one consisting of ten turns on 12in. sides, with ⅜in. spacing, is quite satisfactory. As a screen-grid valve will be used it is essential to have fairly good screening, and again it is desirable to mount the whole set inside a metal box, as above mentioned. The tuning arrangement following the S.G. valve may be quite conventional, and consist of either tuned anode or tuned grid, with a reaction winding. The number of turns depends, of course, on the type of coil; usually about two-thirds the number of turns are required for the amateur band as for ordinary medium-wave broadcast reception. Alternatively, a special coil may be made on a 2½in. former, consisting of 35 turns, with 9 turns for reaction. Here, again, the frame aerial must be centre tapped, as for the two-valve set, and care should be taken in mounting it. It will be seen that an existing set can be quite easily converted to this circuit, the main alterations necessary being in the

Direction Finding for Amateurs—

aerial circuit. Note that the moving plates of the aerial condenser are not at earth potential, and must therefore be insulated.

In every case the frame aerial should be mechanically strong and rigid. The usual way of taking bearings after the frame has been set in position on minimum signal is to sight a prismatic compass along one of the wires of the frame aerial and in that way to get its magnetic bearing, not forgetting to add or subtract 90 degrees in order to get the magnetic bearing of the station, and also remembering that the magnetic North is approximately 13 degrees West of True North.

The Vertical Component

An alternative method is to mount a compass scale between the frame aerial and the set, and, after having put the set in position, to rotate the compass card until its North corresponds with True North. A pointer should be fitted on the frame aerial so that when the frame aerial is at a position of minimum signal strength the pointer will give a direct bearing on the station in question.

Those who do not mind the extra constructional work involved would be well advised to try adding the aerial and the earth shown in the diagram connected to the small single-plate differential condenser A for neutralising the effects of the vertical component, which tends, unless balanced out, to flatten the minimum positions. For the 160-metre waveband the aerial need only consist of a vertical metal rod about 3ft. long, and the condenser should consist of a single moving plate and two separate fixed ones, each with an area of about 1in. square.

One of the biggest amateur direction finding events is the annual D.F. competition organised by the Golders Green and Hendon Radio and Scientific Society. This year's competition takes place on Sunday next, July 2nd. There will be two objects in view: (a) to locate the direction of a mobile transmitter called Station X, and (b) to discover transmitting Station X. A fixed transmitter station called Station Y at a known position will be available in order to test apparatus used and make any necessary corrections to data available.

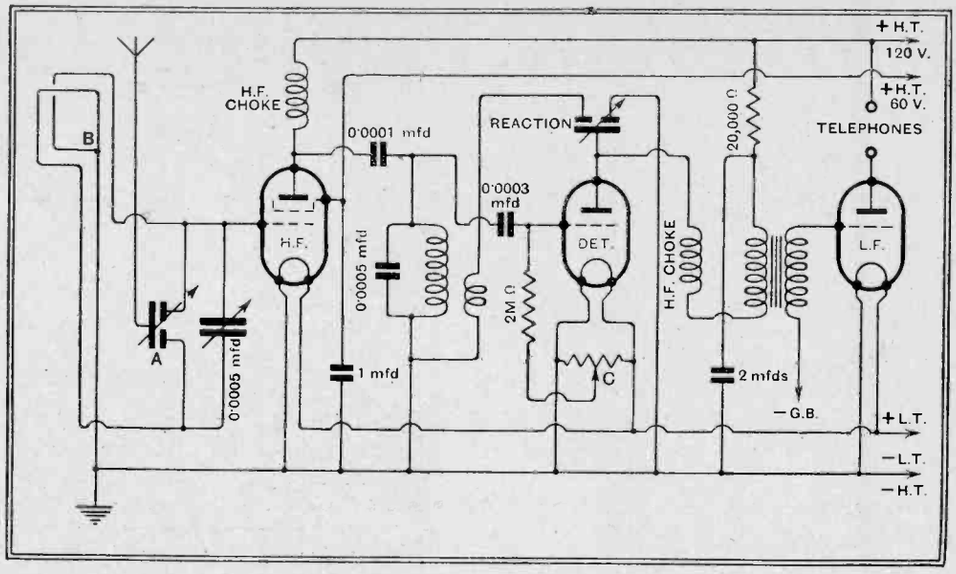


Fig. 2.—A three-valve circuit, consisting of an S.G. stage followed by a conventional detector and L.F. arrangement.

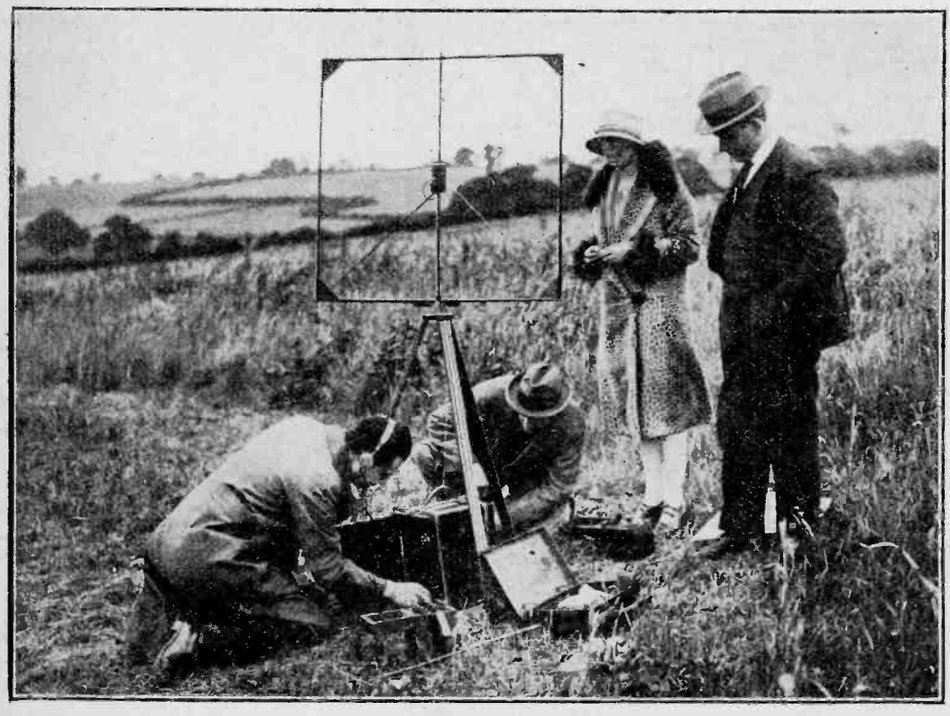
The Wavelength Used

The mobile station (Station X) will be a crystal-controlled transmitter using pure C.W. on a wavelength of 164 metres, the call sign being G5CD. At stated times during the day Station X will transmit for 15-minute periods, during which time competing groups will endeavour to trace the movements of the transmitter.

In the second part of the scheme Station Y will transmit from a house on the south side of a road at the intersection of imaginary lines drawn between Chipperfield Church, Bricket Wood Station, Moor End Halt and Bushey Halt. The wavelength will be 157.7 metres, and the call sign 5RD. During the transmission periods groups, each consisting of not more than three active members, will operate in an area bounded by the main roads linking Chesham, Berkhamsted, Boxmoor, King's Langley, Watford, Rickmansworth, Chenies, Blackwell Hall, and Chesham.

A field day of this kind gives excellent scope for the exercise of skill, resourcefulness and imagination in the operation of D.F. sets under difficult conditions. It is expected that many clubs in the London area will take part.

The Hon. Secretary of the Golders Green and Hendon Radio Society, 55, Ebury Street, London, S.W.1, is always pleased to supply direction finding hints to interested experimenters.



HOT ON THE TRAIL. This photograph, taken several years ago, shows the somewhat cumbrous outfit then used to track a hidden transmitter.

Surplus Eliminator Output

The Advantages of a High Voltage

WHEN setting out to design an H.T. battery eliminator for use on A.C. mains it is always an advantage to aim at an output voltage much greater than that which will normally be required. The reason for this is chiefly that it will be possible to make use of decoupling resistances of a fairly high value, and this will ensure complete freedom from motor-boating and similar troubles. In addition, the surplus voltage will be found extremely handy for supplying the field current needs of a moving-coil loud speaker when desired.

Electrical Interference

Removing Crackles that Disturb Reception: Brighton and Hove to Lead the Way

WHILST receivers continue to improve in performance and broadcasting becomes daily more important in the general scheme of civilisation, interference caused by electrical machinery and apparatus continues and is to-day in many localities the most serious trouble with which the broadcast listener has to contend.

The applications of electricity are constantly increasing, and yet comparatively little has been done until quite recently to tackle the causes of interference at the source and make electrical apparatus incapable of radiating. Probably things would have drifted on for a long while yet had not an effort been made to bring matters to a head. *The Wireless World* can claim to have taken an initial step in trying to bring together those authorities chiefly concerned with the question, with a view to getting support for legislation which would give the Post Office control over electrical interference and the necessary authority to suppress it.

What *The Wireless World* Has Done

Readers will recollect that last year *The Wireless World* originated an interference crusade, the object of which was to stimulate wireless societies and qualified individuals in all parts of the country to undertake the task of assisting the Post Office in their efforts to trace interference, in order that the Post Office might then approach the owners of the offending apparatus with a view to inducing them to suppress it. The Post Office, unfortunately, has, as yet, no authority to insist upon precautions being taken by the owners of radiating apparatus; they can do no more than try to persuade those responsible that in the common interest they should do something about it. The Post Office has done all they can both tactfully and effectively, and is ready and willing to give advice as to the best means of suppressing the numerous and varied causes of this trouble.

The Wireless World was not satisfied that this state of affairs should continue: whilst fully appreciating the excellent work which the Post Office was doing, it was felt that it was essential that there should be authority to compel where persuasion had no effect. We realised that this authority could only be obtained with Parliamentary sanction and by the passing of legislation to meet the situation. We realised, too, that legislation was unlikely to go through unless some agreement could be reached between the various electrical manufacturers and associations concerned as to what would be a fair basis on which to legislate, that is to say, to decide how long a period must be allowed before existing apparatus was modified and when the new requirements should come into force in regard to new apparatus supplied or installed. We therefore recommended, after careful consideration as to what body was most suitably situated to take the initial step, that the Institution of Electrical Engineers should be prevailed upon to appoint a committee representative of the various electrical interests to consider the problem, keeping the question of legislation as their main terms of reference.

Here is a new plan to help to remove the unnecessary crackles which mar your reception. Starting with the Brighton and Hove district, "The Wireless World" shows how the problem may be tackled by local action.

National and International Conferences

No sooner had we put forward this recommendation in *The Wireless World* than we were gratified to receive spontaneous support for it from *The Electrical Review* and from *The Electrician*, whilst the Institution of Electrical Engineers promptly accepted the task and appointed a committee which is at present deliberating on the problem.

It must be realised that it would be unfair to expect that hasty decisions could be arrived at in a matter of this kind, or that legislation could be put through in a matter of a week or two. Even when agreement may be reached in regard to all apparatus manufactured or installed by British firms, the problem of imported goods of an interfering character has to be dealt with simultaneously. At once the problem assumes an international aspect, and it is, therefore, not surprising to find that an International Conference has been convened by the International Electrotechnical Commission, to be held in Paris this month. At this Conference there will be representatives of about a dozen international organisations, either directly or indirectly interested in the question of interference with broadcast reception. It is stated that the chief purpose of convening this conference is to endeavour to ascertain the best means whereby the fullest co-operation between all these international bodies can best be effected in the interests of the solution of this particular problem. It is proposed that this conference shall consider setting up a joint committee, composed of representatives of the international organisations, to draft recommendations which may form the basis of legislation in the different countries.

The matter is so urgent and pressing that we feel confident that those who are dealing with it will not procrastinate unnecessarily. The longer we wait for legislation the harder will be the task involved, and the greater the burden on manufacturers and others in conforming to the new regulations, so that a prompt settlement of this trouble is in the best interests of all parties.

How Listeners Can Help Themselves

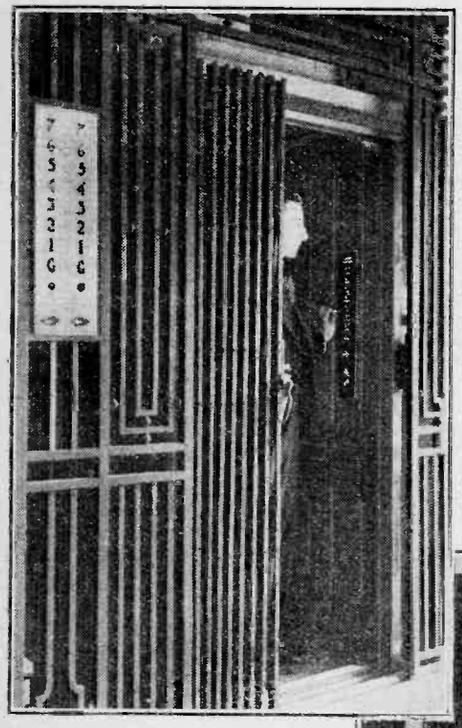
In the meantime, however, there is much which individuals throughout the country can do locally to assist. When we launched our interference crusade we visualised the possibility of the wireless societies and individuals relieving the Post Office of much of the work involved in tracking down and identifying sources of interference, but information which reached us led us not to press further for co-operation of this kind at that time, because it was likely to prove an embarrassment to the Post Office if interference search parties were organised and by their activities ran the risk of prejudicing the owners of interfering apparatus before they were approached officially by the Post Office.

It may not be sufficiently well known that engineers of the Post Office are always prepared to investigate serious interference on receiving reports from listeners, and a special Post Office form is available for this purpose, but it is rather too much to expect that the engineers can rush about hither and thither throughout the country to deal with individual cases.

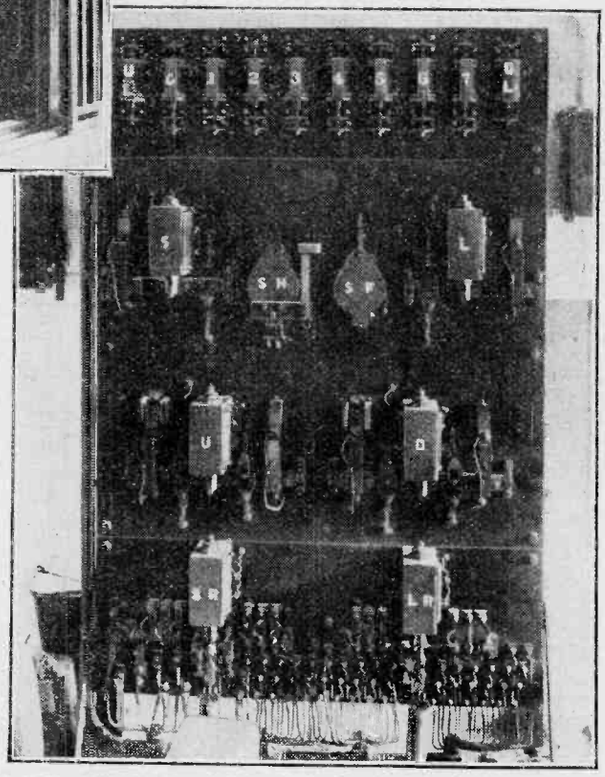
If the Post Office is ready to investigate cases on the strength of individual reports by listeners we feel sure that if a large number of reports of interference were received at the same time from a particular locality, the Post Office would then be likely to make a very special effort to tackle interference in that area, and their

Electrical Interference—engineers would have the advantage of a large amount of material to work upon. *The Wireless World* is therefore proposing that wireless societies, individual readers, wireless dealers and others who are actually experiencing interference in a given district should obtain the Post Office interference forms and fill them up, and by acting promptly and collectively in this way we feel confident that very satisfactory results can be attained.

The official Post Office interference form consists of a questionnaire designed to elicit as much information as possible on the nature of the interference experienced. The questionnaire asks for information on the nature of the receiver used, whether the receiver works from batteries or from mains, nature of the aerial, and whether interference has increased since any alterations have been made. You are asked to state whether you are aware if your neighbours are similarly suffering, and whether the interference occurs on any particular wavelength, and, amongst a number of other questions, you are invited to state if you are aware of any electrical machinery in your neighbourhood which might be likely to cause the trouble.



Electric lifts are often responsible for serious interference to broadcasting reception—



—unless the relay and other actuating mechanism (shown above) are electrically "silenced."

These forms are at present available either by direct application to the General Post Office, or through the local District Engineers. We would strongly urge that the Post Office should simplify matters by arranging for the distribution and collection of these forms by all Head Post Offices.

In order to test out the value of a collective effort to encourage the Post Office to investigate causes of interference more thoroughly, it seems to us essential that there should be concentration in a given area.

Brighton and Hove First

We propose, therefore, to commence with the Brighton and Hove district, as being a thickly populated neighbourhood in which interference of all types is likely to be present. We would like all listeners in that area, therefore, who are troubled with interference, to undertake to procure at once the official interference form from the District Post Office Engineer (addressed care of the local Head Post Office) and complete it with as much despatch as possible, ensuring that the form is back in the hands of the Post Office officials in the course of a day or two. We do not want this effort to be restricted to our readers alone, and we hope that every reader will encourage others to co-operate.

The greater the number of genuine complaints of interference received by the Post Office in the Brighton and Hove district, the more ready we may anticipate the Post Office will be to concentrate their technical forces on the problem. Careful and sympathetic official consideration of the project is already assured, and it rests with listeners to see that it does not miss its mark through apathy on their part.

A New Edition of Morecroft

MORECROFT'S "Principles" has been such a well-known text-book for the past dozen years that a new edition needs but little introduction. The first edition, published in 1921, has since been followed by a second edition in 1927, and a third edition is now to hand.*

In bringing the work up to date the author has been reasonably rigorous in his excision of obsolete matter, retaining only such features as are of fundamental importance and still remain necessary for the explanation of the phenomena under discussion. In new matter an attempt has been made—and with notable success—to present technical facts and tendencies up to the time of writing. Thus we find the chapter on valves dealing adequately with A.C. heating, with the variable-mu tetrode, Barkhausen oscillations, etc. Modern circuit practice, both in broadcast and commercial apparatus, is also discussed, and such important modern subjects as microphone and loud speaker characteristics are reviewed, while commercial telephony channels (e.g., the Transatlantic) are illustrated, with descriptions of antenna arrays such as are used in this type of communication.

Non-mathematical Expositions

The new edition is a good account of modern wireless practice in all its branches, characterised—as were the earlier editions—by a minimum of mathematics, which makes it an excellent expository text-book for the reader who desires a broad general view without being over-burdened by mathematical detail.

The book is, of course, written from the American standpoint, and has thus features which are less attractive to the English reader. It is a definite criticism that British sources of information are not utilised as liberally as they might have been, this being particularly true of the section on propagation and atmospherics, where British work of fundamental importance appears to have been overlooked. A criticism that must be made of all Morecroft's editions is also the length of the chapters. A book of over 1,000 text pages is divided only into ten chapters, and one has always felt—in using the old Morecroft as a general reference—that more subdivision would have been helpful to the reader. This is, however, a minor objection to an excellent work. J. F. H.

* "Principles of Radio Communication," by John H. Morecroft, D.Sc. (assisted by A. Pinto and W. A. Curry). London: Chapman and Hall, Ltd. 1933. Price, 46s. 6d. net.

1933 Short-Wave Manual by Don. C. Wallace. Although intended primarily for the beginner, this practical handbook contains a wealth of information that will prove of inestimable value to the short-wave enthusiast. Commencing with a brief history of the origin of short-waves and the part played by amateurs in opening up this new avenue for communication, it then deals with aerial design, construction of short-wave coils, and the layout and practical operation of receivers and transmitters. A section is devoted to ultra-short-wave apparatus for use on the five-metre waveband. Published by the Pacific Radio Publishing Co., Pacific Buildings, San Francisco, California, U.S.A. Price one dollar.

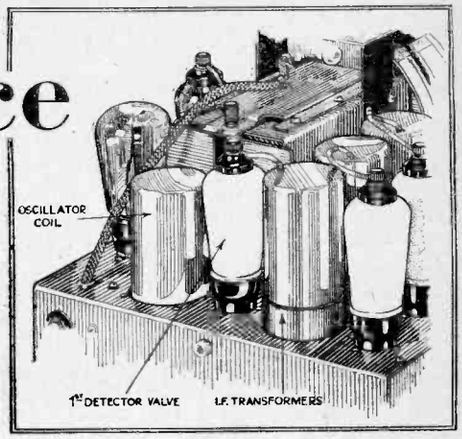
How the Superhet Works. 6.

Whistle Interference

The Need for Well-designed Pre-selector Circuits

By W. T. COCKING

PERHAPS the most baffling phenomenon associated with the superheterodyne is the incidence of whistles, which are sometimes erroneously attributed to instability. As a superhet must be judged partly by its freedom from whistles, it is essential that the designer should comprehend their cause and cure.

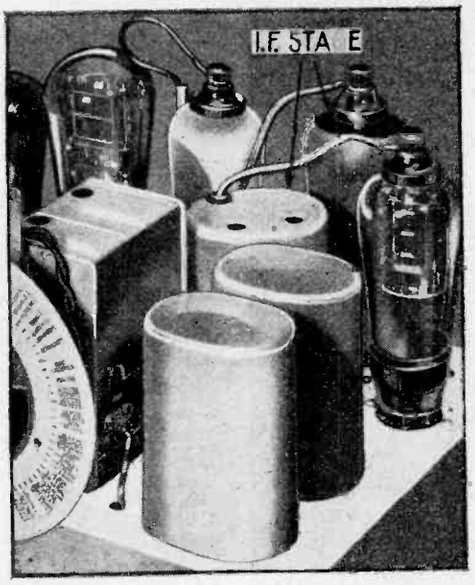


If whistles are to be avoided in a superhet with single dial control, careful choice must be made of the pre-selector circuits, the I.F. frequency, and the H.F. valves. This illustration shows the essential components associated with the frequency changer.

IT has so far been assumed that the intermediate frequency has a value of 110 kc/s, but it will be obvious that any desired frequency could be employed, and it is necessary to justify our choice. The intermediate frequency is equal to the difference between the frequencies of the oscillator and of the incoming signal. There are, therefore, two different oscillator frequencies which will permit the intermediate frequency to be obtained for any signal, and there may be two different signals transferred to the intermediate frequency for any oscillator frequency.

This will be readily apparent, for to receive a station on 1,000 kc/s, the oscillator can be set to either 1,110 kc/s or to 890 kc/s, since in each case the difference between the oscillator and the signal frequencies is 110 kc/s. Using the 1,110 kc/s oscillator frequency to beat with the 1,000 kc/s signal, it is equally apparent that a station on 1,220 kc/s will also beat with the oscillator to provide the intermediate frequency.

This is the phenomenon known as second channel interference, and in modern single control superheterodynes the station causing the interference is always higher in frequency than the wanted station by twice the intermediate frequency. Selectivity in the I.F. circuits will do nothing whatever to reduce second channel interference; the selectivity necessary for combating the evil must occur before the first detector. In order to avoid second channel interference it is necessary merely that the pre-selector circuits should give large discrimination between the wanted station and one on a frequency higher by twice the intermediate frequency. Not only the intrinsic selectivity of the signal-frequency circuits must be taken into consideration, therefore, but also the relative initial intensities of the stations, and the value of the intermediate frequency.



Part of the "Alba" set in which second channel interference is avoided by the use of an I.F. frequency of 473 kc/s.

It will be apparent that the higher the intermediate frequency we choose the less will second channel interference be evident with pre-selector circuits of given efficiency, for the higher the intermediate frequency the further away from resonance will be the station causing second channel interference. It has already been pointed out, however, that a low intermediate frequency is desirable from the point of view of adjacent channel selectivity.

The selectivity of a tuned circuit depends not only upon the efficiency of that circuit itself, but upon the percentage difference from resonance of an interfering signal. If we choose an intermediate frequency of 25 kc/s it will reject a station on 35 kc/s, 10 kc/s off tune, with the same ease that a circuit of equal intrinsic efficiency will reject a station on 140 kc/s if it be tuned to 100 kc/s, or 1,400 kc/s if it be tuned to 1,000 kc/s. In each case the percentage frequency difference remains the same, but the actual frequency difference gets smaller and smaller as the intermediate frequency is reduced. Since stations are spaced on the basis of a constant frequency separation the advantages of using a low intermediate frequency are readily apparent.

From the point of view of adjacent channel selectivity, therefore, we should like to choose as low an intermediate frequency as possible, whereas the other extreme is desirable as regards second channel interference. There are other limitations, however; for the frequency can hardly be within the range of frequencies to be received, and it is not advisable that it approach it too closely, nor must it be near the audible range. In general, therefore, the frequency chosen must be higher than 1,600 kc/s, between 500 kc/s and 450 kc/s, or between 130 kc/s and 25 kc/s.

Choosing the I.F.

The chief advantage of the superheterodyne in providing high selectivity is lost if the intermediate frequency be higher than the signal frequency, so that we rule out the use of frequencies higher than 1,600 kc/s. We also pass by the 450/500 kc/s possibility for normal requirements, since this is higher than the long-wave range; its use, however, is by no means impossible, and in special cases it might be desirable. In general, therefore, we must make our choice in the 25/130 kc/s band, and at first we should be inclined to compromise on a mean frequency of some 87 kc/s, but we have not yet considered every factor.

The phenomenon of beat interference has already been dealt with by the present writer,[1] and it was shown that if the signal frequency circuits be tuned to a station spaced from the local by an amount equal to the intermediate frequency, that station and the local could be received together, even in the absence of the oscillator. This, of course, is provided that the pre-selector circuits are not selective enough to prevent the local from setting up an appreciable voltage at the first detector. The local station, in fact, acts as an oscillator to heterodyne certain stations to the intermediate frequency.

[1] The Selectivity of the Superheterodyne. *The Wireless World*, May 13th and 20th, 1931.

How the Superhet Works—

The effect can be prevented in the same way as second channel interference, by making the pre-selector circuits give enough selectivity, and, in general, this is the only remedy. Even if the effect does occur, however, it is only on stations spaced from the local by the intermediate frequency, so that it may not be serious. Should there be two local stations, however, spaced by the intermediate frequency, then it is possible for audible interference due to their beats to occur over a large portion of the tuning range. It is important, therefore, to select an intermediate frequency which is not equal to the difference between the frequencies of any two nearby stations.

Effect of Harmonics

The two London stations are spaced by 304 kc/s the two North stations by 370 kc/s, and the two Scottish stations by 243 kc/s, so that none of these is likely to cause any trouble. The Midland Regional, however, is separated from the London Regional by 91 kc/s, and, although the stations are some distance apart, there are places where they are both receivable at a strength sufficient for beat interference to occur. We should, therefore, not choose an intermediate frequency between about 81 kc/s and 101 kc/s. The Midland Regional and the North Regional are separated by 127 kc/s, so that it is wise not to select a frequency between 117 kc/s and 137 kc/s. A frequency lower than 80 kc/s is hardly practicable on account of second channel interference, so that we find that we must choose in the 101 kc/s to 117 kc/s range. Here there is very little choice, and we are practically forced to 110 kc/s. It is on this account that this frequency has been standardised by *The Wireless World*, and it may be said that practical results have entirely justified the choice.

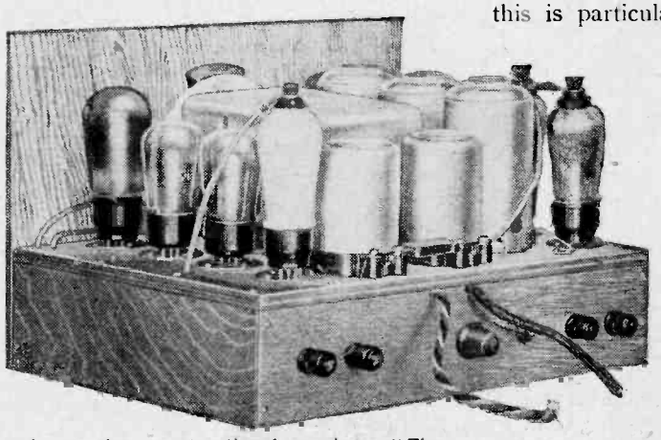
Second channel interference, therefore, may occur when receiving a station 220 kc/s lower in frequency than the local, and beat interference is possible when receiving a station 110 kc/s higher or lower than the local. There are other possibilities of whistles, however, for consider the case when we receive a station 165 kc/s lower than the local. The oscillator will then be working on a frequency 55 kc/s lower than that of the local station, and if this sets up a voltage on the first detector grid a beat frequency of 55 kc/s will be formed. If the first detector is not effectively linear, harmonics will be present, and the second harmonic of 55 kc/s is 110 kc/s, the intermediate frequency.

If either the pre-selection is insufficient, or the first detector is non-linear, therefore, whistles may be found whenever a station is received for which the oscillator must be set on either side of the local by 55 kc/s, 36.3 kc/s, 27.5 kc/s, and so on.

Even this does not exhaust the possible whistles, for harmonics of the oscillator, and harmonics of the signals, produced by overloading the H.F. valve, can account for many more. The writer has calculated that, taking into account harmonics up to the fifth, a superheterodyne used close to Brookmans Park can give a whistle which is due initially to those stations on over 90 distant transmitters. If one local closed down one-half of the whistles would disappear; if both stations closed down they would all vanish.

Previous articles of this series dealing with the theory of the superhet are as follows: (1) the signal-frequency stage; (2) the H.F. stage and the oscillator; (3) the frequency changer and the I.F. amplifier; (4) the second detector; (5) the action of the first detector.

In practice, of course, it is rare for the trouble to occur with such magnitude. Their possibilities should be borne in mind, however, for the writer has actually handled a receiver in which every one of the calculated whistles appeared. The calculation, in fact, was undertaken in an endeavour to account for them, since previously it was not thought that so many were possible. Needless to say, the receiver in question was of poor design.



A popular constructional receiver—"The Wireless World" A.V.C. Monodial A.C. Super in which an intermediate frequency of 110 kc/s is used.

It should be emphasised that whistles are quite rare in a properly designed receiver, and there should never be more than perhaps four points at which such interference is found. Even these can be removed, but, as they do not represent serious interference, it is not always economical to include the extra circuits which would be needed. Good initial design, and the correct adjustment of the receiver, are all that is necessary to avoid the trouble. The importance of correct adjustment can hardly be overstressed, for the intrinsic merit of a design can be completely ruined by mal-adjustment of the circuits.

Second channel and beat interference can be avoided only by the use of a suitable pre-selector system, but while this remedy is applicable also to the various forms of harmonic interference, these can also be avoided by the use of a first detector which is effectively linear. Since such a characteristic is necessary to avoid distortion in frequency changing, it would naturally be used. One must guard against overloading the first detector, however, for the first symptom of this would normally be the appearance of whistles rather than of noticeable distortion.

Avoid Overloading

Under the majority of ordinary circumstances, two tuned circuits with screened air-core coils will provide sufficient selectivity for the avoidance of all but three or four whistles when the set is used on a good aerial within a few miles of modern twin-wave high-power stations. Under the same conditions, three tuned circuits will remove all whistles. It is necessary, however, that the first detector should be effectively linear, and that neither this valve nor the H.F. valve should be overloaded, otherwise many whistles will be found even with three tuned pre-selector circuits. The question of overloading is important, since if the receiver be used very close to a local station it may prove advisable to limit the size of the aerial; this is particularly likely to be the case when battery valves are used, since they will not handle such a large input as the mains types.

Although the receiver may include the necessary number of pre-selector circuits of the requisite efficiency, and the operating characteristics of the valves be adjusted to perfection, this will be of no avail unless the circuits are accurately ganged. In a straight set mis-ganging merely reduces the sensitivity and selectivity, and if it be slight it may pass unnoticed. In a superheterodyne the result is initially the same, but the reduction in the selectivity of the signal frequency circuits greatly increases any tendency for the generation of whistles, and these will certainly make themselves evident.

There is no difficulty in obtaining accurate ganging, provided that a suitable circuit be chosen and the receiver be correctly built. This matter, therefore, will be treated at length in Part 7 of this series of articles.

A.R.R.L. Convention at the World's Fair, Chicago

An Invitation to British Amateurs

The Central Division of the American Radio Relay League will hold its Annual Convention on August 3rd, 4th and 5th at the World's Fair in Chicago in connection with the Century of Progress Exhibition. A cordial invitation is issued to all licensed amateur transmitters.

A special committee of the A.R.R.L. has undertaken the task of inviting as many as possible of the amateurs in other countries of the world, and a comprehensive programme has been mapped out for the benefit of those attending the Convention.

UNBIASED

Lend me . . . .

A Repeat Performance

THE other evening I was at a loose end owing to the fact that Mrs. Free Grid had rendered my house uninhabitable by turning it into a meeting place for a wretched committee for supplying flannel waistcoats to the Andaman Islanders, or something equally foolish. Eventually I passed the evening at an open-air theatrical performance which had been widely advertised.

To hear the dialogue better, I took my seat underneath one of several loud speakers suspended from the trees. Hardly had the performance begun, however, than I was completely disconcerted. The speech from the loud speakers was followed almost immediately by a gibbering echo. Hastily putting myself into that calm and judicial frame of mind which comes as second nature to those of us who dwell in a scientific atmosphere, I soon observed that the "echo" was in reality no echo at all, but the actual voices of the performers reaching me a fraction of a second after being heard *via* loud speaker, and the resultant lack of synchronisation was the cause of all the trouble.

The performers on the stage were as close to the microphone as I was to the loud speaker, and consequently one channel for the conduction of their voices was about 99 per cent. electrical, while the other channel was 100 per cent. air; hence the lag.

Feeling thoroughly incensed at the whole business, I left the place immediately the performance was finished.

From the Milky Way

NEWS from America is always refreshing, and I was delighted to read the other day in one of our public-spirited dailies a delightfuly naïve confession from an American citizen who, with "thousands of wireless fans," has been receiving wireless messages from the Milky Way.

The wavelength of the transmission, it appears, is 14.6 metres—no doubt about that—but, unfortunately, the frequency is giving a little trouble, as it cannot be tied down to a very definite figure, but is somewhere in the neighbourhood of 20,000 kc/s! The "fans" are apparently human ones, all out to help the learned professor, and not, as I had at first supposed, ordinary mechanical ones for the purpose of cooling his fevered brow.

Don't Infringe the Monopoly

THE Post Office, apart from its privilege of collecting our wireless licence money, possesses a monopoly of the means of communication in this once fair land, whether by letter or by telegraph.

Strictly speaking, this means that you are transgressing the law every time you receive the glad eye, and after what has come to my ears it would not surprise me in the least if some Jack-in-Office applied for a summons under the Wireless Telegraphy Act on the grounds that this was wireless transmission on a very short wavelength; indeed, it would scarcely cause me to raise my eyebrows if I heard that a summons for "inciting to commit an unlawful act" was taken out against the writer of the wretched song which tells about an unfortunate woman who stuck a lamp in the window every night in the hope that one day her prodigal son, far out at sea, would spot it and be guided on his homeward path.

Transgressing the Law.

Their sublimest effort, however, is in connection with the installation of a simple aerial transporter railway which two small boys established between their respective gardens. The Post Office came down upon the unfortunate infants like a ton of bricks and invoked all the majesty of the law to prevent them wilfully conspiring together to usurp its monopoly of message carrying.

In the end the lads had to enter into a solemn undertaking that they would use the railway "solely for the carrying of goods and merchandise, and not for the carrying of any intelligence."

On the subject of *intelligence*, I should just like to say . . . [No doubt you would, but you mustn't.—Ed.]

I Am Disgusted

NEVER before had I come across such flagrant flouting of the warnings, not only of the B.B.C., but of the various recording companies, as the other day,

By FREE GRID

. . . . your ears.

when paying a visit to a large departmental store in a well-known provincial city. The time of my visit was quite early in the forenoon, before the B.B.C. had started work, and yet I found that in every department a large loud speaker was churning out its stuff. Between each tune an announcement was made, and it soon became apparent that it was not radio at all, but that the establishment was running its own "Christopher Stone" act from somewhere in the building, the stuff being fed to all departments.

The quality of the music was distinctly good, but when the announcer threw in the microphone the results were simply devastating, though I could not make out whether this was due to a poor microphone or an announcer with faulty dentures.

A Lamentable Affair

EVENTUALLY I asked one of the shop walkers if it were possible to catch a glimpse of the studio from which the music emanated. He directed me to the wireless department, in a corner of which I was horrified to discover a hand-wound playing desk and an old G.P.O. microphone in charge of a scruffy-looking youth sucking bull's-eyes. The speech distortion was thus easily accounted for.

When I addressed him he deftly transferred his bull's-eye to his cheek, and was not at all loath to give me full information concerning the installation. As I had supposed, his duties were to feed gramophone stuff to the various loud speakers in the building until the B.B.C. came on the air. In addition, he had, from time to time, to interpolate advertisements of various articles which the store sold. I questioned him about the news bulletin, and he said that as the shop did not close until 7 p.m. it was sent out daily.

Needless to say, I left the building in disgust, pondering on the open defiance of law and order, which, unfortunately, seems so rampant in this country nowadays, and which must, I feel sure, shock the moral susceptibilities of all decent-minded citizens.

It is unfortunate, but nevertheless true, that in no sphere of activity is this flagrant flouting of the law so rampant as in the case of radio. In my opinion, the only way to prevent this lamentable state of affairs is to change the law; the trouble would then automatically disappear.

News of the Week

Current Events in Brief Review

Something for Nothing

IN marketing a new receiver a French radio manufacturer advertises that "all new customers are refunded with an amount equal to the cost of a wireless licence."

Table d'Hôte

GASTRONOMIC analogies are popular in France. The latest concerns radio and the gramophone, the former being compared to a *table d'hôte* meal, the latter to *à la carte*.

Unfortunately, in both cases there is no waiter to find fault with.

Catching the Subscriber

IN order to popularise the Anglo-Indian Wireless Telephone Service the Government of India has decided that when a telephone call comes through for a particular person who cannot be found, instructions will be given to "chase" him by 'phone, and when found connect him overseas without extra charge.

Ferrié Research Fund

SO great was the response to the appeal for a monument in memory of the late General Gustav Ferrié that the required sum was greatly exceeded, and the trustees decided with the balance to initiate a fund to stimulate wireless research. It is stated that 100,000 francs are still needed to provide the desired amount of capital.

Lyons : A Radio City

THE extraordinary signal strength from Lyons 1a Doua station, with its reputed power of only 1.5 kW, has awakened radio interest in the city. We hear that the Fifth International Wireless and Gramophone Exhibition is to be held at Lyons from September 16th to the 24th. Last year the attendance amounted to 50,000, and as Lyons is steadily building up its own wireless industry, it is hoped that a record number of visitors will attend this year.

More Transoceanic Broadcasting

BROADCASTS designed "to bring the American public a more complete understanding of international relations, and to provide Europe, South America and Asia with reliable interpretations of American thought," are being arranged by a Public Affairs Institute with the co-operation of the Columbia Broadcasting System.

The plan (writes our Washington correspondent), which is to exchange more programmes with foreign countries, has the support of such authorities as Dr. Nicholas Murray Butler, President of Columbia University, and Mr. Alan Welsh Dullies, now advising the American delegates at the London Economic Conference.

There seems little doubt that next winter will see regular programme exchanges across the Atlantic.

"The Wireless World" and the Lucerne Plan

OUR readers may or may not be aware that *The Wireless World* was the only journal (with the exception of one German contemporary) to publish the complete Lucerne Wavelength Plan as early as Friday last.

In this list, which was secured by special arrangement within a few minutes of the signing of the Plan in the Conference Hall, we were able to give exclusive publication of the B.B.C.'s wavelengths as allotted to particular stations. It is understood that the B.B.C. at present has little latitude in the distribution of the wavelengths allotted to it, one of the terms of the new Plan being that station wavelengths must not be altered at shorter notice than six weeks. The B.B.C. wavelengths given in the published list are those officially allotted to the British stations.

Lucerne Plan : French Sarcasm

THE Lucerne Conference has not had a good Press in France, particularly from those journals which were denied close contact with the progress of events. In a bitter article one of our Paris contemporaries says: "In spite of the ostracism which journalists had to submit to at Lucerne, we have been able to obtain precise details with regard to the working arrangement. The Assembly's five great commissions consisted of: *The Commission of Silence, The Commission of Self-Congratulation, The Commission of Digestive Functions, The Protocol Commission, and the Commission of Status Quo.* Everyone was an important official; indeed, not a single member held a rank lower than that of President, Vice-President or Secretary. The next Conference ought to be held in Mexico, where, we believe, the whole of the army is on the General Staff."

Wireless Sweepstake

A NEW kind of lottery has been initiated by the Hungarian Broadcasting Company. Only licence holders are allowed to compete in the sweepstake, in which the prizes consist of free licences.

Concerts from Ostend

DESPITE rumours, we understand that authority has been given for summer broadcast concerts from the Ostend Kursaal which proved so popular last year. Certain of these are likely to be relayed by the B.B.C.

London Tests on Five Metres

MR. D. WALTERS, Fairfax Corner, Bedford Park, London, W.4, who welcomes tests on his five-metre transmissions, asks us to state that his call sign is G5CV, not 5CB, as stated in our issue of June 16th.

Radio Week in Italy

THIS is Italy's National Radio Week. This great campaign for popularising wireless began on Sunday last, June 25th. Special price reductions in receivers are current during radio week. Sets are installed free of charge and a number of free wireless licences are being distributed. In addition a special broadcast sweepstake has been instituted, the winners of which will be entitled to such awards as a stay in a first-class hotel, a sea voyage, or a short trip in a 'plane.

Magnavox Moves

WE learn that as from July 1st the manufacture and sale of Magnavox loud speakers for all purposes will be transferred to the Benjamin Electric, Ltd., of Tariff Road, Tottenham.

British International Pictures

THE photographs reproduced in our issue of June 9th to accompany Mr. Dallas Bower's first article in his series on "The Sound Film" are the copyright of British International Pictures.

SEA FEVER (RADIO VERSION). Set construction is one of the most popular hobbies in the Navy. Here is a scene on H.M.S. Hood.

Five-Metre 'Plane Tests Postponed

Many Transmitters Active on Sunday Next

IT is much regretted that, owing to a serious mishap to the 'plane which he had engaged for the ultra-short-wave tests scheduled for Sunday last, Mr. S. G. Morgan (G6SM) was unable to take off as arranged. Any alteration to an aeroplane—even the addition of a single aerial wire—necessitates a new certificate of airworthiness from the Air Ministry, and it was impossible to secure a new machine and comply with this regulation at such short notice.

Accordingly, the trial is postponed until Sunday week, July 9th, when the programme will be carried out as described in our last issue. Many listeners have already intimated their intention to take part. Full particulars, together with time-table, will appear in *The Wireless World* of Friday next, July 7th.

Mr. S. G. Morgan, who asks us to offer apologies on his behalf to any amateurs who did not read the published notices of postponement, states that last-minute details of his flight will appear in the "Personal" column of *The Daily Telegraph* on Saturday, July 8th.

Although the delay is unfortunate, many readers may be able to turn it to advantage by ensuring that their five-metre receivers are operating satisfactorily. Several opportunities will occur in the South of England on Sunday next, July 2nd, when two "districts" of the Radio Society of Great Britain are co-operating in five-metre (56 m.c.) field-day experiments extending from Kent into Hampshire. A chain will be formed by stations 2NH, 3AW, 5IS, 5SA, 6GZ, 6NF, and 6QB. Among the transmission sites will be Blackdown and Tatsfield. Special five-metre transmissions will also be made from the tower of the Crystal Palace from 10 a.m. to 6 p.m. by G6NF.

In this connection we should be glad to receive the names and call signs of owners of five-metre transmitters who would be willing to send out test signals on July 7th and 8th, and thus help listeners in calibrating their receivers. Call signs and schedules should reach *The Wireless World* offices, Dorset House, Stamford Street, London, S.E.1, not later than first post on Monday, July 3rd.

The Sound Film—3

"Wild" Shots and Sound Mixing

By DALLAS BOWER

EDITING is one of the most important departments of film production; in fact, it may be said that a film is not made in the strict sense until it is "cut." The editor or "cutter," working in co-operation with the director, gives a film its final shape, arranges the some hundreds of shots in their proper sequence as laid down in the scenario; he selects from what, in its unedited form, is no more than the raw material of a film.

He is like the builder of an elaborately tiled wall. The tiles, of various shapes and sizes, are the raw material; they are the elements of the wall, but they will not take on the sensible form of a wall until they are arranged in a pattern in accordance with a preconceived plan or design.

The term "film editor" is somewhat confusing, as it leads the uninitiated person to suppose film editing must surely be something to do with the scenario; such, however, is not the case.

A 75,000 dollar travelling camera crane used for filming many Universal Pictures productions.

In the early days of sound-films the sound track was regarded as incapable of being edited to any large extent in the way that the picture could be edited. Sound cutting has evolved somewhat slowly; in fact, only quite recently have the potentialities of sound editing become fully appreciated. This is brought about largely by the development of re-recording machinery, i.e., a means for mixing two or more sound tracks, and so producing a composite. For instance, a musical background to a dialogue sequence is mixed with the dialogue on a machine called a re-recorder, or dubber. The sound tracks of the various shots in the sequence are edited—put into their proper continuity—and set aside for the time being. The "mute" or picture is then projected while the orchestra or whatever musical accompaniment is required plays music of such duration that it starts and finishes with the starting and finishing of the sequence.

The Work of the "Dubber"

The musical record obtained is called a post-synchronised music track. This track, or, rather, a special print or positive of it, together with a special print of the original dialogue track, is then put on the dubber for mixing. Obviously they are of the same length, as they both synchronise with the picture. The dubber is in reality no more than a specially-prepared multiplicity of sound projectors, each channel having its own photo-electric cell, initial amplifier and gain control. The common output from each channel passes into the recording amplifier proper, and so to the sound-camera. It will be understood that such a facility is extremely valuable, as it enables all manner of sounds to be mixed, thereby achieving through entirely artificial means a result which is in every way requisite and by no means a violation of verisimilitude.

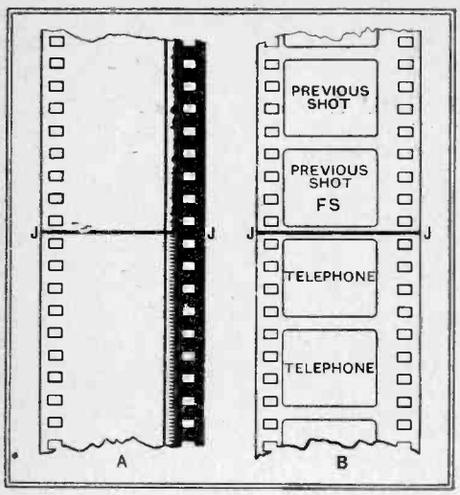
RECENTLY the potentialities of sound editing have come to be more fully recognised in talkie production, and it is now possible to think in terms of "film time and film space." In this, the third and concluding article of the series, the author relates how disconnected noises, recorded at different times and in different places, are now merged by means of the "dubber" to provide synthetic sound effects with convincing realism.

The matter resolves itself once more into the selection of raw material in sound, just as it does with pictures, but with the difference that, with modern dubbing facilities, the scope and flexibility available for extending the great physical freedom so peculiarly indigenous to the screen, are increased far beyond the wildest dreams of directors in the early days of sound-film production. To-day, it is a common practice to record "wild" sound tracks, i.e., records without any specific mute counterparts, and mount them in positions along the film where they may be required; in short, cutting sound just as mute was cut in the silent-film days, achieving synchronisation, where necessary, by parallel juxtaposition of mute and sound on the editing table itself.

Let us take an example of a simple piece of sound "editing." First, we must examine briefly the most important of the editor's primary tools—the synchroniser, which is illustrated on page 466. It consists essentially of two or more sprocketed drums placed alongside each other and locked together. The rolls of film (mute and sound) on the input end of the machine pass over the drums and are held in position on them by spring-tensioned rollers. These rollers are the key of the whole machine, as, once set into position for running, they maintain the ratio of all the rolls of film to each other. The mute and sound track are placed parallel on their respective drums, the synchronising marks (using the example of a simple dialogue shot) are exactly opposite, i.e., the length ratio of the two rolls is 1:1. The rollers, held tight in position on the film, maintain the ratio as the film passes into the output side of the machine.

Synchronising Picture and Sound

We will suppose there is a sequence of shots, already joined together in continuity, but where, between a particular two of them, the editor wishes to insert a close view of a ringing telephone. He will put the two rolls of film—mute and sound—on the machine, synchronise by the marks he has already made on the first two or three feet of the rolls, lock



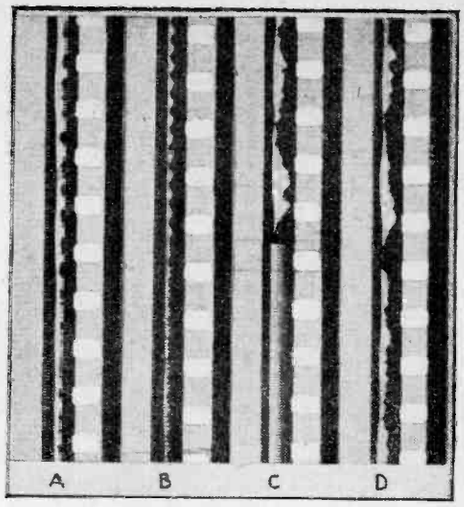
A is a positive sound track, B a positive mute. Sound and picture are on separate films for editing, but in the finished or "married print" they are on the same film.

synchronisation by the rollers, and wind the film to the point where he wishes to make his insertion. Here he does the physical act of cutting, passing his scissors through the mute and sound-track of the foregoing shot at the place he decides it shall end, still maintaining synchronisation by keeping both rolls, even at the point of cutting, on the drums. Then he takes the mute of the telephone, joins it (in the first instance temporarily by means of a clip) to the end of the shot he has just cut, and likewise with the sound-track of the telephone's bell. He continues to wind until he decides there is sufficient of the telephone, he cuts it (i.e., mute and track) just as he did the end of the foregoing shot, and joins its end to the beginning of the next shot.

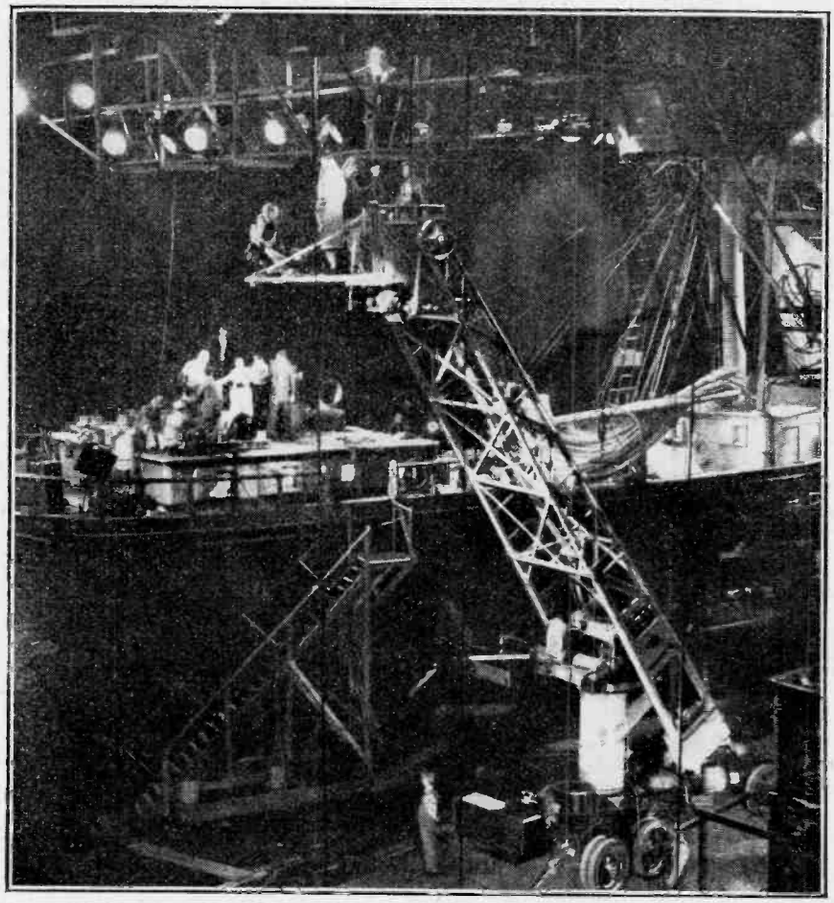
The above illustration will help to make the example more clear. We have the two films A and B, A being the sound-track and B being the mute. FS is the last picture or frame of the shot which, when the film is seen on the screen, we shall see immediately before the telephone. J is the "cut" or join, the place where the insertion of the telephone mute and sound is made. The chief interest of this example of a simple mute and wild sound "cut-in" lies in the fact that it is very unlikely the track of the bell will be a record of the bell belonging to the actual telephone we see in the mute. More likely it is a wild track of a telephone bell ringing, recorded at some totally different time and place to the taking of the photograph we now see wedded to it. Thus we have proved by this very ordinary case the existence of film time and film space. A philosophically inclined reader may ponder over this with great pleasure, given our example as a cue for his thinking.

Synthetic Sound

Now let us examine a case where the entire sound constituent of an event can be created in the editing room by wild track selection and re-recording. As we are primarily concerned with sound, we will suppose the little "incident" we are about to build up has been photographed entirely without sound, that it is already edited and in continuity, just as it will appear on the screens of the cinema halls. The scene is a street accident. First, we see the street, a busy thoroughfare; perhaps we are tracking through it on the pavement, or maybe it is a shot from a stationary camera position. Then, in another shot, we see our character, perhaps the leading man, crossing the street. A flash of a car approaching. Another flash back to the character. A short shot of a pedestrian on the pavement calling "Look out!" immediately followed by a terrific shriek of brakes. A shot of people running. Another shot of a crowd gathered round a stationary car. Our problem is to build the sound for such an incident.



A—sound record of traffic noises; B—"Look out!"; C—brake on wheels; D—the synthetic record obtained, as explained in the article, by grafting one sound upon another.



The crane camera in use in a big indoor set. The "ship" is stated to be the largest ever constructed for filming purposes.

Analysing the sounds we need, we find (1) Traffic noise, (2) A man's voice, (3) Shrieking of brakes. The generalised sound of the street, i.e., traffic noise, must be behind both the man's voice and the shriek of brakes. Although both will be much too loud for us to hear the traffic behind them during their time of utterance, we must not break the continuity of the background, because by so doing we should stress the artificiality of the medium at a situation where it would be most imperative that no consciousness of the *deus ex machina* should be felt by the audience in any way whatsoever. To take a musical analogy, it is rather as if we were removing the ground-bass at a point where it was the foundation of what we had to say harmonically.

We will call the traffic noise A, the man's voice B, and the brakes C, with sub-headings C1 and C2. The above photos show how the ratios of the wild tracks would appear on the synchroniser mounted in such a way as to synchronise with the sequence of events as described. Our traffic track A is probably stock material, kept in the editing room library of wild tracks, track B "Look out!" is a wild record taken in the studios of any individual with a voice suitable to the shot of the man we see, while C is a synthesis of two tracks of shrieking brakes—C1 the actual shriek caused by the brake acting suddenly on the drum, C2 the heavy spin of the tyres on the locked wheels of the car slithering over the road surface.

We might have been lucky and obtained

The Sound Film—

a record of the two sounds good enough in itself, but in order to give the extra dramatic emphasis necessary, we need both sounds to be heard clearly, and in order to achieve this we take the best of each from a number of records of the same thing, and join them together. We have, therefore, a synthetic noise to represent our car pulling up, recorded at some time in some place. We have our traffic, perhaps recorded a year ago in another place. We have our voice, recently recorded in the studio.

All our sounds have hitherto been widely separated in time and space; they have borne, until we have mounted them in the way we have, no relation to our picture. Now, by our editing process of selection and arrangement, and by passing the three tracks simultaneously through a three-channel dubber, we obtain a composite track D, which is what we need as the sound counterpart to our sequence—a street accident.

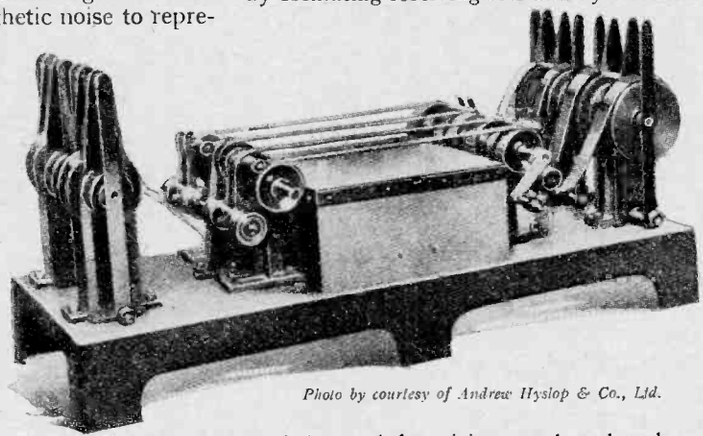


Photo by courtesy of Andrew Hyslop & Co., Ltd.

A four-film synchronous winder used for mixing sounds and applying them to "mute" pictures.

DISTANT RECEPTION NOTES

WELL, the deliberations at Lucerne are completed at last, and the new wavelength plan is out. Naturally, it will not please everybody, for there is hardly a country in Europe which does not think that it is entitled to at least one, and preferably two, long-wave channels. Nobody, again, wants any channel much below 300 metres, but most countries have to have one or two amongst their share. Taken as a whole, the plan seems a very sound one, carefully worked out and likely to have good results so long as everyone concerned does everything to ensure rigid adherence to its details.

One reads rather sadly that no fewer than seven countries—Lithuania, Finland, Holland, Hungary, Sweden, Poland, and Greece—have not signed the Convention, though it is stated that it is "anticipated that they will comply with its provisions." This is not good enough, for more than one of the countries concerned owns sufficient high- and medium-powered stations to wreck the entire scheme if it should choose to indulge in wavelength grabbing. It is to be hoped that all of these seven will sign before the plan comes into operation, as it will on January 15th next.

Interference from Small Stations

Signing the Convention again may or may not mean going the whole hog, so to speak. France, if my memory serves me, signed both the Geneva and the Prague agreements, and so did Sweden; but the smaller stations of these two countries seem to have been using almost any wavelengths that they liked, and they are responsible for a great deal of the chaos that has prevailed for so long in the lower part of the medium band. When reception conditions are good, even a quarter-kilowatt relay can cause interference at a surprising distance.

It is good to see that several European countries are waking up to the seriousness of the other kind of interference, that caused by oscillating receiving sets and by electrical machinery. Austria passed a law dealing with this matter some time ago, and I believe that Germany has taken similar steps. Both Spain and Denmark are now taking action, too. Our own Parliament will be considering man-made interference before long, and it is to be hoped that a satisfactory Bill will pass into law. It should certainly be made a punishable offence to sell or to install any kind of apparatus that can interfere with broadcast reception, for extensive experiments made by or on behalf of the Post Office authorities show that there is hardly a case in which radiation cannot be eliminated altogether or reduced to something very small if proper steps are taken.

I wonder if any fellow long-distance enthusiasts have picked up a very powerful Dutch transmission, which is usually to be heard rather late at night. This is the new 50-kilowatt station at the Hague, which is eventually to take over Huizen when Huizen is Huizen, or Hilversum when Hilversum is Huizen.

The Upper Medium Band

At the moment of writing the weather is very unsettled, and atmospherics have been a distinct nuisance for some days. This is only what one would expect, for thunderstorms of considerable violence have occurred in many parts of the country.

Except from stations at the bottom of the long-wave band and the top of the medium-wave band signal strength continues to be almost phenomenal for the time of year. It appears that the band between approximately 520 and approximately 1,160 metres is the one to suffer most this summer. Luckily, it contains few broadcasting stations of importance, though there may be a different tale to tell next year.

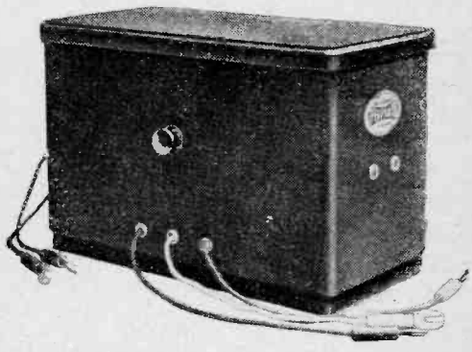
Stations particularly worth attention are Vienna, Prague, Langenberg, Lyons Doua, Beromünster, Paris Ecole Supérieure, Rome, Berlin Witzleben, Katowice, Söttens, Leipzig, Hamburg, Strasbourg, Milan, the Poste-Parisien, Hilversum, Turin, Gleiwitz, Nürnberg, and Fécamp on the medium waves. On the long waves all of the important stations are well heard except for Kalundborg and Oslo, whilst Radio-Paris, Zeesen and Warsaw are outstanding.

D. EXER.

Ferranti Class "B" Super Power Converter

THERE must be a large number of owners of battery sets who have decided to take advantage of the new Class "B" push-pull amplification system whereby nearly seven times the normal output can be obtained for practically no increase in H.T. battery consumption. It may be difficult, however, to find room in an existing receiver to house the necessary extra valve and components, and it is to meet these conditions that the Ferranti Class "B" converter has been introduced. The valve which has hitherto done duty as an output valve in the receiver is made to act as driver, and may with advantage be biased to a more negative value so as to reduce anode current. The converter consists of a highly efficient driver transformer, a Class "B" valve, and a multi-ratio output transformer contained in an attractive walnut finished cabinet measuring but 9in.×6in.×4⅞in. wide.

To put the converter into operation it is necessary to disconnect the speaker from the set and join it in turn to various pairs of terminals on the secondary of the output transformer until the most pleasing results are obtained. In addition to this, the output terminals of the receiver must be joined to the input of the unit and the Class "B" valve fed with L.T., for which purpose two leads with spade terminals are provided.



The Ferranti Class "B" converter, giving an output of about 2 watts. The L.T switch can be seen at the front of the case.

The unit will work equally well after a triode or pentode, and by virtue of the number of tappings on the output transformer can be matched with any speaker of high or low impedance. The price is 63s. complete with valve.

BOOKS RECEIVED

The Inventor and His World by H. Stafford Hatfield. A book of sound practical advice to inventors, explaining what is and is not patentable, the need for practical manufacturing knowledge, or the aid of one having such knowledge in producing a successful patent, the psychology of marketing and disposing of inventions, and a brief outline of present Patent Law. Pp. 269, with 4 illustrations. Published by Kegan, Paul Trench, Trubner & Co., Ltd., London. Price 6s.

Photo-Electric Cell Applications by R. C. Walker, B.Sc., and T. M. C. Lance. Describing the uses of Photo-electric cells in Television, Talking Pictures, Electric Alarms, Counting devices, etc. Pp. 193+viii with 111 Diagrams and Illustrations. Published by Sir Isaac Pitman and Sons, Ltd., London. Price 8s. 6d.

BROADCAST BREVITIES

By Our Special Correspondent

Break in the "Foundations"

THE "Foundations of Music" series is to cease—for two months. There is something cataclysmic in this decision, for the "Foundations," like the poor, have been always with us. Although the interruption will not be longer than a few weeks, i.e., during July and August only, the break is the first in a sequence of 285 weeks during which they have held the stage every evening except Sunday.

For the Student

The "Foundations" started as broadcasts of classical music, when classical music was less common in the programmes than it is to-day. Nowadays there is a little more latitude in the choice of pieces, the sole criterion being that the material chosen and the manner of its playing shall be of value to the serious student of music.

Practically every artiste of distinction in this country has contributed to the "Foundations." The composers most frequently drawn upon have been Beethoven, Bach, Schubert and Brahms.

Mid-Week Service Closes Down

Another temporary suspension will be that of the Mid-Week Service, which will not be held during the months of August and September.

A little while ago there was some talk of terminating this feature, but the Rev. W. H. Elliott, addressing a special appeal from the pulpit for opinions on the value of the service, was overwhelmed with requests for its continuance.

Are Announcers Human?

IT is a good thing that announcers are human enough to make mistakes sometimes, otherwise we should fail to appreciate their almost machine-like precision and accuracy. The other evening we were told that the next soloist would be "Mr. Michael Cole," and it was quite entertaining to sense the flutter of excitement in the studio and hear the hurried whispers which preceded the correction, "Mr. *Maurice* Cole." Instantly listeners felt more at home; the announcer was a human being after all!

Nerve Strain for Listeners

IT is good news that Mr. Val Gielgud, the Productions Director of the B.B.C., has decided to revive "Flags on the Matterhorn," the German radio play, on July 6th (Regional) and 7th (National). "Flags on the Matterhorn" was broadcast here in a translation in July last, the sixty-fifth anniversary of the conquest of the mountain. Until 1865, the year of the race between Whymper and Carrel, the 14,780 feet high Matterhorn was thought to be unconquerable. The play tells the story of the Englishman's victory over the Italian guide, a victory which took a terrible toll of human life. Some listeners found the thrilling story as brought to them by the microphone too severe a strain for their nerves. The tremendous realism of the microphone performance, however, made "Flags on the Matterhorn" one of the outstanding plays of a decade of broadcasting.

Sir John Reith

THE very latest rumour at Broadcasting House is that Sir John Reith intends to resign. There is no doubt that the broadcasting machine has been so efficiently organised that it practically "runs itself," but anyone with any experience of machinery knows that an untended machine is about as trustworthy as a cat among pigeons, and I shall be very surprised indeed if, when Sir John leaves Portland Place, he does so because the B.B.C. "can look after itself."

In any case, there is probably no truth in the rumour.

The King to Broadcast

THE King is to be heard on the broadcast microphone on July 26th when His Majesty travels to Southampton to open the new graving dock there.

In addition to the King's speech there is to be a running commentary on the scene by Mr. Howard Marshall.

Mast Climbing: The New Sport

I AM surprised that no publicity seeker has ever before hit upon the idea executed by Mr. E. L. Mallalieu, M.P., on Sunday last, when he climbed the North Regional mast to take a photograph of his constituency.

We all know that the B.B.C. is forbidden to broadcast advertisements, but there should be no legal difficulty in using the masts for propaganda purposes.

B.B.C.'s Opportunity

The spectacle of an athletic man balancing on a Daventry 500-footer would be very compelling, and I have no doubt that the B.B.C. could speedily arrange a scale of charges for ascending the various masts belonging to the Corporation.

No doubt the tariff would be fairly high for the Brookmans Park masts, for, although comparatively low, their nearness to the Metropolis would ensure large Sunday afternoon crowds. On the other hand, Scottish Regional masts would be available for a mere song for obvious reasons.

Views Across the Atlantic

TRANSATLANTIC conversations on the World Economic Conference will be broadcast next month. An American economist, talking from the United States, will give his views to listeners on both sides on July 10th, and on the following night a British expert will reply. Further talks will be given on July 17th and 18th. I understand that the B.B.C. programmes may be revised from time to time at short notice, as and when the opportunity presents itself, for a special broadcast from the Conference.

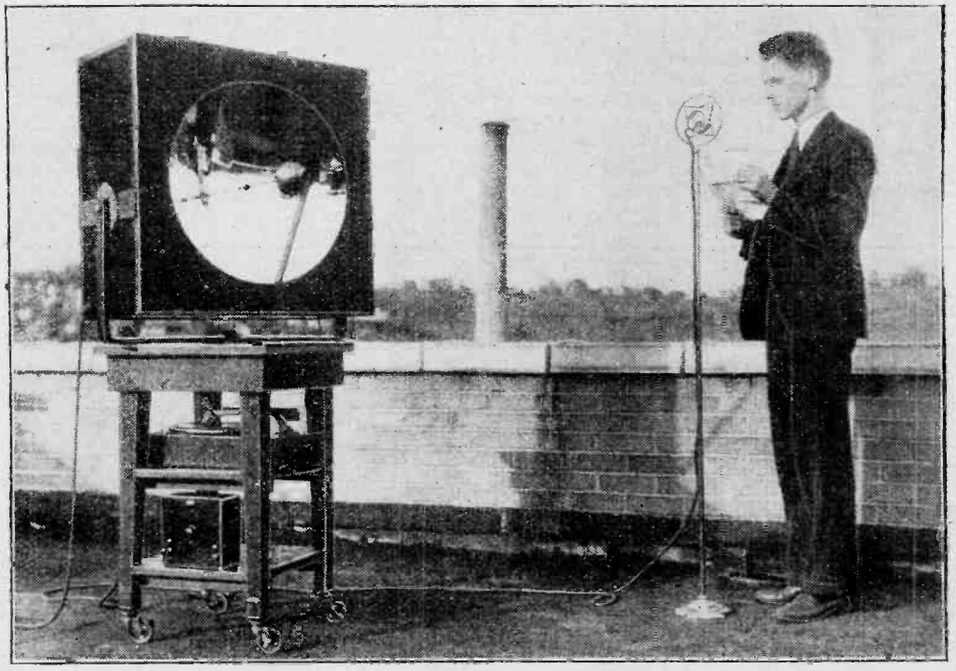
The B.B.C.'s Chaplain

THE Rev. F. A. Iremonger will on July 17th take over his duties as "Chaplain to the B.B.C." At least, this seems to me to be the most appropriate title, though there have been all sorts of other suggestions, such as "Vicar of Broadcasting House," "Bishop of Broadcasting," and "Priest of the Ether," none of which seems quite the correct thing. What do you think?

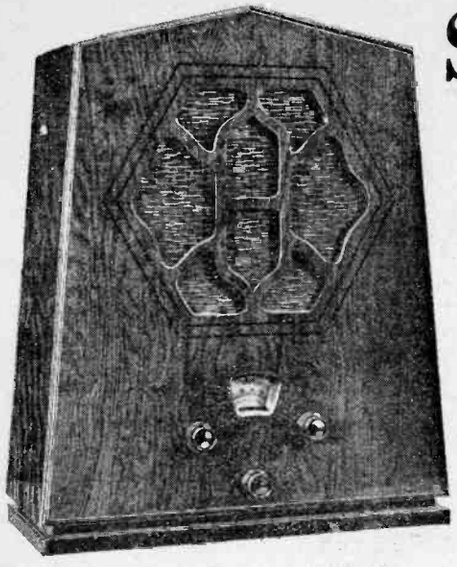
Criticism

OVERHEARD at a cinema following the inaugural recital on the B.B.C. organ:

"I say, Minnie, what did you think of the B.B.C. organ? A bit old-fashioned, what! It didn't seem to tremble properly."



ULTRA-SHORT WAVES AND THE MICROPHONE. Parabolic mirrors are used for "beamcasting" at the Chicago Century of Progress Exposition. This is the apparatus under test. Its sponsors guarantee that, unless the beam is intercepted, complete privacy is secured.



Six-Sixty "Super Five"

Good Performance Combined With Simple Tuning

FEATURES

Type.—*Four-valve "straight" receiver with two H.F. stages (no reaction).* ***Circuit.***—*Tuned screen-grid H.F.—aperiodic screen-grid H.F.—triode grid detector—power pentode output.* ***Controls.***—*(1) Tuning with illuminated dial calibrated in wavelengths. (2) Volume and on-off switch. (3) Waverange.* ***Price.***—*14 gns.* ***Makers.***—*Six-Sixty Radio Co., Ltd., 17/18, Rathbone Place, London, W.1.*

A SUPERFICIAL glance at the title suggests that this receiver is yet another superheterodyne. Actually, it is a straight set incorporating two screen-grid H.F. stages—a type which has many advocates among discriminating people. Although perhaps not quite so sensitive or selective as the superhet, the straight receiver is free from second channel whistles, and has a lower general level of background noise.

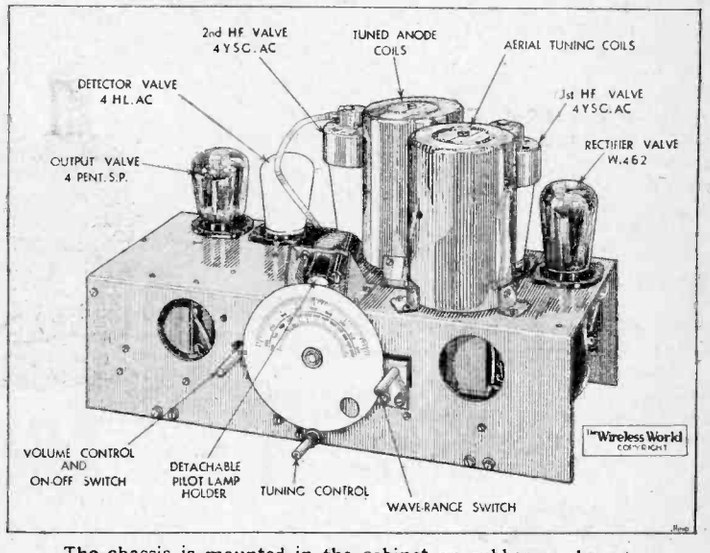
In the Six-Sixty "Super Five" the first H.F. stage is tuned and the second aperiodic. The aerial and tuned anode coils associated with the first stage are tapped down to improve selectivity. The grid detector—a triode—is transformer-coupled to the power pentode output valve, which feeds the moving-iron loud speaker through a choke filter circuit. High-tension current is derived from a full-wave valve rectifier and is smoothed by a choke in the negative lead. A potentiometer in series with the choke supplies the variable grid bias for volume control in the first H.F. stage, and also the bias for the power valve. The second H.F. valve is independently biased by a resistance in the cathode lead.

The principal components comprising the chassis are of exceptionally good quality. Isolantite insulation is used at all vital points in the high-frequency circuits and the tuning condensers and coils are of efficient design. The latter are enclosed in copper cans of large volume. The well-mounted detachable pilot lamp and the neat mains voltage adjustment with its automatic reference scale are details which stamp the chassis as a high-grade product. Freedom from microphonic noises is ensured by inserting thick rubber washers on both sides of the holding-down bolts in the base. Plug and socket connections are provided for the loud speaker, and the plug itself is fitted with additional sockets for an external loud speaker.

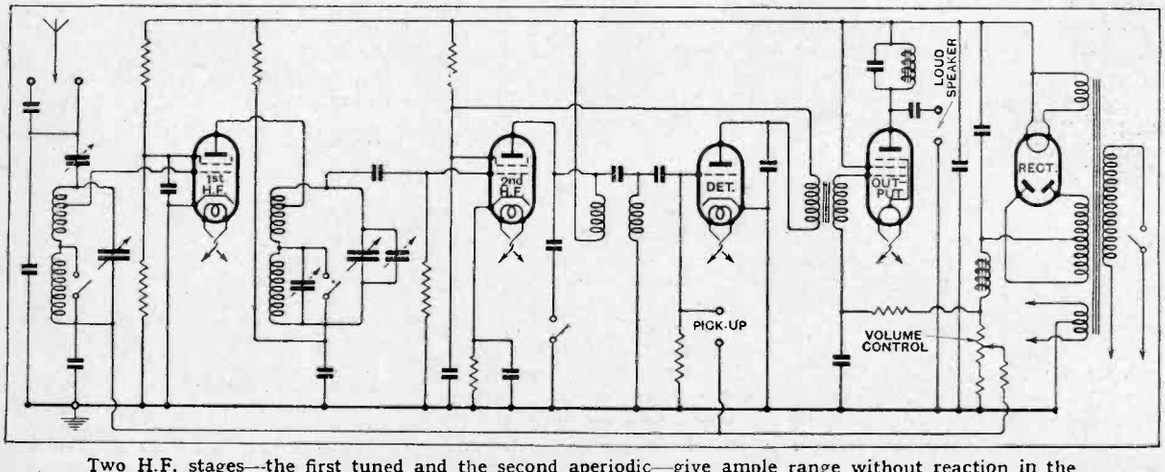
The gramophone pick-up is connected directly in the grid circuit of the detector valve, and must therefore be removed when reverting to radio reception. During the playing of records the detector becomes the first L.F. amplifier, and derives the necessary bias from the radio volume control potentiometer which should be set in the maximum position. An external pick-up volume control is required.

No reaction is employed, and the receiver is simple to operate. There are three controls: the tuning dial, which is calibrated in wavelengths, the volume control and on-off switch, and the waverange switch. Alternative aerial connections are provided at the back of the set, one for local station reception at close range and the other for distant reception at maximum efficiency.

The range is equal to, or slightly better than, that of a good three-valve set using reaction, and the performance is obtained without the need for critical tuning adjustments. Five or six foreign stations were received on medium waves during the daytime, and the long-wave range was exceptionally good from the point of view of sensitivity—more so than in many superhets we have tested. Selectivity on long waves was also of a very high standard, and the Zeesen programme, in London, was quite free of interference from Daventry and Radio Paris. On the medium waveband approximately five channels on each side of the Brookmans Park transmitters were taken up by the spread of these stations. The power output is ample for the built-in moving-iron loud speaker, which gives surprisingly good quality for its type. The reproduction is particularly clear and incisive in the middle and upper middle registers, and there is sufficient bass response to save the set from sounding high-pitched. There is no evidence of box resonance, and the walnut-finished cabinet is both solid in construction and imposing in size and appearance.



The chassis is mounted in the cabinet on rubber washers to minimise microphonic noise.



Two H.F. stages—the first tuned and the second aperiodic—give ample range without reaction in the Six-Sixty "Super Five."

VALVE AND CIRCUIT TESTING

USERS of the older type of Avometer multi-range testing meter may not be aware that a booklet giving much useful information on valve and circuit testing is now issued by the manufacturers.

During the month of July, all buyers of Avometers will be given, free of all cost, an Avodapter, which facilitates the testing of valves *in situ*.

LABORATORY TESTS

A Review of Manufacturers' New Products

HIVAC VALVES

HIVAC valves are made by The High Vacuum Valve Co., Ltd., 113/117, Farringdon Road, London, E.C., attention having been given so far to the development of the two-volt battery valves. Other types are in course of development, and will soon make their appearance. In all, eleven different battery types are contemplated, but at the time of preparing this review seven only are generally available, but the remainder will be released very soon. The seven two-volt battery valves examined comprise an H.210, L.210, D.210, P.220, PP.220, SG.210 and VS.210. The last two mentioned are screen-grid H.F. amplifying valves, the VS.210 being a variable-mu type. The working grid bias is from 0 to 14 volts and over this range the mutual conductance changes from 1 mA/volt to 0.075 mA/volt. The maximum anode potential is 150 volts, and the price of this valve and the ordinary screen-grid model is 10s. 6d.

The D.210 is a triode valve designed especially for use as a detector. It differs from the other general-purpose types in that the entire electrode assembly is surrounded by an earthed shield, the function of which is to reduce the external electrostatic field of the valve. The D.210 has an A.C. resistance of 13,300 ohms, an amplification factor of 16 and a mutual conductance of 1.2. Its price is 5s. 6d.

The H.210 and the L.210 are general-purpose valves, the former being suitable for use as a grid detector or oscillator in superheterodyne receivers while the latter will serve as a first stage L.F. amplifier or anode-bend detector. The H.210 has an A.C. resistance of 22,000 ohms and an amplification factor of 25, while the L.210 is rated at 8,600 ohms A.C. resistance and amplification factor 10, and the price is 4s. 6d. in each case.

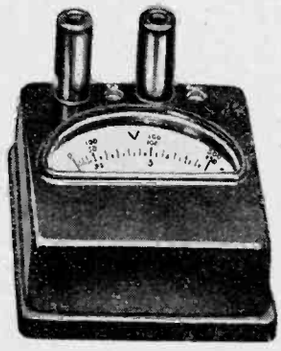
Selection of Hivac two-volt valves.

Two power valves are available, a P.220 and a PP.220, the former costs 5s. 6d. and the latter 6s. 6d. The P.220 is intended primarily for use in portable sets and provides an undistorted output of 175 milliwatts, while the PP.220 gives about 250 milliwatts. Pentode equivalents and also a Class "B" amplifier will be available very soon.

Tests made with some specimen Hivac valves in a recent *Wireless World* receiver gave results in every respect comparable with those they replaced, selectivity, sensitivity and volume being sensibly the same and the performance of the receiver was entirely satisfactory from every point of view. When the remaining valves in this series become available there will be an exact replacement for every valve now in general use.

DIX-MIPANTA TEST METER

A SMALL vest-pocket size universal test meter suitable for D.C. or A.C. measurements has been introduced by Electradix Radios, 218, Upper Thames Street, London, E.C.4. It has three voltage ranges selected by sockets placed just above the scale window, and they cover respectively 0-7.5 volts, 0-150 volts, and 0-300 volts. On the lowest range the resistance of the meter is exactly 100 ohms, and if used for the measurement of anode current will enable readings up to 75 mA. to be made. The 150- and 300-volt ranges each have a resistance of 71 ohms per volt and require 14 mA. for a full-scale deflection.



Universal vest-pocket test meter—the Dix-Mipanta.

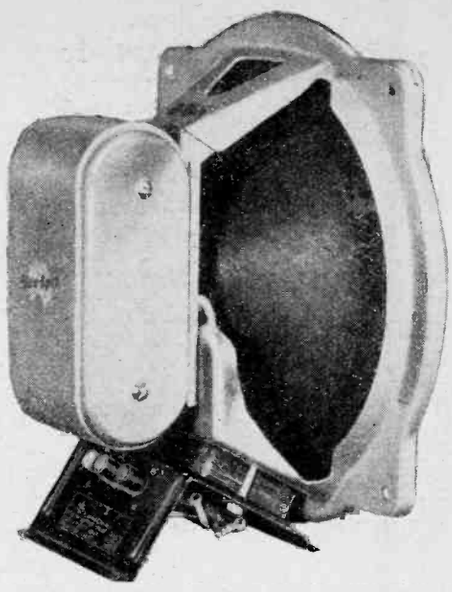
Despite its small size the accuracy with which voltage measurements can be made is surprisingly high, indeed, it could not be improved in view of the limitations imposed by the scale. For example, an A.C. potential of 300 volts was read as being 297 volts on the Dix-Mipanta, the difference being of the order of the thickness of the pointer only. The same high order of accuracy was maintained over the major part of the 300-volt range.

The 7.5-volt range can be regarded as sensibly accurate over the most useful part of its scale, and measurements of A.C. valves' heater voltages can be made with the assurance that the meter error is negligible.

This instrument should prove exceedingly useful to the experimenter, since the one meter suffices both for A.C. and D.C. measurements, and the price is 19s. 6d., complete with a pair of leads and plugs.

BLUE SPOT MODEL 45 P.M.

IN the Blue Spot range of permanent-magnet moving-coil loud speakers the model 45 P.M. occupies an intermediate position between the inexpensive 29 P.M. and the de luxe model 99 P.M., which is already well known. The chassis, diaphragm, and moving coil are similar to those of the more expensive models, but the permanent magnet and output transformer are of slightly different design. Three ratios are provided in the transformer, which is



Blue Spot model 45 P.M. permanent-magnet moving-coil chassis.

mounted underneath the chassis on an angle bracket suitable for supporting the loud speaker vertically. As in the 99 P.M. model, the centring spider is of unusually large diameter, which ensures adequate flexibility with lateral rigidity.

The useful frequency range is from 75 to 4,500 cycles, but the diaphragm responds up to more than 8,000 cycles. In the bass the output is greatest between 90 and 140 cycles, with a maximum at 120 cycles, while in the upper register the response is at a maximum between 2,500 and 3,000 cycles. Speech is exceptionally clear, and the essential elements contributing to good reproduction of music are adequately represented. The sensitivity is in every way satisfactory.

The chassis is finished in the characteristic Blue Spot copper enamel, and the price is 45s. The makers are The British Blue Spot Co., Ltd., 94-96, Rosoman Street, Rosebery Avenue, London, E.C.1.

SOLON RESIN-CORED SOLDER

MADE by W. T. Henley's Telegraph Works Co., Ltd., Holborn Viaduct, London, E.C.1, the Solon resin-cored solder is particularly well suited for use in the construction of wireless receivers, for the flux embodied in the solder is entirely free of any corrosive content. It is exceedingly handy and simple to use, and as only the correct quantity of flux is expended, clean and safe joints are made with the greatest of ease. The soldering iron must be maintained at a reasonably high temperature, in which connection it should be mentioned that this firm market, also, an electric soldering iron under the same trade name.

Solon resin-cored solder is sold in 6d. reels, while the price of the Solon electric soldering iron is 7s. 6d.

Trade Notes

The Curtis Manufacturing Co., Ltd., 32, Spring Street, Paddington, London, W.2, manufacturers of resistances of every kind, have now acquired new premises at 26-28, Paddenswick Road, Hammersmith, London, W.6. The telephone number is Riverside 4456.

The Edison Swan Electric Co., Ltd., 155, Charing Cross Road, London, W.C.2, announce that accommodation has now been found at the above address for their Publicity Department and the telephone number is Gerrard 8660.

READERS' PROBLEMS

THESE columns are reserved for the publication of matter of general interest arising out of problems submitted by our readers. Readers requiring an individual reply to their technical questions by post are referred to "The Wireless World" Information Bureau, of which brief particulars, with the fee charged, are to be found at the foot of this page.

Short-circuiting the Pick-up Coil

A READER, who is using a metallised first detector valve in his Monodial superheterodyne, has noticed that signals disappear when the metal coating of this valve is touched. He can see no definite reason for this effect, but imagines that it may possibly be due to an alteration in the value of the bias resistor brought about by shunting it with the resistance of the body to earth. We are asked to say whether this assumption is correct, and also whether the effect is a normal one.

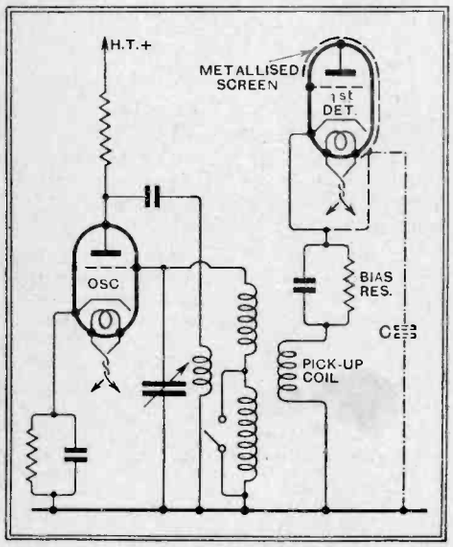


Fig. 1.—When the metallised bulb of a first detector valve is touched, signals will be weakened as a result of the added body capacity C.

It is natural that signals should be weakened in strength, or even cut out entirely, by touching the metallised coating of the first detector valve. The pick-up coil, through which energy from the oscillator circuit is induced into the detector grid circuit, is included in the cathode circuit, and, as a result of touching the metal, this pick-up coil is shunted by the capacity of the body, and what amounts to a partial short-circuit is introduced across it. At the same time the amount of capacity transferred to the tuned circuit of the oscillator is increased, with the result that the oscillator frequency changes, and so the signal may easily be lost entirely. The "phantom" condenser C, connected by dash-dot lines in Fig. 1, represents body capacity.

This accounts for the effect noticed; the change of effective bias resistance brought about by touching the valve is entirely negligible, and could not be responsible.

Internal Short-circuits

MANY L.F. transformers, smoothing chokes, and similar components are fitted with earthing terminals through which their cases or iron cores may be connected to earth. Whether these terminals be used or not is seldom a matter of importance, but at any rate no harm should be done by earthing them in the manner intended by the makers, and indeed it is a good plan to make it a rule always to "tie down" all masses of metal wherever possible.

These remarks are prompted by a letter from a reader, who finds that his H.T. fuses "blow" as soon as the metal shroud of the smoothing choke is earthed. The set works quite well without the earth connection, but we are asked to say what is likely to be wrong with the choke.

It seems that there must be a short-circuit between the metal shroud and the winding; very probably one of the terminals or leading-out wires is imperfectly insulated, and the fault should not be a difficult one to trace or to put right.

The Wireless World
INFORMATION BUREAU

THE service is intended primarily for readers meeting with difficulties in the construction, adjustment, operation, or maintenance of wireless receivers described in *The Wireless World*, or those of commercial design which from time to time are reviewed in the pages of *The Wireless World*. Every endeavour will be made to deal with queries on all wireless matters, provided that they are of such a nature that they can be dealt with satisfactorily in a letter.

Communications should be addressed to *The Wireless World* Information Bureau, Dorset House, Stamford Street, London, S.E.1, and must be accompanied by a remittance of 5s. to cover the cost of the service. The enquirer's name and address should be written in block letters at the top of all communications.

CORRESPONDENCE

Iron-dust Cores

THE universal application of dust-core radio-frequency inductances seems to call for standardised representation.

In the development of Nucleon tuning coils I have found it convenient to utilise a symbol consisting of a broken or dotted line instead of the usual full line normally used for an iron-core coil.

I am suggesting that this convention be adopted, and I believe a number of radio workers are already utilising my suggestion.

The use of a broken line is actually symbolical of the exact nature of the core, and it therefore appears to be a very appropriate symbol.

It is to be hoped that the suggested symbol will be recognised by the standardisation committees to whom the suggestion is being communicated. PAUL D. TYERS.

Watford.

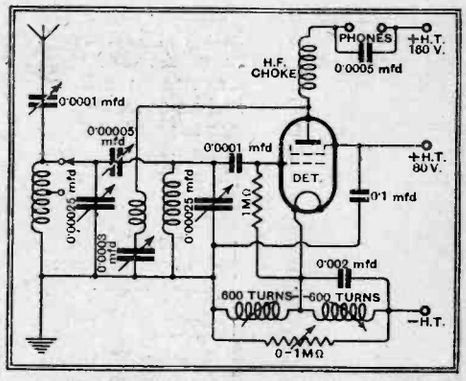
Inexpensive Short-wave Receiver

YOUR readers may be interested in a single-valve super-regenerative circuit with which I have had considerable success. To those acquainted with the Armstrong Super-regenerative arrangement, the diagram will more or less explain itself. It will be recalled that one of the chief drawbacks of this type of receiver is the poor selectivity, which together with the enormous H.F. amplifying properties makes this disadvantage even more acute. In order to overcome this shortcoming a form of pre-selector circuit is employed, which is coupled to the grid circuit by a small capacity condenser: it is advantageous for this to be variable.

This idea may sound rather unreasonable for short-wave reception where all possible sources of losses should be avoided, but in practice it makes little difference to a super-regenerative receiver, where the sensitivity is very high.

All the tuned circuits and associated parts, including the valve which is of the screen-grid type, are completely screened—on top as well. This is very important if the selectivity gained by the additional tuned circuit is to be realised, since a super-regenerative receiver will pick up on the coils and wiring to a surprising extent, even though screened all round; and an aerial often makes little or no difference to the rectified output.

In order to avoid extra coil changing, the aerial coil can be tapped to cover the required wavelength bands, while the grid coil can be interchangeable; or two of the common dual-range short-wave coils can be utilised. Efficiency of coils is not so very important; I find that coils wound on any old formers give very satisfactory results.



Circuit of super-regenerative receiver described by Mr. J. H. Slater.

Using a small indoor aerial about 12ft. long, 15 or more American and Canadian stations could be heard on most nights with this circuit; W8XK, Pittsburg on 48.86m. and 25.27m. often came in with sufficient strength to work a loud speaker at moderate volume. Results do not come all at once with this type of receiver, which requires considerable practice and patience to adjust. The strength of the quencher oscillations (controlled by the variable resistance), has an important bearing on the performance of the receiver, and the best strength can only be found by trial, and may vary with different wavelengths.

For those who like to get the utmost out of a single valve, there is nothing to beat the super-regenerative circuit, and with improved selectivity, it bids fair to rival many of the smaller super-het. arrangements.

J. H. SLATER.

Bradford.