SINGLE-VALVE LOUD SPEAKER SET

The Wireless World

AND RADIO REVIEW

4D

The Paper for Every Wireless Amateur

Wednesday, August 6th, 1930.

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(1926)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS OF THIS ISSUE.

	PAGE
EDITORIAL	115
SCIENCE MUSEUM RECEIVER. BY R. P. G. DENMAN AND A. S. BRERETON	116
SINGLE-VALVE LOUD SPEAKER SET. BY W. I. G. PAGE	119
PRACTICAL HINTS AND TIPS	121
WIRELESS THEORY SIMPLIFIED. BY S. O. PEARSON	123
CURRENT TOPICS	126
BROADCAST RECEIVERS REVIEWED. THE MURPHY PORTABLE	127
INSULATORS TESTED. (3) BAKELITE. BY W. H. F. GRIFFITHS	129
BROADCAST BREVITIES	131
LABORATORY TESTS ON NEW APPARATUS	132
CORRESPONDENCE	133
READERS' PROBLEMS	135

PROBLEMS OF EMPIRE BROADCASTING SOLVED.

ONE by one the obstacles which have stood in the way of the establishment of Empire broadcasting have been overcome, until now we learn that the last excuse for delay, namely, the problem of funds, has been solved by the Colonial Conference. We understand that the establishment and maintenance of an Empire short-wave station at an approximate cost of £23,000 has been agreed to, the cost to be borne by the Colonial Office, which will also be responsible for the maintenance of the station, whilst the B.B.C. will staff the station and conduct the transmissions.

The British Broadcasting Corporation, it will be remembered, had recently expressed their willingness to run the station, provided that out-of-pocket expenses were met, and it is therefore assumed that the sum now agreed upon to be furnished by the Colonial Office is intended to cover these out-of-pocket expenses in connection with the erection and maintenance of the station. Reuter's News Agency, we understand, has been approached, and has agreed to provide a special news service for the Empire station at an annual cost of £3,000. No other programme expense is likely to be involved, as the B.B.C. have undertaken to relay their programmes day by day.

This is exceedingly welcome news, and, since the final decisions have now been taken, there should, we think, be no further delay in the establishment of the station.

The transmitter will in all probability be erected in the neighbourhood of Daventry, in proximity to the existing B.B.C. stations there. As soon as the station is erected it will no doubt take over the service at present being conducted through 5SW at Chelmsford. Just how long it will be before the station is ready for service must largely depend upon the enthusiasm shown by the B.B.C., but in view of the generous attitude which they recently adopted towards the scheme as soon as they learnt that it had strong support from the representatives of the Colonies meeting in London, we do not think that the period for the erection and inauguration of the station is likely to be prolonged.

Twenty-four Hour Programmes ?

We have previously been informed that the aim of the B.B.C., in the event of funds for the cost of the station being provided, would be to conduct a twenty-four hour service. Just how this is going to be arranged is not clear at present, but no doubt the B.B.C. will find some means of overcoming any difficulty in the way of conducting such a continuous transmission. We may perhaps expect that the first efforts in this direction may take the form of recording the day's programme and re-broadcasting from the record during the night hours. Such an arrangement would provide the twenty-four hours' continuous programme and enable listeners in all parts of the world to participate. How unanimous must have been the support given to Empire broadcasting by the Colonial Conference is indicated by the fact that it is understood that the question will not be raised again at the Imperial Conference, as it is considered that the matter has been virtually settled.

After so many years of hoping and urging for the establishment of an Empire service, it is intensely gratifying to learn that the accomplishment of our ideal now approaches fulfilment. The value of an Empire broadcasting service can scarcely be over-estimated, and perhaps no more opportune time could be found for inaugurating such a service than the present, when so much attention is focused upon Imperial issues and the need for closer co-operation in inter-Empire trade.

SCIENCE MUSEUM RECEIVER

Constructional Details. A Special B.B.C. Transmission.

By R. P. G. DENMAN, A.M.I.E.E., and A. S. BRERETON, M.A.

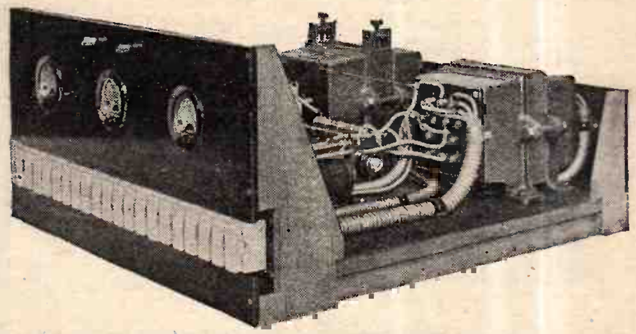
(*Concluded from page* 99 *of previous issue.*)

A FEW details of the mechanical design and construction of the receiver may be of interest, but it is quite impossible to give full working drawings (which, indeed, are not likely to be in demand). It was found convenient to divide the set into units arranged vertically in an iron framework, as is done in central station switchboard practice.

The duplicate high-frequency stages are housed side by side in special boxes made of plywood coated on both sides with thin copper sheet, all joints being electrically continuous. Each box has an internal vertical partition through which the valve is mounted and which acts as a screen between the grid and anode circuits. The screen forms part of a framework on which all components are mounted and which can be withdrawn bodily from the outer screening box for repairs or adjustments.

In each compartment is mounted a double-pole, double-throw, push-pull switch. These are ganged together and serve to connect or short circuit (according to which H.F. unit is in use) the input and output circuits. The switches in the two units are in their turn ganged together and to a two-way switch controlling two illuminated panels indicating the programme which is being received. Extension spindles with flexible couplings are used for the controls in the rear compartments.

Immediately below the two H.F. units is mounted a



Mains equipment panel. Note the large number of fuses employed. Stray fields are prevented by carrying the leads in flexible metallic tubing.

third, housing the push-pull detectors and the first-stage amplifier. The general construction is similar to that of the H.F. units, the internal framework being removable from the copper-covered case. In order to provide a check on the working of the valves up to this point, two milliammeters are controlled by a series of spring-loaded key switches, enabling the anode currents of the H.F. stages, as well as of the detectors and first-stage amplifying valves, to be read. The volume control, consisting of a large hand-wheel, is provided with an adjustable stop pin to prevent its advance beyond the safe limit for 100 per cent. modulation, and a flexible coupling is fitted to ensure sweet movement. The volume control varies the input to the first-amplifying stage, and is mounted on the same panel as the meters and keys, so that the whole operation of the set can be checked from one point. The attendant responsible for its working, indeed, only has access to this panel

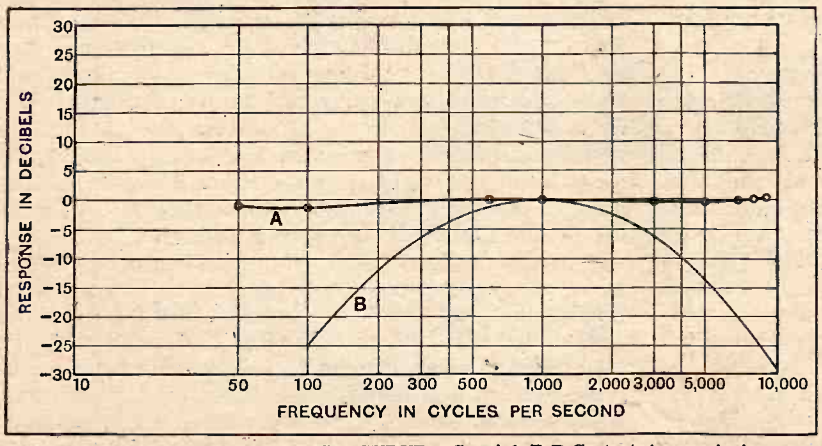


Fig. 4.—FREQUENCY RESPONSE CURVE. Special B.B.C. test transmission on 356.3 metres, June 4th, 1930. Curve A shows 20 $\log_{10}\left(\frac{v}{v_{1000}}\right)^2$ where v is the receiver output voltage and v_{1000} is the value of this voltage at 1,000 cycles per second. Transmitter modulation voltage constant. Curve B is for a small portable receiver measured under like conditions.

Science Museum Receiver.—

and to the main control switches at the rear of the framework, all other controls being protected by locked panels.

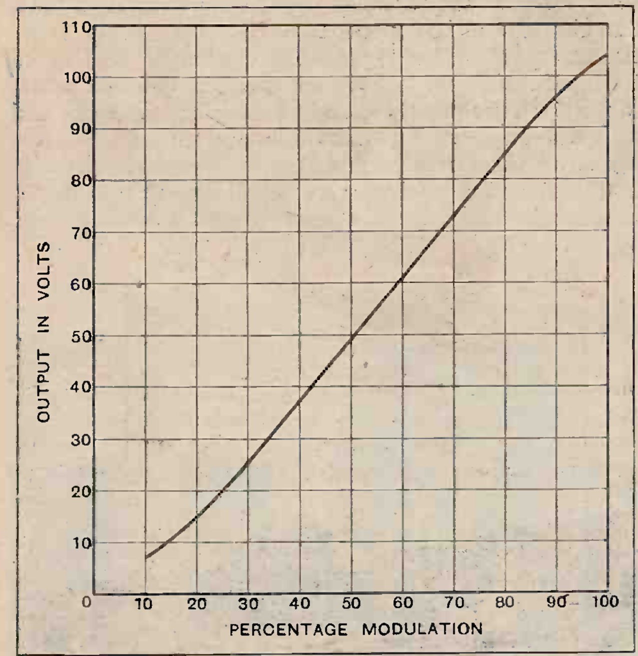


Fig. 5.—MODULATION-AMPLITUDE CURVE. Special B.B.C. test transmission on 356.3 metres, June 4th, 1930. The curve shows that distortionless demodulation (detection) is obtained for modulation up to about 90 per cent. The distortion for 100 per cent. modulation is small.

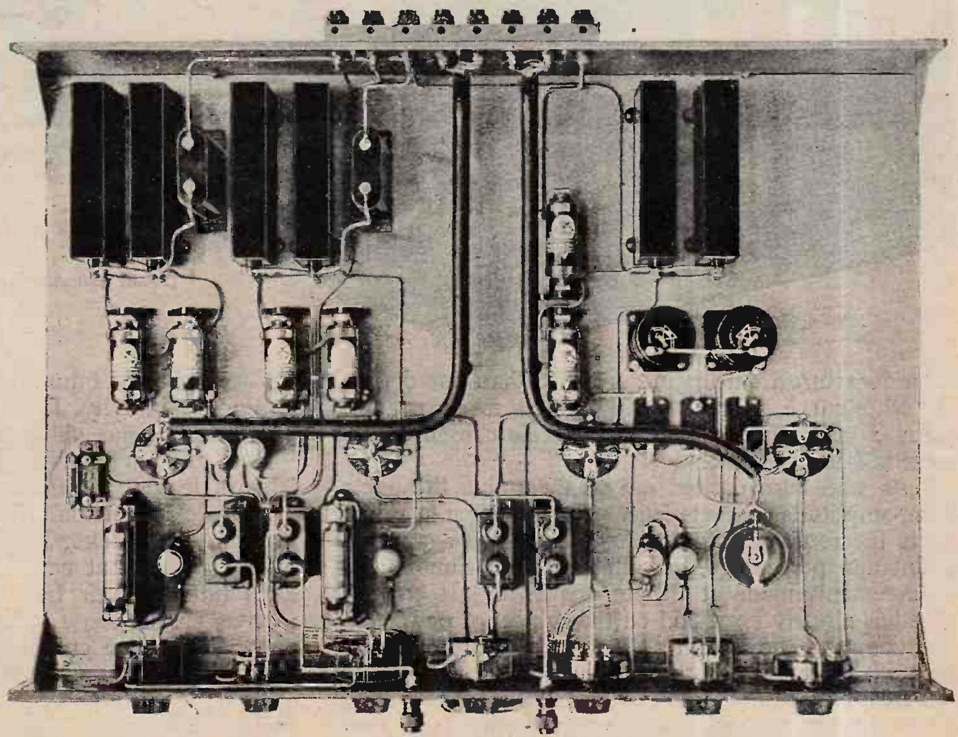
Immediately below the detector and first-amplifier unit is mounted a large double-deck unit in which are housed the penultimate and output stages; a full-wave thermionic rectifier feeding H.T. to all previous stages, and two mercury-vapour rectifiers providing H.T. for the penultimate and output stages. Smoothing chokes and condensers for these stages, and high- and low-voltage transformers are also included, together with fuses for all circuits in the unit, and meters for checking grid and anode currents and voltages. The framework is again removable from the outer case of $\frac{5}{8}$in. mahogany. The lowest unit houses the smoothing chokes and condensers for high-tension to the earlier stages and for the detector filament circuit. The low-voltage transformer for the earlier stage filament circuits is included, and separate fuses are used to feed each stage. There are also meters for checking detector, speaker field, and A.C. mains voltages, and the framework carrying these components is removable. The first three units can be pulled out of the framework without disconnecting the power supply wires. The iron framework in which the units are mounted is covered with sheet metal, the side panels being of light gauge, fitted with ventilating louvres to deal with the considerable heat dissipation of the output and power units. The front and rear panels are of stouter gauge, into which are fitted suitable locked plate-glass windows, preventing access but allowing the principal portions of the set to be seen where the exigencies of screening permit.

The switches controlling the A.C. mains, the aerial, earth switch, and the programme-selector switch are fitted at the rear of the frame, together with the output-control switches. All are protected by locked panels.

All circuits carrying raw or partly smoothed A.C. are shielded, particular attention being paid to the H.T. circuits after smoothing. Screening in the earlier units is carried out in rigid copper tubing which can easily be seen in the photographs.

An elaborate system of flexible metallic tubes and junction boxes is used in the final units and frame. By placing the purely radio components of the penultimate and output stages in the same unit as the transformers and valves, a considerable number of strapping wires was avoided, and dangerously high potentials confined to that unit.

Safety switches connected in the H.T. transformer primary render all H.T. circuits dead immediately any panel giving access to dangerous parts is opened. In



Underside of the push-pull detector and first L.F. amplifier unit.

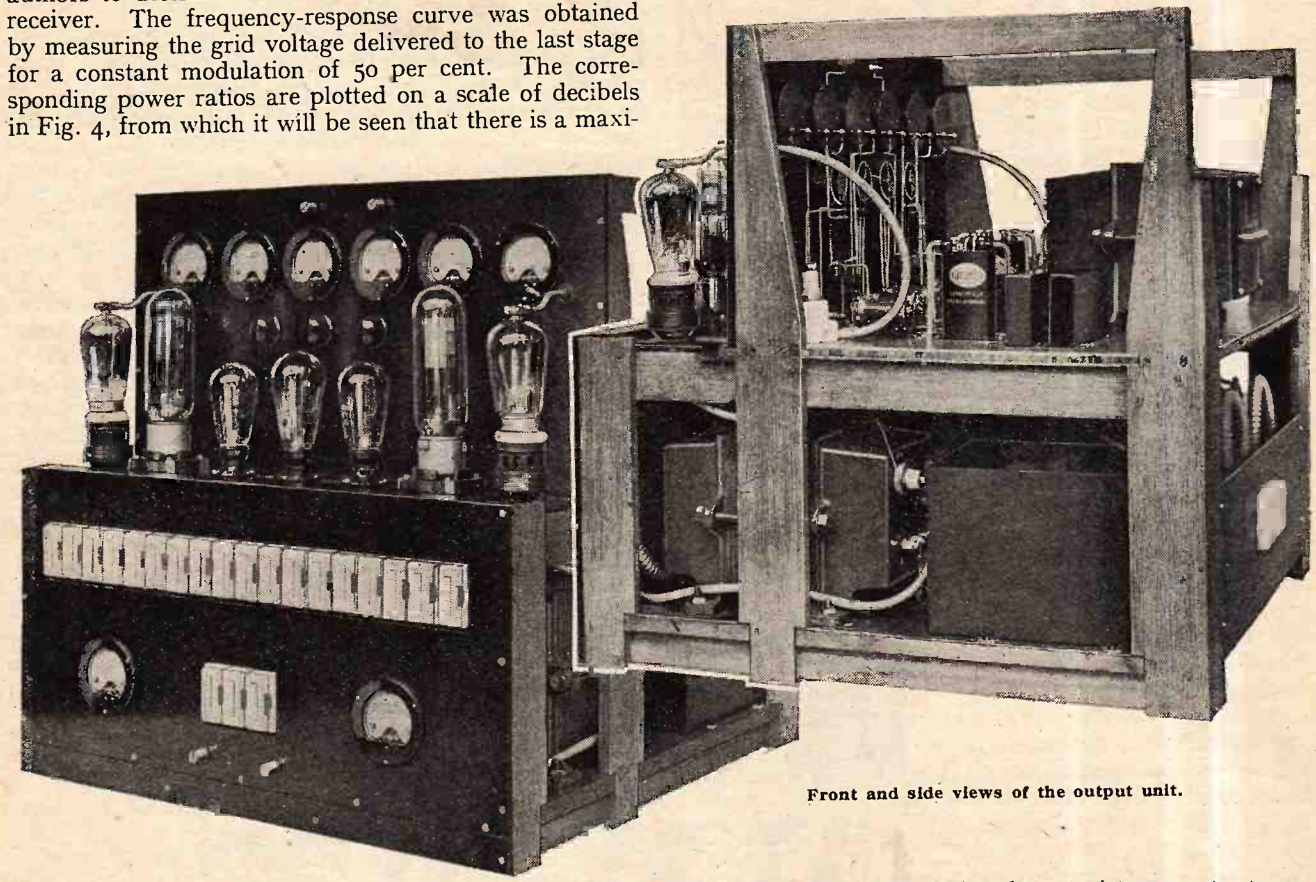
Science Museum Receiver.—
addition, special locks are fitted to these panels, and red and green signal lights indicate when H.T. and L.T. are connected. These precautions may seem rather elaborate, but it should be remembered that in almost all units it is possible to receive a 400-volt shock, and in certain parts one of 3,400 volts. The engineer who may attempt to make hurried adjustments must be protected no less than the public.

By the kind permission of Mr. H. L. Kirke, leader of a most able B.B.C. group whose services in the cause of high-quality broadcasting are beyond praise, a special transmission was given from Brookmans Park on the morning of June 4th for the purpose of enabling the authors to determine the overall characteristics of their receiver. The frequency-response curve was obtained by measuring the grid voltage delivered to the last stage for a constant modulation of 50 per cent. The corresponding power ratios are plotted on a scale of decibels in Fig. 4, from which it will be seen that there is a maximum departure from the mean of less than one decibel. The other curve is for a certain portable receiver, and is included in order to show that the scale chosen for this curve is fair and reasonable.

Tests were also carried out to determine the modulation-amplitude characteristic. This is shown in Fig. 5, where the receiver output voltage is plotted against the modulation percentage, as obtained from simultaneous measurements made at Brookmans Park. It confirms what has already been said on the subject of power grid detection, and shows that no distortion need occur until the modulation exceeds 80 per cent., and that it need not be perceptible at any time. Thus, the receiver voltage output for 100 per cent. modulation is only 5 per cent. less than it would be if the curve were quite straight.

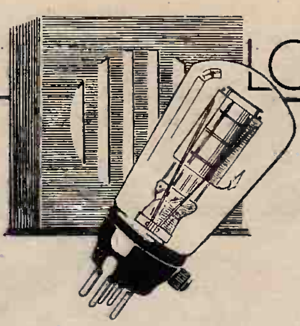
So far as steady-state conditions go, then, the tests show that the performance of this receiver could hardly be distinguished from that of one having ideally linear characteristics. But since music and speech are in their very essence characterised by *movement*, it is now thought that all components having time delay (viz., reactance) must be regarded as potential sources of transient distortion. At present these components necessarily occur frequently in the transmitting network, and no extra harm is caused by the single (output) transformer that has been permitted to reside (for the present) in this particular receiver. But should the circumstances warrant it, there is no reason why it should not be replaced at some future date by a resistance-output connection. Naturally, there would be a loss of efficiency, but it might conceivably be worth while.

Both authors have now retired from the scene of their labours, leaving to others the task of accounting for this or that defective result; whether it be due to the transmission, room echo, local machine interference, valve softening, or what not. They may modestly claim to have fulfilled their task of producing a distortionless receiver in the sense in which that word is at present understood; they gratefully acknowledge the help they have received on every side, and they look forward to a time when improvements in transmission and loud speaker technique will have further lessened the gap that still divides the reproduction from the original.



Front and side views of the output unit.

SINGLE-VALVE LOUD SPEAKER SET



The Indirectly Heated Pentode as Power Grid Detector.

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

A SHORT time ago in *The Wireless World* in an article[1] describing the practical application of the power grid detector it was prophesied that A.C. sets might soon make their appearance in which the loud speaker would be fed directly from the detector. At the time that this article was written the indirectly heated valves on the market capable of giving an adequate detector power output required a large input grid swing such as could be obtained only from a preceding high-frequency stage and not directly from an aerial circuit. Since that date the first indirectly heated pentode (the Mazda AC/Pen) has become available, and such is its sensitivity as a power grid detector that with a modest signal obtained directly from an aerial circuit sufficient loud speaker volume for a moderate-sized room can be had from the local station unaided by any high- or low-frequency amplifying stage. Thus the straight-circuit one-valve loud speaker set becomes *un fait accompli*.

Now to more definite figures. It has already been shown that a triode power grid detector will give an output one-quarter that obtainable from the same valve under amplifying conditions with a similar H.T. voltage; furthermore, the valve will accept half the grid swing that is possible under amplifying conditions. The AC/Pen as an output amplifying valve will deliver some 1,400 milliwatts when biased to 10 volts negative, and when working into a load not exceeding about 10,000 ohms. This valve, therefore, as a rectifier may be expected to give approximately 350 milliwatts when fed with a signal of 5 volts. The reader will probably like to be reminded of some other valves giving an undistorted output of about 350 milliwatts so that he can judge what volume may be anticipated when working the one-valve set close to a station. The P.240 type two-volt power valves and the two-volt pentodes with correctly matched loud speakers deliver about this power at 150 volts H.T.

Experiments show that the field strengths of the London Regional and National Stations are such that an outside aerial will give a sufficient input with a well-designed aerial tuning circuit up to a distance of some 30 miles. In this connection it should be noted that the attenuation of the shorter wave transmission (261 metres) is rather marked; except at very short distances the Regional Station supplies the louder signal.

A suitable circuit arrangement shorn of eliminator and aerial details is given in Fig. 1. The control grid is fed through the usual grid leak and condenser, the latter having a value of 0.0001 mfd. The grid leak R_1 when associated with a three-electrode valve should have a value of 150,000 to 250,000 ohms to provide the correct time constant with the grid condenser C_2, but as the pentode V_1 is liable to accentuate the higher audio frequencies when feeding a moving-iron loud speaker, frequency correction can be carried out in the grid circuit. Accordingly the grid leak R_1 can conveniently be made either 0.5 or 1 megohm. There is the advantage that when frequency correction is carried out in the detector grid circuit no additional components are needed, and the input is damped to the minimum.

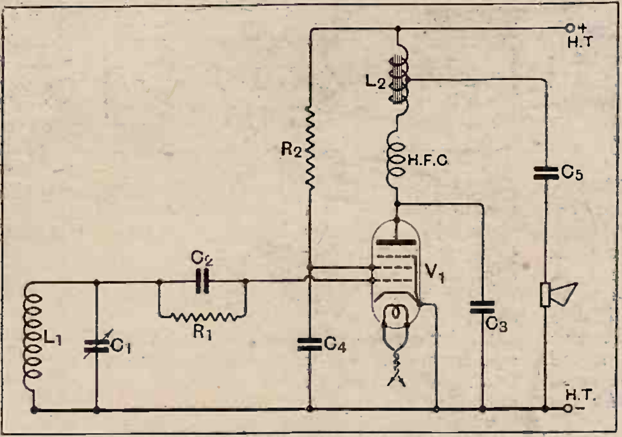


Fig. 1.—Simplified circuit diagram of one-valve loud speaker receiver. Details of the complete aerial tuning scheme and the A.C. eliminator have been omitted.

When a pentode is used as an output valve preceded by a separate detector, it is better to correct in the loud speaker circuit as lately explained in detail in the pages of this journal.

The auxiliary grid of the pentode should be fed in the conventional way through a resistance R_2, and the voltage which tends to vary in sympathy with the anode is held down by the by-pass condenser C_4. There is no applied grid bias in the receiver, the cathode being connected to the low-potential end of the tuned circuit. Contrary to expectation, grid current does not flow at zero grid voltage in the valve under discussion, but in view of its efficiency as a grid circuit detector it is evident that it functions by virtue of asymmetric conductivity rather than by curvature in the grid current characteristic. In other words, grid current only flows during the positive half cycle with comparatively large inputs.

A recent article entitled "Detector Damping"[2] made it clear that the input load due to reverse reaction in

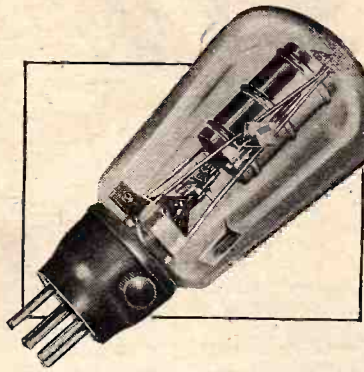
[1] See "Power Pentode Two," May 7th, 1930.

[2] *The Wireless World*, July 30th, 1930; by W. T. Cocking.

Single-valve Loud Speaker Set.—

a power grid detector was somewhat serious unless a large anode by-pass be used. A value of 0.001 mfd. (C_3) has been found to be about the maximum before high note loss is evident. The logical procedure is to cancel out the reverse reaction with positive reaction, and if not carried too far there should be no harmful effect on quality. Little notice is taken of the anti-reaction effect present with anode bend and ordinary leaky grid detectors, yet there is not much doubt that both forms of reaction—in-phase and out-of-phase—have the same unequal effects on the upper and lower sidebands and are both harmful only if they are applied to excess.

The anode-grid capacity of the AC/Pen appears to be a little less than that of a triode, the auxiliary and earth grid having only a slight effect in reducing feedback. Whatever be the internal structure of a valve, it would appear almost impossible to reduce the effective residual capacity below about 5 micromicrofarads when the anode and grid connections are brought through a single glass pinch to pins in a composition valve base.



The indirectly-heated pentode—the Mazda AC/Pen. With a signal of 5 volts from a local transmission it is possible to obtain about 350 milliwatts output.

The optimum auxiliary and anode voltage for rectification is found to be 200, causing a total current of 45 mA. when the grid is at zero. The watts dissipation limit is not reached, and life tests of the valve by the manufacturers under the above conditions are quite satisfactory. Although at zero grid volts the pentode has a comparatively low working A.C. resistance, it is still a little too high for a moving-iron loud speaker designed to follow a 2,000-ohm triode. A centre-tapped output choke L_2, therefore, giving a step-down ratio of two-to-one, is advisable if the low notes are to be reproduced in their correct proportion.

A set built to this specification is almost foolproof; the quality is excellent, and the "background" particularly silent even when the very minimum of smoothing equipment (a choke and a condenser) is employed. The valve is non-microphonic, and the rectification efficiency is not audibly impaired if a slight deviation from the optimum H.T. voltage is made. No screening is needed, and, owing to the absence of any intervalve coupling, motor-boating cannot occur.

Constructional details of a receiver on the above lines containing a highly selective band-pass tuner will appear shortly. The filter has been designed to give a peak separation of 10 kilocycles at the middle of the medium broadcast band, and visible indication of the "double-hump" tuning can be got by the use of a milliammeter in the plate circuit.

TRANSMITTERS' NOTES.

The 7- and 14-megacycle Waveband.

The following remarks from a letter received from Mr. S. Townsend, G2CJ, of Gloucester, are interesting in reference to the abnormal conditions observed by other amateurs working on the 7- and 14-M.C. wavebands.—

"I have been working on the 14-M.C. band from November, 1929, up to the present time. From November to March it was found comparatively easy to work stations in all continents, districts 1, 2, 3, 4, 8, and 9 of North America coming in particularly well. On March 31st I was in communication with twelve different stations in U.S.A., signal strength being reported as R7 in all cases but one, where R6 was given. At the end of March conditions for North America and, in fact, all continents except South America, began to decline rapidly, and it is now quite exceptional to hear more than a few of the higher-powered W stations on any given evening.

"A point particularly noticed during the last three months is the phenomenal strength at which numerous South American stations have been received here. PY1AH and PY1CM seem to be about the best. The former has been heard as early as 18.00 B.S.T., but appears to be at his best at 23.30 B.S.T. as a rule.

"The following record from my log shows how conditions have changed. From November 15th, 1929, to January 31st, 1930, working about eighty out of eighty-seven days, South American stations were worked on thirteen occasions. From January 31st to June 15th, however, working on fifty-six days only and using slightly less power, South America was worked on forty-eight occasions.

"I have received reports from ON4OZ and from several other European stations to the effect that similar conditions are prevailing practically all over Europe.

"On 7-M.C. conditions since beginning of March (when I returned to this band after a long absence from it) have been hopeless as far as work with other British stations is concerned. On the rare occasions when British stations have been audible at reasonable strength they have almost always been subject to extreme fading. My own 'fone' signals on this band have several times been reported as R9 to R1. G6RG, of Galashiels, Scotland, however, seems to be an exception, his signals being received here when no other G station was audible.

"A study of weather and lunar conditions since January has failed to yield any useful data.

"Finally, I entirely agree with your correspondents that the more distant European stations, usually audible at night only, are coming in at all times of the day. On looking at my log for this period last year, I find that OZ and OH were practically never workable before 17.00 B.S.T. This year they appear to be most easily workable (on 7-M.C.) at any time between 10.00 B.S.T. and dusk, though as a rule they are not heard later than this."

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Short-wave Transatlantic Working.

Mr. A. Lambourne, of Norcot, Reading, sends us the following particulars of regular short-wave traffic, which will probably be of interest to many of our readers :—

GBU, Rugby, on 16.10, 24.41 and 30.15 metres, works with WMI, Deal, New Jersey, who replies on 15.14, 20.56 and 30.39 metres.

GBW, Rugby, on 16.54, 20.77 and 30.64 metres, works with WNC, Ocean Township, New Jersey, who uses 15.61, 20.73 and 30.77 metres.

GBS, Rugby, on 16.39, 24.69 and 33.26 metres, works with WND, Ocean Township, N.J., who uses 16.36, 22.40 and 32.71 metres.

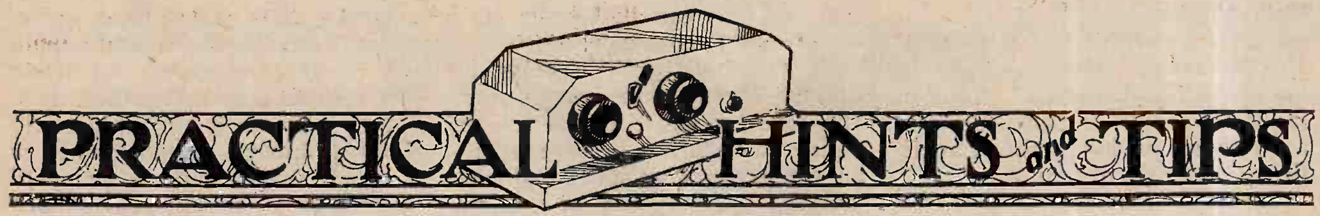
GBX, Rugby, on 27.5 metres, works with VK2ME, Amalgamated Wireless (A'sia) Ltd., Pennant Hills, N.S.W., who replies on 28.5 metres.

GBK, Bodmin, on 16.57, 26.10 and 32.40 metres, works with CGA, Drummondville, Quebec, who uses 16.50, 26.00 and 32.12 metres.

WLO, Ocean Township, N.J., on 14.01, 18.44 and 28.44 metres, works with LSM, Monte Grande, Argentine, who uses 20.00 metres.

G2GN, S.S. "Olympic," on 18.30, 24.00 and 35.00 metres works with F8BZ, Paris (19.50, 22.14 and 38.56 metres), G2AA, Slough, (36.00 metres), and with WOO and W2XG, Deal, N.J.

WSBN, S.S. "Leviathan," on 33.98, 45.21, 68.30 and 87.51 metres, works with WOO, Deal, N.J., who replies on 34.76, 46.05, 72.89 and 96.03 metres.



Simplified Aids to Better Reception.

GRID BIAS FROM D.C. MAINS.

Requests are occasionally received for information regarding grid-bias eliminators for use on D.C. supply mains. One is rather tempted to say that there are no such things, but this statement would hardly be true; if the querist intended to use his mains only for the supply of grid voltage, obtaining his feed current for filaments and anodes from some other source, it would be an easy matter to devise for him a simple piece of apparatus which might be connected externally to almost any set, irrespective of its peculiarities. All that is needed in this case is a smoothing circuit with a suitable tapped potentiometer connected in parallel with it. Filters to prevent inter-circuit coupling could be included in the eliminator, thus making it compleely self-contained and ready for external attachment to a receiver normally intended for batteries.

But it almost follows that the mains supply will already be in use for feeding anode circuits, and so any attempt to connect a grid-bias eliminator of this sort would produce a short-circuit. Other methods must accordingly be adopted, and it becomes necessary to take the set itself into consideration; a "universal" foolproof device is no longer practicable.

The principles of a workable scheme are indicated in Fig. 1. The first essential is a resistance (R_1), across which biasing potentials are developed, and which is joined between the negative output terminal of the eliminator and the negative H.T. terminal of the receiver. A number of tapping points must be provided on this resistance element, of which the value will depend on the total anode current and on the maximum grid bias voltage required. Here Ohm's Law comes to our aid; the formula is $R=\frac{E}{I}$, where R is the value of the necessary resistance (in ohms); E, maximum grid voltage required, and I, total anode current to be consumed by the receiver under intended operating conditions. If a considerable surplus voltage is delivered by the H.T. eliminator, it is permissible to assign to the bias

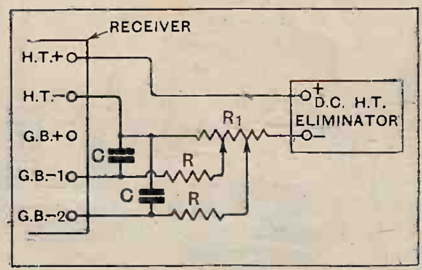


Fig. 1.—Adding a "grid bias battery eliminator" to a receiver deriving its anode current from D.C. mains.

resistance a rather higher ohmic value than is given by calculation.

As already indicated, it will generally be necessary to take precautions against unwanted transference of voltages from one circuit to another. With this object, decoupling resistances (R) of some 100,000 ohms or more, and bypass condensers (C) of about 2 mfds. should be inserted as indicated.

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THE PERIODICAL OVERHAUL.

For some time during the pre-broadcasting era the writer of these notes was responsible for the maintenance of a number of wireless telegraph stations. The apparatus would now be regarded as crude, and his task was not lightened by the fact that it was worked mainly by comparatively unskilled operators, who were products of intensive but sketchy war-time training. A description of the many and varied faults that manifested themselves in the spark transmitters would hold but little interest for the present-day reader, but the behaviour of the crystal receivers gives food for thought even at the present day. No careful record was kept, but it is certainly not far wide of the mark to say that 90 per cent. of reported failures were found to be due, not to real faults, but either to sheer neglect or to over-enthusiasm in using unsuitable cleaning materials for switches, contact studs, etc. Of course, the crystal set depends entirely for its operation on energy picked up by the aerial, and, unlike the valve receiver, cannot turn on a source of local voltage to overcome the effect of high-resistance connections; consequently, it may well become dumb under conditions where an up-to-date set would continue to function with hardly perceptible loss of efficiency.

But the point is that there is bound to be some loss if a receiver is neglected. It would be a counsel of perfection to suggest that every user of a broadcast receiver should allot an hour or two every month to a systematic overhaul of his apparatus, but it may be suggested, with all due diffidence (and with the admission that the writer does not do so himself) that time so spent would hardly be wasted. At any rate, it can be recommended that a receiver which is "below par," although not suffering from any definite complaint, should be given this attention.

The wireless correspondents of the lay Press are never tired of advising their readers (from the comfortable security of their armchairs, presumably) to overhaul their aerial systems. It is excellent advice; but they might add that the wire, if of the stranded variety, and particularly if enamelled, should be examined to see if there are any broken strands. The earth connection is particularly likely to develop a high contact resistance, which may be re-

Hints and Tips.—
sponsible for erratic and unaccountable behaviour, more especially in modern mains-driven sets. Lead-in insulators should be taken to pieces and cleaned, paying particular attention to the faces of terminals.

Turning to the receiver itself, the accompanying illustration may serve as a reminder as to points which should not be forgotten. It is best to begin operations by removing as much dust as possible with the help of a brush, a clean rag, a bicycle or motor pump, and even, if available, a vacuum cleaner. Then, working in the order of the key numbers, the switch contact blades (1) should be cleaned; this can often conveniently

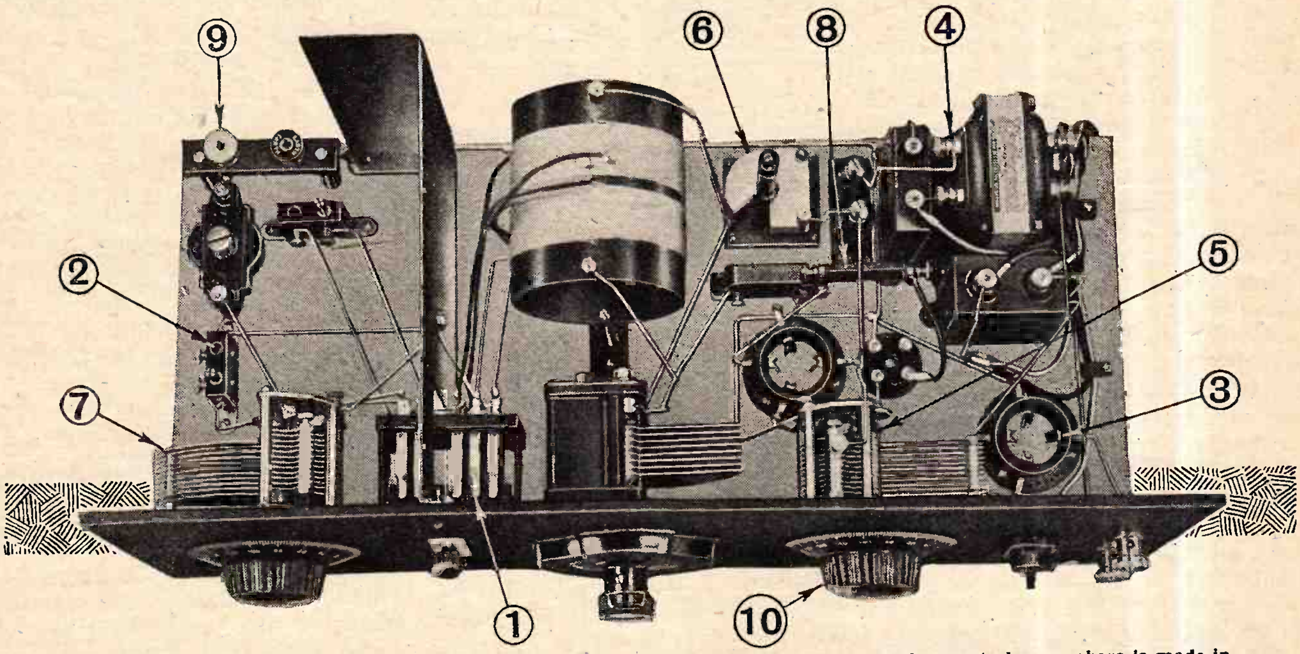
If the time can be spared, it is worth while removing every terminal head (4) and lightly cleaning its working surface with emery paper, afterwards giving it a final rub on a piece of clean rag. Before replacing connecting wires, the bared ends (or tags, if fitted) may be scraped.

Condenser spindle bearings (5) may develop slackness or end play; it is not beyond the capabilities of a mechanically minded handyman to readjust them, but it is wise to leave well—or fairly well—alone unless one is sure that the method of doing so is properly understood. In dealing with the simpler type of condenser, and particularly with those designed for neutralising or reaction

ally take place, and no harm will be done by cleaning the conical ends of the resistance elements and seeing that they fit properly in their clips.

Terminal shanks (9), particularly if fitted through ebonite panels or terminal strips, have a habit of working loose, and so it is as well to go over their securing nuts.

Nothing is more annoying than a condenser dial (10) which grates against the panel through part of its rotation. This trouble is occasionally due to warping, and it may be cured either by setting the dial back on its spindle, or, much better, by trueing it up by rubbing its rear surface on a sheet of emery paper spread on a flat board or table top.



Points at which mechanical faults and electrical contact failures may possibly develop. Reference to key numbers is made in the text.

be done by interposing a piece of paper between the contacts, moving the arm vigorously to and fro. The sockets of coil holders, etc. (2), might well be polished with a piece of fine emery paper, afterwards brushing out any remaining dust. Similar attention may be given to the corresponding pins, of which the slots should be opened out.

If modern A.C. valves with solid pins are used, the valve holder and sockets (3) should certainly be cleaned in the same way, and if springy valve pins are used they should be attended to. This matter was discussed recently in these notes.

purposes (6), it is worth while cleaning the spindle and bush if no other electrical connection to the moving vanes is provided.

It has been proved that an accumulation of dust between variable condenser vanes (7) can be responsible for lowered efficiency. Probably a feather is the best appliance for cleaning; it may with advantage be supplemented by a blast of air.

A grid leak (8) has normally such a high resistance that it may appear ridiculous to suggest that its contacts should be examined. Nevertheless, complete contact failure may actu-

Wire-wound rheostats and potentiometers are sometimes responsible for noises due to imperfect contact between bush and spindle; this can be remedied by cleaning and tightening up, or, in obstinate cases, by fitting a flexible wire pigtail. A touch of vaseline on the resistance element does no harm, and will cure roughness, but one is inclined to deprecate the use of lubricant in a wireless receiver, as it collects dust. Exceptions exist, of course, when dealing with contacting surfaces not carrying current, and it pays to apply a drop of fine oil to the operating gear of linked switches, etc.

WIRELESS THEORY SIMPLIFIED

The THREE-ELECTRODE VALVE.

(Continued from page 109 of previous issue.)

By S. O. PEARSON, B.Sc., A.M.I.E.E.

HAVING considered in outline the action of the grid in controlling the anode current of a three-electrode valve, we can now revert to the anode voltage/anode current characteristic curve armed with sufficient knowledge to understand its exact meaning in relation to the so-called anode resistance of the valve. We have seen that when a small alternating voltage is applied to the grid the anode current varies between two limits, but never reverses. When the valve is operated in this way over the straight part only of one of its grid-anode characteristic curves the mean value of the current is unchanged. The current simply varies above and below this mean value at the frequency of the voltage variation applied to the grid, and a moving-coil milliammeter connected in the anode circuit shows no change in reading, the moving parts being too heavy to follow the rapidly varying value of the current, so that it simply reads the mean or average value.

It should be clear, then, that this pulsating anode current is equivalent to the sum of a steady direct current (equal to the mean value) and a true alternating current whose amplitude or peak value is equal to the maximum variation of the actual current above and below the mean value. In other words, the anode current may be considered as being made up of an A.C. component and a D.C. component added together. A moving-coil instrument in the anode circuit indicates the D.C. component only.

Since the D.C. component is independent of the alternating one when the valve is worked on the straight part of the characteristic curve, we may consider these separately and investigate the "resistance" of the valve as applied to each individually.

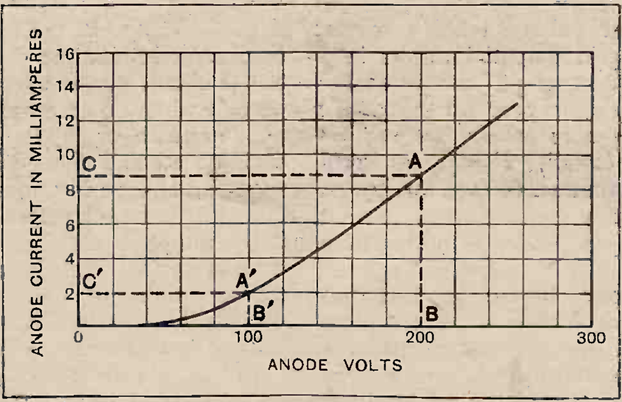


Fig. 1.—The anode voltage/anode current curve of a valve obtained with the grid potential fixed. At 200 volts the apparent or D.C. resistance is given by $\frac{AC}{AB}=\frac{200}{0.0088}=22{,}700$ ohms. At 100 volts the apparent resistance is $\frac{A^1C^1}{A^1B^1}=50{,}000$ ohms. Fig. 3 shows how the effective A.C. resistance is obtained.

The Apparent Resistance of a Valve.

Although the heat generated at the anode of a valve is not due to resistance in the ordinary sense, but to the bombardment of the anode by high-velocity electrons, we can express the power consumption in terms of an apparent resistance. In any circuit where the rate of generation of heat is P watts and the current I amperes, the effective resistance is given by $R=\frac{P}{I^2}$ ohms. When the whole of the electrical energy put into the circuit is converted into heat, that is, when there is no "back E.M.F." of any kind, the resistance is simply given by Ohm's law, being equal to the ratio of voltage to current.

In the case of the three-electrode valve the whole of the energy coming from the H.T. battery in the circuit of Fig. 1 of the previous section is converted into heat at the anode, even though it is in a roundabout way. Thus by dividing the voltage between the anode and the cathode by the anode current we obtain what may be termed the D.C. resistance, or apparent resistance, of the valve.

For a simple resistance of constant value the graph connecting the current and voltage is a straight line passing through the origin, that is, through the common zero of the two axes of the graph. We have already seen that the curve showing the relationship between the anode voltage and the anode current for a valve with the grid maintained at a constant potential is not a straight line; only a portion of it is fairly straight, but even this part, if projected downwards, does not pass through the zero. Thus the apparent resistance, or D.C. resistance, of the valve is a variable quantity depending on the anode voltage.

The curve connecting the D.C. resistance with the anode voltage can be obtained quite easily from the anode voltage/anode current curve of the valve, with any given value of grid potential, simply by finding the ratio of volts to amps. from the curve at various points. The ratios obtained in this way may then be plotted as a new curve against the corresponding voltages.

Fig. 1 gives the anode voltage/anode current characteristic curve for the same valve as was considered in the previous part, namely, an amplifying valve with an indirectly heated cathode. This particular curve gives values obtained with the grid maintained at a potential of two volts negative with respect to the cathode, this figure having been chosen so as to fit in with conditions previously stipulated.

From the curve of Fig. 1 the apparent anode to cathode resistance of the valve has been deduced by

Wireless Theory Simplified.—

finding the ratio of volts to amps. at various points along the curve, as indicated by the broken lines in Fig. 1, the results having been plotted as a new curve in Fig. 2, showing the apparent resistance for various values of anode voltage. This curve shows at a glance that the apparent resistance is not even approximately constant except over a limited range of anode voltages. As the anode voltage is reduced below 100 the apparent resistance rises very rapidly.

This curve of D.C. resistance, or apparent resistance, is not of much practical use. It is included here, for theoretical reasons, to show clearly that in dealing with a three-electrode valve we cannot apply the ordinary rules as for a simple circuit with more or less constant resistance. Nevertheless, with a steady anode current the power absorbed and dissipated at the anode is given by the product of the square of the current and the apparent anode resistance.

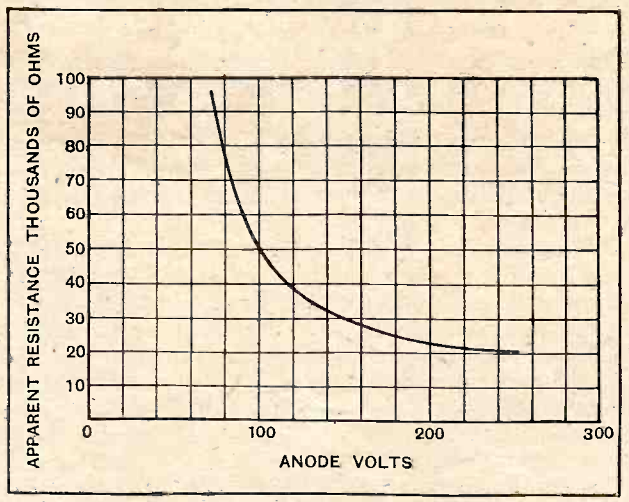


Fig. 2.—The apparent resistance of a valve obtained by dividing the anode voltage by the anode current. The curve is derived from the characteristic curve of Fig. 1.

The A.C. Resistance of a Valve.

By the aid of Fig. 4 of the previous part it was shown that, with the anode maintained at constant voltage relative to the filament, a small change in grid potential results in a corresponding change in anode current, and when the valve is operated on the straight part of the anode characteristic curve *the change in anode current is exactly proportional to the* (*small*) *change in grid potential*, so that a small alternating voltage applied to the grid produces an alternating component of current in the anode circuit, the D.C. component or mean value being undisturbed.

The point of prime importance here is the fact that the amplitude of the alternating component of the plate current is exactly proportional to the amplitude of the alternating voltage applied to the grid. *Therefore the effective or R.M.S. values are also exactly proportional to each other.* Now, it has already been shown that when a valve is operated over the straight part only of its grid voltage/anode current characteristic corresponding to the anode voltage in use, it is also being operated over the straight portion of the anode voltage/anode current characteristic curve corresponding to the mean grid potential, and, further, that under these conditions a change of one volt on the grid has the same effect as a change of μ volts on the anode, where μ is the amplification factor of the valve.

From this it follows that an alternating potential of V_g volts applied to the grid is equivalent in its effect to an alternating *component* of voltage equal to μV_g volts applied to the anode in addition to the steady H.T. voltage, and also that *the alternating component of the anode current is exactly proportional to the equivalent alternating voltage* μV_g *injected into the anode circuit.* But it is only in the case of a circuit with constant impedance that the R.M.S. value of the alternating current is exactly proportional to the R.M.S. voltage producing it; or, in the absence of inductance and capacity, exact proportionality between current and voltage signifies constant resistance. Thus we arrive at the very important conclusion that, although the apparent resistance offered to the D.C. component of the current is a quantity which varies between wide limits, the impedance offered to the alternating component is constant, provided, of course, that the alternating voltage applied to the grid of the valve is not large enough to operate round the bend in either of the anode characteristic curves.

Valve Impedance Defined.

It is this sensibly constant "impedance" offered to the A.C. component only of the anode current which is referred to as the *A.C. resistance* or *anode impedance* of the valve. Its numerical value can be simply defined in two ways, namely, (*a*) the A.C. resistance of the valve is given by dividing the equivalent alternating component of voltage μV_g in the anode circuit by the alternating component of the anode current when no external impedance is connected in the anode circuit, or (*b*) the A.C. resistance is obtained by dividing a small change in anode voltage by the corresponding change in anode current, the grid being maintained at constant potential. Now, of these two definitions, although the former gives a clearer idea of the meaning of A.C. resistance, as it refers to actual operating conditions, the latter is simpler, and, furthermore, enables the numerical value to be found from the anode voltage/anode current characteristic curves of the valve.

In contrast to the apparent resistance given by the ratio of actual anode volts to current, the "A.C. resistance" is given by the ratio of the *change* of voltage to the *change* of current; that is to say, the A.C. resistance is the ratio of a difference between two voltages to a difference between two currents. For this reason it has been suggested that the term "differential resistance" would be much more satisfactory as it conveys the exact meaning. The suggestion, originally due to Professor G. W. O. Howe, has been widely adopted by technical writers but not to any extent by valve manufacturers, who use mostly the terms "impedance" and "A.C. resistance." The term "impedance" used in this sense is rather misleading, as it gives one the impression that the A.C. resistance of a valve is dependent to a large extent on the frequency; but

Wireless Theory Simplified.—

this is not the case; at very high frequencies the reactance due to the capacity between the anode and the cathode, being in parallel with the A.C. resistance or differential resistance, results in a true impedance, but the manufacturers' term "impedance" does not include the effects of capacity.

Finding the A.C. Resistance.

Let us now revert to the anode voltage/anode current curve of the valve, redrawn in Fig. 3, and see how the differential resistance can be evaluated from it. Previously we considered the particular valve, to which this curve belongs, to be operated with 200 volts on the anode. At this voltage the anode current is seen to be 8.8 milliamps or 0.0088 ampere. If the voltage is reduced by 40 volts to 160, the current falls to 5.8 mA., a reduction of 3 milliamps or 0.003 ampere. From the above definition the differential or A.C. anode to cathode resistance of the valve is $R_a = \frac{40}{0.003} = 13{,}300$ ohms approximately.

When the measurements are made graphically in this manner it is always difficult to obtain accurate results if the triangle ABC in Fig. 3 is small, and yet if the points A and B are situated too far apart the portion of the curve between A and B may not be sufficiently straight for our purpose. To overcome the difficulty the straight part of the curve is produced downwards to meet the voltage axis at F. The A.C. resistance is then given by the ratio of FD in volts to AD in amperes. In this case we have FD = 118 volts and AD = 0.0088 ampere, so that $R_a = \frac{118}{0.0088} = 13{,}400$ ohms, which is practically the same as previously found.

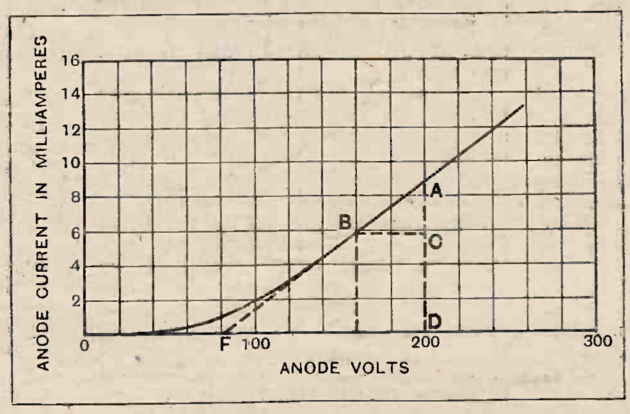


Fig. 3.—Diagram showing how the A.C. resistance or differential resistance is obtained from an anode voltage/anode current characteristic curve of a valve. The A.C. resistance is given by $R_a = \frac{FD}{AD} = \frac{118}{0.0088} = 13{,}400$ ohms.

It is quite evident that the steeper the slope of the straight part of the curve of Fig. 1 the greater will be the ratio of AD to FD. But $\frac{AD}{FD}$ is the ratio of change of anode current to change of anode voltage, and is therefore the *reciprocal* of the A.C. resistance. Now, the reciprocal of resistance $\left(\text{meaning } \frac{1}{\text{resistance}}\right)$ is called *conductance*, so the slope of the curve expressed in amps per volt (or mhos) gives the A.C. anode conductance of the valve. It was previously explained that the ratio of change of anode current to change of *grid* voltage was called the mutual conductance of the valve; and since one volt change on the grid has the same effect as μ volts change on the anode, it follows that the mutual conductance is μ times as great as the A.C. conductance between anode and cathode.

Thus: mutual conductance $= \mu \times \frac{AD}{FD} = \frac{\mu}{R_a}$ amps per volt, or, in other words, the mutual conductance of a valve is equal, in amps per volt, to the amplification factor divided by the A.C. resistance, or knowing the amplification factor and the mutual conductance of a valve, its "A.C. resistance" or differential resistance is obtained by dividing the amplification factor by the mutual conductance.

(To be continued.)

KEEPING H.F. ENERGY OUT OF THE L.F. AMPLIFIER.

A Compromise Between Detector-efficiency and High-note Loss.

IN the interests of good quality, no less than from the point of view of getting rid of all traces of L.F. instability, it is highly desirable to prevent the entry of H.F. energy into the L.F. amplifier. This is most conveniently done in the majority of cases by the use of an H.F. choke in the plate circuit of the detector valve and a condenser connected from plate to filament negative of the valve. From the point of view of filtering out H.F. energy, this condenser cannot be too large, but, unfortunately, other considerations, among which is the question of high-note loss, prevent the use of a capacity much greater than 0.0005 mfd. The maximum capacity permissible is governed by various factors such as the nature of the L.F. coupling following the detector valve, and no definite value can be assigned to it to cover all cases. If reaction is used, the predetermined value of this condenser can be kept constant by the use of a differential reaction condenser. In addition to the above precautions, it is desirable to connect a resistance in series with the grid of the first L.F. valve. A value of 100,000 ohms is usually ample, but sometimes a higher value up to 250,000 ohms is called for, especially if the receiver caters for long wavelengths, in which case more H.F. energy will have escaped the choke and condenser arrangement previously mentioned. Once again, however, the question of high-note loss steps in to prevent us using a still higher value of resistance. High magnification sets, which are especially prone to instability, may need a proper filter circuit following the detector.

Current Topics

Events of the Week in Brief Review.

THE SILENT CITY.

The Brussels Police have issued an edict prohibiting the use of loud speakers or gramophones after 11 p.m.

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THE ACID TEST.

Ilford's new tramcars are out of bounds to all who carry accumulators containing acid. The borough council has issued this regulation to prevent damage to the upholstery.

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GERMAN TELEVISION SHOW.

Specimens of all the television apparatus in use in different parts of the world are being collected for exhibition at the Munich Deutsche Museum.

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WHERE FRANCE LEADS.

French holiday-makers are discovering that the majority of State trains to the well-known watering places are equipped this year with broadcast receivers. No similar discovery seems to have been made on the British lines.

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FREE RADIO REPAIRS.

One of the most novel "radio weeks" in history has just drawn to a close in Copenhagen. Discovering that the many new recruits to radio were showing signs of giving up the hobby in disgust owing to their inability to obtain satisfactory results, the manufacturers organised a "free repair" week, during which any wireless owner in difficulty could submit his set for a complete overhaul without any cost. The "week" has been a joyful success.

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STATIC TO ORDER.

All forms of electrical interference are unwelcome to the broadcast listener, but there may be some small satisfaction in knowing exactly what kind of static is troubling one at any given moment. To assist listeners in identifying "parasites" a Czecho-Slovakian firm has produced a gramophone record in which every known form of interference is included, from natural atmospherics to the noise created by medical and domestic appliances.

Local radio clubs are enthusiastic over the idea and are endeavouring to secure a wide circulation for these unique records.

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"TELEVISION AT THE CINEMA."

Congratulations are due to the Baird Company for boldly submitting their television system to the ordeal of the public gaze at the Coliseum during the past week. The daily demonstrations—undoubtedly the "big turn" of each performance—were carried out with the metal filamented lamp screen described in *The Wireless World* of July 9th last. This was placed well up stage at a sufficient distance from the nearest members of the audience to render the individual lamps indistinguishable.

The images lacked the brilliance of the picture seen in a televisor, but this was probably an advantage, the violent contrast between light and shade being less noticeable. Synchronisation was generally good, and the fact that the faces were inclined to swing vertically at times did not detract from the enthusiasm of the audience at recognising the features and voices of celebrities. Clearer loud speaker results might have been obtained, but otherwise the demonstration was remarkably effective.

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PRIZES FOR SET BUILDERS.

Cash prizes totalling £175 are offered for home-made wireless sets and wave traps in the competition to be held in connection with the *Manchester Evening Chronicle* Wireless Exhibition, opening on October 8th.

In previous years the competitions have been strictly limited to amateur entrants, but this year one class will be open to workers in the radio industry. Intending competitors should apply at once for an entry form to the Radio Editor, *Evening Chronicle*, Withy Grove, Manchester. A stamped addressed envelope should be enclosed. The closing date for receiving the apparatus is September 22nd.

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SCIENCE MUSEUM RECEIVER.

In the footnote (3) on p. 97 of the issue of July 30th "resistance capacity push-pull receiver" should read "resistance capacity receiver."

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MAN-MADE STATIC.

An appeal to the Postmaster-General by the Wireless League in regard to the growing interference to broadcast reception by electrical machinery has brought the following reply:—

General Post Office,
London, E.C.1.
July 22nd, 1930.

The Hon. Sir Arthur Stanley, C.B., M.V.O.,
Chairman of the Wireless League.

Sir,—With reference to your letter of the 14th inst., concerning the question of interference with the reception of broadcast programmes by motors and other electrical machinery, I am directed by the Postmaster-General to say that the Wireless Telegraphy Acts, 1904-1926, do not empower him to impose restrictions on the use of electrical equipment in the interests of broadcast reception, and no fresh legislation is at present in contemplation in which such power could be sought

In these circumstances the Postmaster-General can only appeal in the interests of the general public to the owners of electrical machines to make such adjustments as may be necessary to prevent interference with the reception of broadcast programmes. His technical staff investigates complaints and gives advice as regards suitable remedies, and he is glad to say that, generally speaking, his efforts in this respect obtain the cordial co-operation of the owners of the plants concerned.

I am, Sir, your obedient servant,
(Signed) W. E. WESTON,
for the Secretary.

Commenting on this letter, a representative of the League states that "the cordial co-operation of the owners of the plants concerned" has not been experienced by the Wireless League.

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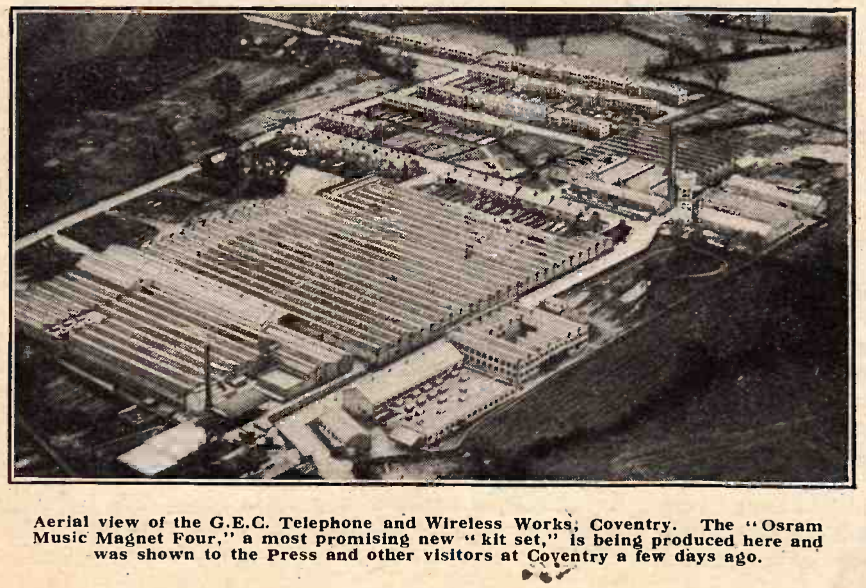
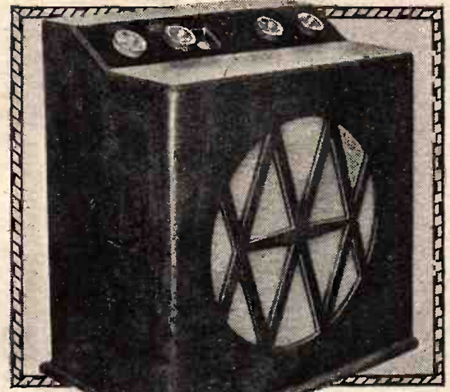
"W.A.C."

Mr. H. L. O'Heffernan, the photograph of whose station appeared in our last issue, asks us to correct any wrong impression which might have been conveyed by the caption: "The First English W.A.C." Mr. O'Heffernan is the first to have worked all Continents on telephony, but "W.A.C." certificates have previously been issued for Morse.



Aerial view of the G.E.C. Telephone and Wireless Works, Coventry. The "Osram Music Magnet Four," a most promising new "kit set," is being produced here and was shown to the Press and other visitors at Coventry a few days ago.

BROADCAST RECEIVERS REVIEWED



The MURPHY PORTABLE

Outstanding Range and Selectivity with a Single H.F. Stage.

A CASUAL glance at the exterior of this receiver is sufficient to mark it as something a little out of the ordinary. The disposition of the controls, for instance, with a projecting ledge upon which to rest the hands when tuning is at once evidence of careful attention to detail on the part of the designers. No carrying handle is provided, as the makers feel that this would spoil the general appearance, but recesses for lifting are cut under the base of the cabinet at each side, and their position is such that the hands automatically fall under the centre of gravity of the set. A waterproof cover complete with carrying handle and straps fitting under the base is being designed and will be sold as an extra, so that the set could be equally well described as a "Portable," "Transportable" or "Table Model." On second thoughts one might be inclined to delete the term "Transportable," as this generally suggests weight; actually the Murphy portable weighs only 32 pounds, which is less than many so-called "portables."

The Circuit.

The circuit, which comprises a single-screen grid stage of H.F. amplification, reacting leaky grid detector and two transformer-coupled L.F. stages, does not contain any strikingly unconventional feature, but rather more than the usual care has been taken to extract the last ounce of efficiency from each component. Through the courtesy of the directors we were afforded the opportunity of seeing the sets in course of construction, and of inspecting the apparatus for checking the electrical constants of H.F. circuits before assembly. Every factor from the frame aerial circuit through the always troublesome detector stage to the output from the power valve has been the subject of exact measurement, and where compromise has been found necessary this has been made on the foundation of concrete fact.

The H.F. stage is coupled by the parallel choke-feed method, the tuned anode circuit being connected between grid and filament of the detector valve. The frame aerial and anode circuit condensers are ganged and the H.F. properties of both circuits are so adjusted that the amplification over both long- and short-wave ranges are practically constant. Every precaution has been taken to exclude all couplings between the circuits other than the residual capacity of the valve, which is taken into account when setting the ganging of the two circuits. The screening material used in the chassis is tinned iron, and additional precautions to prevent stray coupling include insulation of the tuning condenser spindles, screening between the contacts of the wave range switch, the elimination of common earth wiring, and decoupling of the bias to the S.G. valve. These precautions have borne fruit in another direction in that threshold howl, which is a frequent trouble in portables, particularly on the long-wave range, has also been eliminated.

Unless great care is taken with the detector stage all the precautions made with a view to accurate ganging of the H.F. circuits are nullified. The working grid-filament capacity of the detector, which is in parallel with the tuned anode circuit, must be kept within well-defined limits and of as small a value as possible. To this end a fixed by-pass condenser and reaction coil of small inductance are used, and control of reaction is obtained by rotating the reaction coil. The loading effect of grid current has been allowed for in designing the tuned grid circuit. Positive bias for the detector valve is derived from a fixed potentiometer across the filament circuit, and the anode voltage is reduced to the required value through a decoupling resistance and condenser.

The valves used in the first and second L.F. stages are Osram HL.210 and P.215 respectively, and the characteristics of the coupling transformers have been adjusted to compensate for deficiencies in the loud speaker response. A modulated source of H.F. is used in conjunction with a completely assembled set in making this compromise so that all factors such as side band cutting and box resonance are included in the final result. In this way the objectionable resonance in the vicinity of 150-200 cycles so common in portable sets has been eradicated, and speech is free from unpleasant "boom." The middle and upper registers are well represented and the general impression is one of crispness and clarity.

The Controls.

Mention has already been made of the convenient disposition of the controls. The wave-range switch in the extreme left is smooth in operation and does not produce any sound in the loud speaker when changing over with the set in operation. Next to it is the main tuning knob for the slow-motion ganged condensers. The condenser scale is calibrated in wavelengths and is viewed through a small window carrying a horizontal hair line.

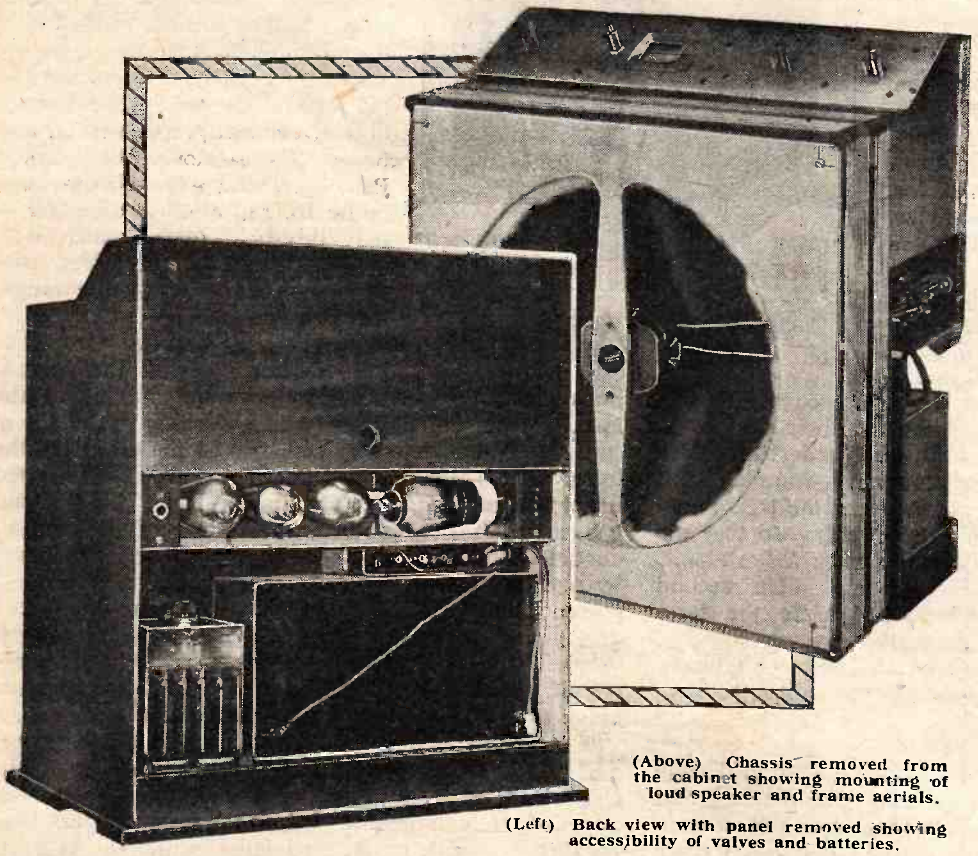
Broadcast Receivers Reviewed.—
The reaction control is smooth and free from backlash or threshold howl. On the extreme right is the combined on-off switch and volume control. This consists of a switch for the detector and L.F. valves and a filament resistance in the positive filament lead of the H.F. valve.

The performance of the set both as regards range and selectivity fully justifies the care taken in designing the H.F. circuits. On long waves there is a commendable absence of mush, and the range is distinctly above the average. No difficulty was experienced in tuning in ten stations where only six or at the most seven are usually available, and Königswusterhausen could be received at unusually good strength clear of 5XX and Radio Paris without making full use of the directional properties of the frame (a ball-bearing turntable is a standard item of the equipment).

In the space of half an hour after dark, twenty-four stations at programme strength were tuned in on the 200-600-metre band. This is a conservative estimate as several strong carrier waves were passed over which did not happen to be modulated at the time.

At five miles from Brookmans Park there is not the least difficulty in separating the twin transmitters, while in North-West London at a distance of 10 miles, London National (261 metres) can be limited to a band 7 metres wide, and London Regional (356 metres) to a band 20 metres in width. To obtain these figures the frame aerial must, of course, be set at minimum, but the performance is exceptionally good for a single H.F. stage and only two tuned circuits. As further proof of the range it may be mentioned that Langenburg (473 metres) could be received consistently in daylight.

The photograph of the back of the set shows that the valves are readily accessible, and that economical use has been made of the space allocated to batteries. The H.T. battery has only two sockets, which greatly simplifies replacement, and the internal resistance would have to rise to 5,000 ohms to produce motor-boating—a value unlikely to be reached in practice. The battery is rated for a 12 mA. discharge, so that the normal anode current of 8 to 9 mA. is well within its capacity. The measured total H.T. current of the receiver tested was 8.0 mA. Further evidence of careful attention to detail is provided by the mounting of the L.T. battery. This is insulated from the woodwork by moulded ebonite guides and a paxolin sheet which is removable for cleaning, so that the possibility of acid creeping along the bottom of the cabinet is considerably reduced.



(Above) Chassis removed from the cabinet showing mounting of loud speaker and frame aerials.

(Left) Back view with panel removed showing accessibility of valves and batteries.

During the course of the tests more than 80 miles were covered in a not too comfortable car without any detriment to valves or wiring.

To the student of portable set design this receiver should prove of special interest, as it demonstrates conclusively that a single H.F. stage coupled with reaction in the detector can be made, by careful design, to give more than adequate range and selectivity without the mush and background noise which is frequently associated with two H.F. stages.

The price of this receiver complete with valves and turntable but without waterproof carrier is £17 17s., and the makers are Murphy Radio, Ltd., Broadwater Road, Welwyn Garden City, Herts.

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CALIBRATION SIGNALS IN NORTH AMERICA.

THE Massachusetts Institute of Technology, in Boston, the Elgin Watch Company, in Elgin, Ill., and a Pacific Coast station not yet selected, will shortly begin regular daily transmissions of calibration signals which will be of sufficient power to be received regularly over North America and generally in other parts of the world. This service is intended to ensure a far greater degree of accuracy among the 17,000 amateur stations than can be maintained by the aid of the calibration signals once a month from WWV, the station of the Bureau of Standards at Washington.

INSULATORS TESTED

[3] BAKELITE

The Strong Insulating Material.

By W. H. F. GRIFFITHS, F.Inst.P., A.M.I.E.E.

THE wonderfully strong insulating material known as Bakelite is available in two forms: sheets or rods of laminated material and mouldings. Both forms have the same basis or resinoid, a resin-like material which results from the interaction of formaldehyde and phenol. In its primary stage, this synthetic resin can be melted, and will dissolve in solvents such as alcohol and acetone. In this state it can be dissolved to form a varnish with which to impregnate the laminating fabric (paper, linen, or canvas), and so form the sheet or rod material. Or it can be combined with various "fillers" to form a moulding material. In either case subsequent pressure and heat treatment are given, the further application of heat advancing the essential resinoid to a new state in which it becomes permanently insoluble and infusible. It is to this chemical change in the resinoid which occurs subsequent to its being variously adapted in industrial processes that the wonderful strength and durability are due.

The great strength of Bakelite can be judged from the mean figures for ultimate tensile strength and compressive strength, which are 20,000[1] and 35,000 lb. per square inch respectively.

In addition to being strong, Bakelite is unaffected by heat, and can be safely kept constantly at temperatures of 100° Centigrade. These two properties make it a most desirable material for the construction of insulating frameworks which have to maintain their geometrical permanence under varying mechanical stresses and temperatures—more especially as its temperature-coefficient of expansion is low. The thermal expansion of Bakelite is of the same order as that of copper and other metals which are employed in the construction of radio apparatus, and this fact makes it indispensable for certain purposes.

Unfortunately, however, Bakelite cannot be employed as a low-loss insulator in wireless apparatus where concentrated electric fields would pass through it, because of its relatively high dielectric loss. The best (electrical) quality Bakelite sheet has a paper base, and this has a power-loss factor of approximately 0.2, or eight times that of best ebonite. Some specimens of Bakelite exhibit still higher dielectric losses; for instance, Bakelite Continental, which has laminations of canvas instead of paper, has a power-loss factor of about 0.35, or fourteen times that of ebonite. These two Bakelites are given in the chart of insulators of Fig. 1, and mouldings of Bakelite may have power-loss factors varying between these two figures, depending upon the "filler" used.

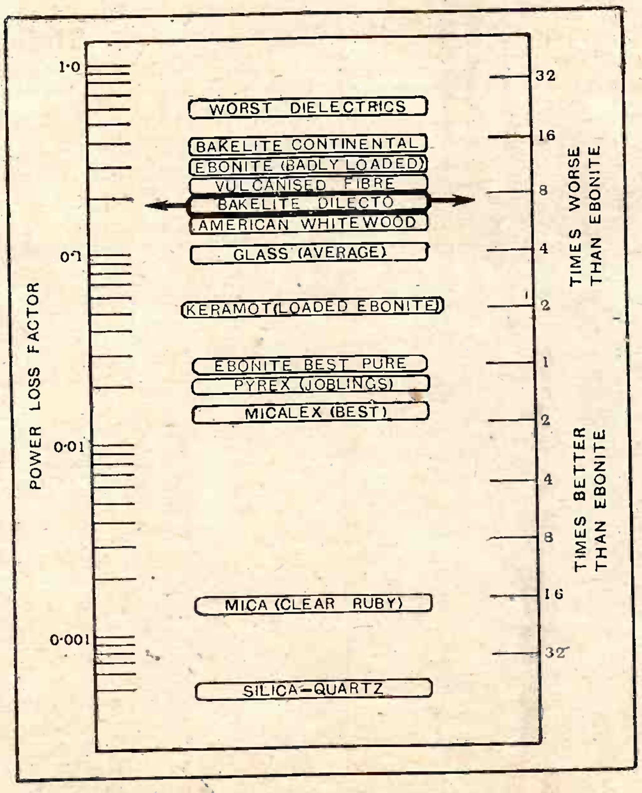


Fig. 1.—The relative power factor of Bakelite in comparison with pure ebonite is shown on the above chart.

It is convenient to know the order of the effect which the use of an insulating material of this quality will have upon a piece of apparatus, such as, for instance, the simple air condenser of Fig. 2. If the total capacity of this condenser is 250 $\mu\mu$F., and the capacity due to electric field *through the insulators AA* is 10 $\mu\mu$F., then, if these insulators were of best pure ebonite, the equivalent resistance of the whole condenser at a wavelength of 300 metres would be 0.2 ohm. If these insulators were re-

[1] The tensile strength of mouldings is only one-third of this value.

Insulators Tested—(3) Bakelite.—

placed by exactly similar ones of paper-base Bakelite, the resistance would be increased to 1.5 ohms, or to nearly 3 ohms if Continental Bakelite were employed.

The high power-loss factor of Bakelite only, however, precludes its *indiscriminate* use in low-loss wireless apparatus, and, by judiciously disposing parts of this material, the skilled designer can often make use of its great strength and heat-resisting properties. Another advantage which the apparatus designer cannot afford to neglect is the ease with which extremely strong Bakelite mouldings of intricate shapes can be produced. The material is prepared for plastic moulding in powder form having as its binding agent Bakelite synthetic resin as previously explained.

Special plant is required for moulding Bakelite in order to obtain the correct application of pressure and heat during the process. The pressure required is sometimes as much as 2,500 lb. per square inch of projected moulding area, and a typical hydraulic press used for moulding Bakelite is shown in the illustration. It should be noted also that the power-loss of the best paper-base Bakelite is very constant over large ranges of frequency. Some of the specimens tested by the author have had constant power-loss factors over a frequency range of from 800 to 10^6 cycles per second.

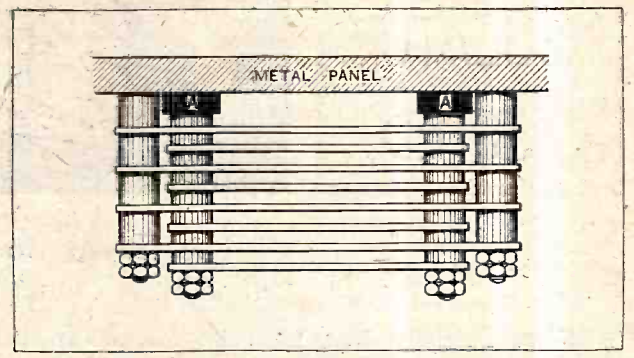
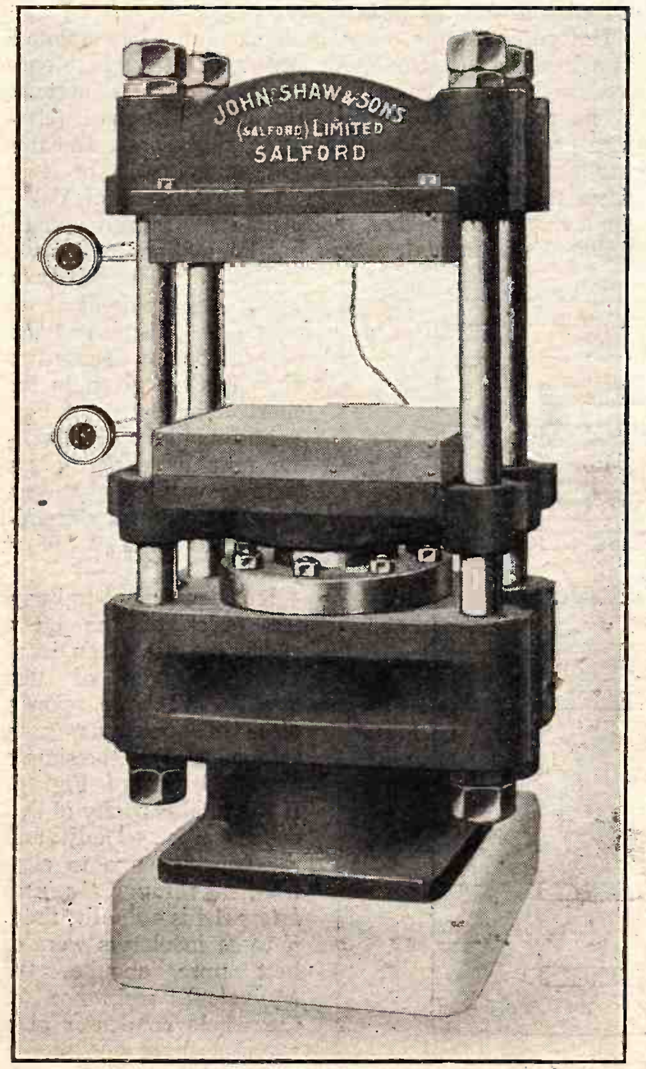


Fig. 2.—Standard air-dielectric condenser used throughout the series of tests.



A 50-ton hydraulic moulding press, by John Shaw and Sons (Salford) Ltd., used in the manufacture of Bakelite mouldings.

The conclusion of this article, it would seem, is appropriate for a general statement on "strength versus electrical quality" of insulating materials. It would appear that, in order to obtain increased strength, the electrical quality (especially the dielectric quality) of a material must be, to some extent, sacrificed. Not only is this the case within the Bakelite family itself—for the stronger canvas-base Bakelites are sometimes very inferior to those having paper laminæ—but also with most other ordinary insulating materials which are not used in their natural state like mica. Ebonite, for instance, although very desirable electrically, has low tensile strength, is brittle, and softens even at moderately high temperatures. In other words, the superiority of ebonite over Bakelite, as regards electrical resistivity and freedom from power-loss, is only obtained at the expense of these three important—sometimes vital—mechanical qualities.

That this is not always the case, however, will be seen in the description of the wonderful new insulating material, Micalex, which is to be dealt with in the next article of the series. This material alone seems to combine the essential mechanical and electrical properties.

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BOOKS RECEIVED.

Electric Testing Simplified, by Harold H. U. Cross, including a short introductory chapter on the practical units and Ohms law, followed by instructions in the use of the measuring and testing instruments generally employed in electrical engineering, including the testing of cells and motor car electrical equipment. Pp. 191 + xv, with 103 illustrations and diagrams. Published by Crosby, Lockwood and Son, London, price 5s. net.

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Definition and Formulæ for Students (Light and Sound), by P. K. Bowes, M.A., B.Sc., containing, in a brief and compact form, definitions of the technical terms employed in the sciences of light and sound, together with the various formulæ relating to these two subjects, including the staff notation of musical notes and their relative and actual frequencies per second. Pp. 36. Published by Sir Isaac Pitman and Sons, Ltd., London, price 6d.

BROADCAST BREVITIES

By Our Special Correspondent.

Empire Broadcasting at Last.

All who have watched the struggle for an Empire broadcasting service will feel that the " consummation devoutly to be wished "' is now in sight. It will now be unnecessary for the forthcoming Imperial Conference to deal with Empire broadcasting for the simple reason that action is to be taken on the findings of the Conference of Colonial Delegates.

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A New Station at Daventry ?

In a recent speech of welcome to members of the B.B.C. Cricket Club, the Mayor of Daventry referred affectionately to those good friends, the B.B.C.—" the biggest ratepayers in the neighbourhood." In the near future they may be paying still more, for I hear from a reliable source that new ground may shortly be taken on Borough Hill, Daventry, as a site for a short-wave Empire broadcasting station.

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An All-day Service.

The scheme which has found favour provides for a station costing approximately £23,000, the expense to be defrayed through the Colonial Office, which will also maintain the station and pay for a news service supplied by Reuters Agency.

The suggestion of a 24-hour service will not be proceeded with at first, but an entire B.B.C. programme will be relayed each day.

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Changing Views on Political Broadcasts.

Two years ago, when views were being freely expressed as to the use which could be made of broadcasting in connection with politics, it was assumed in most quarters that, but for the obstinacy of the B.B.C., the microphone would be used more frequently for political purposes. Now it seems that the boot is on the other foot.

oooo

B.B.C.'s New Viewpoint.

While the political parties themselves are rather squeamish, the B.B.C. is feverishly anxious that politics should be admitted to the broadcasting studio. This is a straw which I prophesy will sooner or later indicate a complete change in the direction of the wind as regards Savoy Hill policy.

oooo

Strong, but Not Silent.

There is a growing feeling at headquarters that broadcasting has more important functions to fulfil than the provision of rather colourless entertainment, and that it should assume the rôle of the strong-but-not-silent man.

oooo

Sir John Reith's Opinion.

Sir John Reith, in his speech at Cambridge last week, said that the presence of any commercial motive in broadcasting was most undesirable, adding that sooner or later broadcasting would command, perhaps in a compelling way, the attention it deserved, neither supercilious indifference nor vested self-interest standing in the way.

A New Dictator ?

There is a challenging note about this which leads one to think that the Director-General sees a time when broadcasting will become the Mussolini of a new social revolution.

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Setting a Standard for School Receivers.

It has always been a ground for criticism of the school broadcasting scheme that there has been no guarantee of good reception. In many schools the apparatus has been " of unknown vintage," operated by persons whose qualifications are educational rather than technical.

For the scholars' sake I am glad to read in the new school talks syllabus (September, 1930, to January, 1931) that a technical sub-committee of the Central Council has been appointed to indicate the main principles of design and performance by which types of apparatus may be recommended for school use.

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The Technical Sub-committee.

Schools purchasing apparatus will be able to insist on a guarantee that it has been approved as conforming to these standards. The chairman of the sub-committee is Sir Benjamin Gott, and among the members are Mr. F. Mellor, M.Sc., A.M.I.E.E., and Mr. O. F. Brown, B.Sc., of the Department of Scientific and Industrial Research.

oooo

Ups and Downs of Announcing.

Stair climbing seems to be one of the few human activities which have not been the subject of record-breaking contests. This is a pity, for a competition in staircase agility would soon reveal the abilities, born of long practice, of the Savoy Hill announcers, who still have to risk self-bisection in flashing from one floor to another between items.

oooo

Keeping Calm.

The marvel is that they are able to preserve the microphone calm which has become proverbial. Some of them, including Messrs. Hibberd and Grisewood, not only retain freshness and spontaneity in their announcements, but themselves contribute to the programmes. Mr. Hibberd's baritone voice is often heard during the children's hour, while the name of Harmon Grisewood figures in radio drama.

oooo

The Happy Future.

Much of this rushing about will be obviated when the B.B.C. moves to Broadcasting House, Portland Place. Here the studios will be concentrated in the central portion of the building, and the few stairs which announcers will have to tread will be sacred to their use and that of the artistes.

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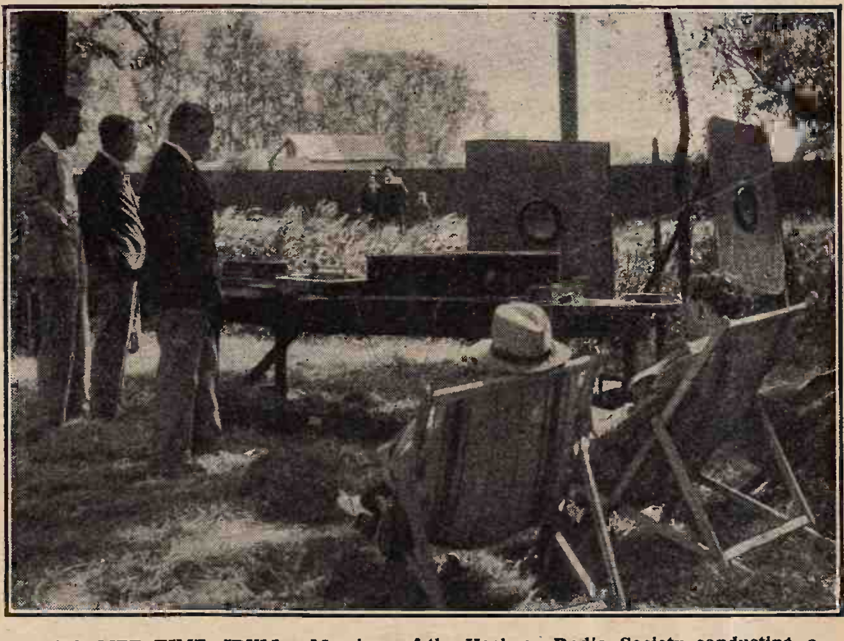
A Galsworthy Play.

Mr. John Galsworthy's great industrial drama, " Strife," will be broadcast next October by special permission of the author.



A SUMMER-TIME IDYLL. Members of the Hackney Radio Society conducting a loud speaker test at Hoddesdon. The amplifier, which operated on 400 volts H.T. from Exide accumulators, gave an undistorted output audible half a mile away. The society is planning another " outing " for September.

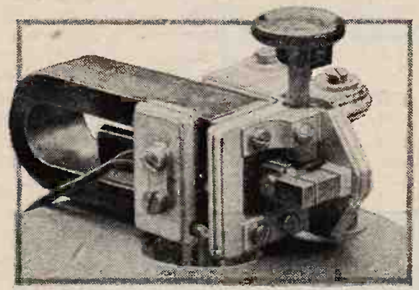
LABORATORY TESTS on New Apparatus.

A Review of Manufacturers' Recent Products.

THE NEW BLUE SPOT UNITS.

In view of the well-merited popularity enjoyed by the Blue Spot loud speaker units in the past, the introduction of two new models to take the place of the old model 66K is of more than usual interest. In the old model a four-pole magnet system was used, but the armature which was mounted on a stirrup, moved as a whole at right angles to the pole faces. In the new models a conventional four-pole balanced armature movement is used with the armature pivoted at the centre in an edgewise steel strip. Both units are adjustable, and their performance is marked by a considerable increase in the bass register without serious detriment to the excellent high-frequency response for which the model 66K was noted.

Model 66P.—This is the smaller of the two new units, and has a D.C. resistance of 1,000 ohms with a permissible continuous current of 30 mA. The output is constant and free from resonances between 400 and 4,000 cycles. Above 4,000 it rises to a peak at 4,500, falls to normal at 5,000, and then drops away to a cut-off at 6,000 cycles. Below 400 cycles there is an increase of output which reaches a maximum between 100 and 200 cycles. At 100 cycles the response is equal to that of the average moving coil, but below this frequency the response falls rapidly, and at 50 cycles there is evidence of frequency doubling.



New Blue Spot Type 66P loud speaker unit.

The sensitivity is very slightly less than the old 66K, but the power-handling capacity is better, and 475 milliwatts were required to rattle the movement at 200 cycles. There can be no doubt that the 66P is a worthy successor to the 66K; the bass register is better, the "valley" at about 3,000 cycles has been removed, and the high-frequency response up to 5,000 cycles is only slightly inferior to that of the original model.

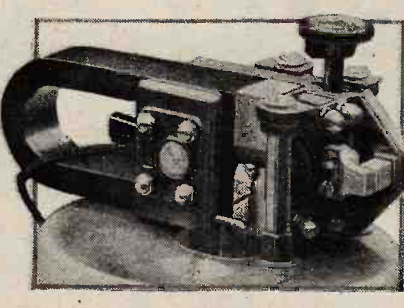
Model 66R.—This unit is specifically designed to handle large inputs, and is built on a larger scale than the model 66P, while retaining the same principle of operation. Curiously enough, the sensitivity is somewhat higher than the model 66P, but the power-handling capacity is considerably greater and an input of 2,750 milliwatts at 200 cycles failed to overload the armature. As in the smaller model, the high frequency response is good up to 5,000 cycles, but the bass resonance is higher and lies between 150 and 300 cycles, and the characteristic starts to rise from 500 cycles downwards. A noticeable resonance also occurs at about 2,500 cycles, which is not present in the smaller unit. The winding is rated to carry a direct current of 50mA. and has a D.C. resistance of 500 ohms.

In both units the windings are by-passed by a small fixed condenser which causes the impedance to fall at high frequencies as the following table shows.—

Impedance (ohms).

Frequency.	Model 66P.	Model 66R.
50	1,350	1,120
100	2,020	1,890
200	3,100	3,060
400	4,060	5,030
800	6,480	12,250
1,600	7,950	15,750
3,200	7,270	7,670
6,400	3,820	3,820

The price of the smaller unit (66P) is 27s. 6d., and the power unit (66R) 35s. The Blue Spot Major chassis, type 37, costs 15s., and the smaller, type 31, 10s. 6d. for each unit. The address of the distributors is F. A. Hughes and Co., Ltd., 204-206, Great Portland Street, London, W.1.



Blue Spot Type 66R unit designed for large power inputs.

REGENTONE PORTABLE ELIMINATOR.

The overall dimensions of this unit are 9in. × 5in. × 3½in., and it can therefore be easily accommodated in the space usually occupied by the dry cell H.T. battery in a portable set. If A.C. supply mains are available the portable can then be used economically as a home broadcast receiver, the dry battery being held in reserve for outdoor occasions.

During reception the L.T. current is taken from the existing accumulator and the H.T. from the eliminator. When the receiver is closed down a change-over switch on the unit brings into operation a trickle charger for the accumulator, which is replenished *in situ*, the leads from the unit being permanently connected to the terminals of the cell. The valve filaments should, of course, be switched off before putting the change-over switch on the unit to the "charge" position.

The H.T. eliminator gives three independent sources of supply at various voltages, the terminals taking the form of sockets in a moulded terminal strip into which the H.T. battery wander plugs may be inserted. V_1 is supplied from a variable potentiometer and gives a range of 0 to 83 volts (at 4 mA.) suitable for screen grid potentials or the anode supply to anode bend detector valves. V_2 is controlled by a series resistance of the compression type and is a useful all-round tapping suitable for H.F. or first L.F. valves or leaky grid detectors. The measured range of voltage is 0 to 65 volts at 3.5 mA. or 0-90 volts at 0.45 mA. The power output tapping P gave 155 volts at 10 mA. and 120 volts at 16 mA., with a total load of 5 mA. from the other two tappings.

Alternative connections are provided for charging either 2- or 6-volt L.T. batteries, the measured charging rate being 0.36 amp. at 2 volts and 0.24 amp. at 6 volts.

Regentone combined H.T. eliminator and L.T. charger for portable sets.

Tested under receiving conditions in a portable designed to run from a common H.T. supply voltage, no trace of motor-boating or A.C. hum could be detected, and the precaution of earthing the metal case was found to be unnecessary. The unit is adequately ventilated and runs cool.

The price of the A.C. model reviewed is £5 17s. 6d. and there is a D.C. model at £4 5s. The makers are the Regent Radio Supply Co., 21, Bartlett's Buildings, Holborn Circus, London, E.C.4.

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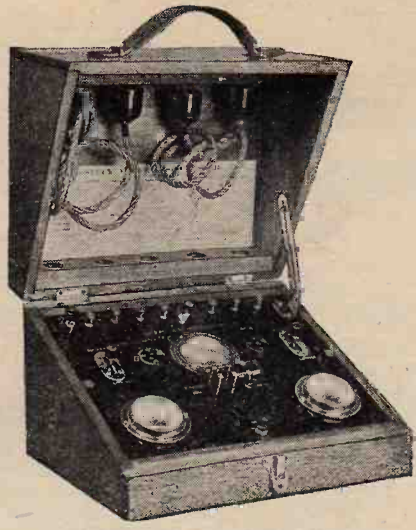
SIX-SIXTY VALVE AND SET TESTER.

This tester has been developed by the Six Sixty Radio Co., Ltd., Six Sixty House, 17/18, Rathbone Place, Oxford Street, London, W.1, to afford a ready means of testing every type of valve used in a modern wireless set. The necessary alteration in the circuits for testing such valves as ordinary triodes, or the five-pin A.C. screen-grid valve, for example, are effected by switches, and the whole of the apparatus is enclosed in a conveniently shaped carrying case. Batteries are not included, as in the majority of cases the receiver batteries, or its power supply, can be employed.

The tester must not be classed as a laboratory instrument, as the accuracy of the various metres fitted is guaranteed to ±5 per cent. only. The process of overhauling a set will be greatly facilitated by this tester, for as each valve is removed it can be inserted into the appropriate valve holder, and, with external batteries connected to the tester, the condition of the valve can be ascertained in a few minutes. Such essential information as emission, effect on anode current of change in grid bias and filament current taken by each will readily show whether it is in good order, or so far below the maker's standard value as to warrant a replacement.



Six-sixty valve and set tester.

The metres fitted in the tester comprise a two-range milliammeter reading 0-15 and 0-45 mA. respectively. Normally the higher range is in circuit, and to bring the lower range into use a spring-loaded push-button switch has to be depressed. This is a good feature, as on the higher range there is far less likelihood of straining the meter by overloading it. Also there is a two-range voltmeter reading 0-10 and 0-200 volts respectively. This is used to measure the voltage of the filament accumulator, the grid bias applied to the valve and the anode voltage. The meter is connected across the appropriate points by means of a three-position rocking switch mounted immediately below the two-pole change-over switch in the centre of the panel. The third meter measures the filament current of D.C. type valves and reads 0-1 amp.

This tester should be extremely useful to radio service mechanics and wireless doctors, as well as to the experimenter who desires to keep a careful check on the condition of his valves by testing them from time to time. The price is £8 16s. 3d., and a waterproof cover costs 10s.

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, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

EMPIRE BROADCASTING.

Sir,—I read in the issue of *The Wireless World* for July 2nd a letter from a correspondent drawing attention to the lack of acknowledgment from any influential source of your repeated efforts to rouse enthusiasm and support for the inauguration of an Empire broadcasting service.

It is gratifying to receive appreciation from casual correspondents who obviously recognise the importance and inevitable materialisation of such an Imperial service. It has been almost a heartbreaking struggle to obtain recognition and support during the four years that I personally have thrown practically all my spare time and endeavours towards this end.

You may remember that in April, 1926, you published an article by me, drawing attention to the interest in broadcasting shown in the Colonies, and thereafter your proposal for a short-wave Empire broadcasting service was made. I may claim, therefore, that we have been mutually responsible for bringing into being the nucleus of a service, notwithstanding antagonism in certain official quarters.

Well, sir, there seems a good prospect of our ideal materialising in the very near future, thanks to a better understanding of the problems involved, and which are being considered at the Colonial Conference. Strangely enough, there has not been a *very* great technical advance since 1926 in this application. It goes to show how unnecessarily slow-moving the authorities can be. "Good luck" to the unanimous findings of the present delegates! H. A. HANKEY.

London, W.6.

DUPLICATING 5XX.

Sir,—The letter from Mr. W. A. Lucas in your issue for July 9th is the only evidence as to the effective range of Brookmans Park which I have seen in print so far. The B.B.C. had hoped for a range of about eighty miles. Mr. Lucas, however, at sixty miles finds the station of no use to him. Added testimony on this important point from other listeners situated on the fringe of the London service-area would be useful.

But it was always an obvious weakness of the Regional scheme that, even if it did all that was expected of it, it would nevertheless fail to cover the ground. If the radiation of the medium-wave high-power stations proves less penetrative than was anticipated, the need for a second long-wave transmission is only accentuated.

North-East England and Northern Scotland are definitely outside the scope of the scheme, and as listeners in these areas are indifferently served, both by their local transmitters and Daventry 5XX, there is a strong case from their point of view for assigning the second long-wave to Moorside Edge or Falkirk.

Newcastle-on-Tyne. K. M. C.

WIRELESS TERMINOLOGY.

Sir,—I have noticed in your advertisement pages that the word "radiogram" is being used to describe a radio receiver and gramophone combined in one cabinet. While this contraction of "radio-gramophone" is an obvious one, confusion may occur through the fairly general prior use of the word "radiogram" to denote a private or business message transmitted by radio, in accordance with the pre-existing words "telegram" and "cablegram."

In the phenomenal advance of radio technique the importance of correct terminology has been rather neglected. A little attention devoted to this question now would avoid a great deal of misunderstanding in the future.

BERNARD C. HOLDING.

AMATEUR TRANSMISSION ON 2.5 METRES.

Sir,—Amateur transmitters may, perhaps, be interested to know that on July 15th our stations were in contact on Morse and telephony. Wavelength 2.5 metres; distance 15 miles.

G-6.T.P. G-2.N.I.

TELEVISION RECEPTION.

Sir,—With reference to the television broadcast on July 14th of "The Man with the Flower in his Mouth," particulars of the reception of this at Newcastle may be of interest to you.

I was using a manufacturers' 4-valve all-mains set for the reception of speech and music, and was using an identical receiver for the reception of television, both off the same aerial.

The atmospherics were extremely bad, local thunderstorms were prevailing during the afternoon, and in consequence of this the speech was so utterly distorted that practically not a word could be made out; music was very little better. In spite of these very adverse conditions, however, I received a perfectly recognisable picture of the faces of the artists, at various times.

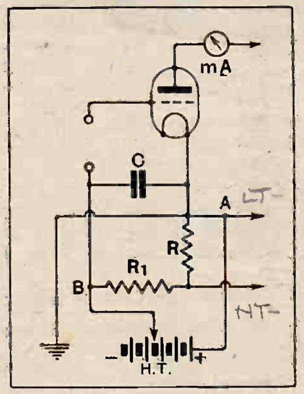
The letters of the opening announcement were very plainly read. The scenic pictures were not very plainly discernible, although once when a miniature animal gambolled across the screen this was very plainly seen.

I can say, without hesitation, that, considering the very bad atmospheric conditions, television certainly came in better than the speech and music. T. PAYNE.

Newcastle-on-Tyne.

FREE BIAS.

Sir,—Several notes have appeared from time to time on the methods of measuring the voltage being applied to the grid of a valve when the "free bias" method is being used. An actual measurement is almost essential, because it is difficult to allow for the increase in bias due to the current taken by the other valve. The methods that have been proposed include the use of valve voltmeters or high-resistance voltmeters, which are usually outside the apparatus available to the average amateur.



The method I suggest, however, is free from that objection and requires no expensive apparatus, and, moreover, can be applied to all methods in which grid bias is obtained from a high-resistance source. In the accompanying diagram, R is the resistance in the H.T. lead, which supplies the bias voltage, R_1 is the decoupling resistance, and C the smoothing condenser. To make a measurement of the bias, connect a piece of flex to the points A (at earth potential) and B (at grid potential). Connect A to the positive of a high-tension battery and vary the position of the lead to B so that no change in the anode current occurs. When this point is found the voltage applied by the battery is, of course, equal to the free bias. Measurements may even be made without a milliammeter by substituting a loud speaker, but are somewhat less easy.

The accuracy is sufficient for all ordinary purposes. Appreciable errors are possible only if the resistance of R_1 is less than about 10 times R or the battery used is not reliable.

Several modifications will suggest themselves.

London, S.W.4. B. DUDLEY SULLY, B.Sc.

RADIO SERVICING.

Sir,—I agree with all Mr. B. Gladstone says in your issue of July 23rd. May I give an example which came under my notice? A lady 'phoned for me to come at once and install a Marconi A.C. set. I found out afterwards she had had it at a cut price. I examined it and told her it might have a chance of working if some valves were supplied. She got the valves and asked me to try again. It would not work, and I advised that it be sent back to the makers. Instead of this, a "Marconiphone" service agent was sent out, age about twenty, experience, I should say, very slight. He struggled for over two hours, and left, saying it now was in perfect order. Next day I enquired how the lady was getting on. By this time she had taken my advice and sent it back to works. The service agent came from a music shop. Two streets away from him there was at that time an experienced service man who has himself told me that the music shop sells 100 sets to his one. He has gone out of business. Up to the time he went out of business he nominally held the Marconiphone service agency of that particular town. But when a job of work came along it went to a music shop. There is no inducement under the music shop system for experienced service men to stay in business. I have a very large business myself, service work and battery charging. At least once a week on the average I am sent for to install sets which have been obtained from other sources. They seldom, if ever, have their low-tension batteries in order. Generally the high-tension battery shows signs that the set has been demonstrated for a long period. When I enquire where the set was obtained I generally find some mystery is attached to its provenance (and that means cut price, of course) or it is "music shop."

My battery-charging bench has seldom less than a hundred cells on charge, and frequently double that number. Yet the number of new cells that I supply is not half a dozen a month. Although I, myself, or one of my men visit something like 300 customers a week we only sell half a dozen high-tension batteries a week. Batteries of every sort are in stock, and these are also on the cars. Yet people *prefer* to buy batteries from dabblers at cut prices. I have even been asked to return as unsatisfactory to the makers sets, mains H.T. units, valves, dry batteries, etc., which I have not supplied and concerning which the usual mystery attaches as to their origin. If people do this sort of thing, how can they expect good service? SERVICE AGENT.

Streatley-on-Thames.

Sir,—I see that my letter *re* "Radio Servicing" in your issue of July 9th has excited a fair amount of interest, and I should like to reply to my critics whose letters appear in the current issue (July 23rd).

Mr. Gladstone, by an extraordinary piece of deduction, arrives at the result that either I buy my goods where prices are cut, or my knowledge of the wireless retailer is small. Without effort I can count thirty-five wireless shops with whom I have dealt—a few at cut prices, but the great majority at the authorised prices. Of these, there is one dealer who knows the subject well; it took me five years to acquire my microscopic knowledge, and having at last found a man who satisfies my requirements I am not going to enlarge it. Most of the remaining thirty-four were ignoramuses, and, as a typical example, one filled an accumulator with water and proceeded to charge it; it took him two days to find the trouble, and I did not enlighten him.

It is the average dealer who expects something for nothing, because he will not service an article for which his enormous profits must necessarily imply service. Such a man appears to be Mr. Ryall's ideal retailer; perhaps Mr. Ryall has mis-stated himself, for I find it hard to believe that he is such a selfish individual to want as much profit as he can get, and neglect any idea of his duty towards the public. Unfortunately, this is true of many dealers. His argument about weighing up the pros and cons is very weak. Returning to our medical analogy, a doctor investigates every patient's case separately, and the public would soon lose faith in a doctor who, without any examination, told a man that he was suffering from appendicitis when the illness was actually influenza. The retailer who pronounces wrongly, as he inevitably would if he did not examine the requirements, is going to lose the public confidence; the only hope of obtaining confidence is to specify accurately in each case.

Mr. Howard seems somewhat frightened of an examination, as are many dealers; he thinks that it is unnecessary because it is inconvenient. Attending a course alone is no guarantee that the dealer has absorbed the teaching, and the only way of finding out is by examination. This is made evident by the large number of men who attend University lectures, and then plough their exams. at the end of the course. The public would not dare risk going to a doctor who stated that he had studied medicine, without some guarantee of his proficiency. An ape could go to the Marconiphone Co.'s course, but would not be able to service their goods. This company's lead is an admirable one, but they could improve their methods by holding an examination at the end of the course, with certificates for successful candidates to display in their windows. Many of the skilled trades, as the radio trade ought to be, have periods of apprenticeship with examinations at the end. The profits in the radio trade are high, and would reward sufficiently any effort spent in the student stage.

I had been hoping that someone would write in the strain of my critics, as it will show to readers of *The Wireless World* the typical attitude of the average dealer. He is only concerned with obtaining large profits, and is too selfish to service properly, and too lazy to qualify himself for his occupation. This is the type which has lost the public's confidence: cannot something be done to obtain the same confidence from the public as it has in the medical profession? R.V. JONES.

London, S.E.24

READERS' PROBLEMS

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Damping Reduced.

Following advice recently given in your journal, I have tried the effect of "tapping down" the connection of my grid detector on its tuning coil; there seems to be some improvement, but reaction control is not as good as formerly, and, indeed, it is difficult to prevent uncontrollable self-oscillation of one end of the tuning scale. Can you give me a word of advice? D. T. F.

This trouble can be cured by removing turns from your reaction coil. When damping is removed by lightening the load imposed on the tuned circuit by the grid rectifier, it is quite normal that self-oscillation should be more easily provoked.

o o o o

Tracing a Short Circuit.

The 600-ohm decoupling resistance which is in series with the anode of my H.F. valve becomes distinctly warm after the set has been in use for a few minutes. This, I suppose, indicates a fault; will you please tell me where it is likely to be.

I should perhaps tell you that the set is a conventional 1-v-1 combination with anode bend detection and transformer coupling for the H.F. stage. C. M. W.

As the anode current consumption of a screen-grid valve should not amount to more than a few milliamperes, it is certain that the decoupling resistance, even if wound with the finest wire, should not show any appreciable temperature rise. The first component to be suspected is, we think, the by-pass condenser (shown at C in Fig. 1), which is used in conjunction with the resistance for decoupling. This component should be tested carefully for insulation resistance. If it is found to be in order, we suggest that your attentions should be transferred to the valve itself, which may have developed a more or less complete internal short circuit between its electrodes; if overheating does not take place when this valve is removed from its socket, it may fairly safely be considered at fault.

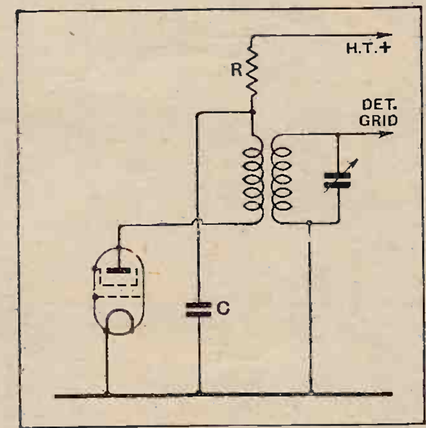


Fig. 1.—Showing where insulation failures may occur in an H.F. anode circuit.

There remains the possibility of a short-circuit between primary and secondary windings of the H.F. transformer, which should accordingly be tested with phones and dry battery or in any other convenient way. Similar tests should be applied to the anode circuit wiring and to the valve holder, which may have a short-circuit between its plate and filament sockets.

o o o o

Another Tuned Circuit Needed.

Will you please examine the circuit diagram of my proposed receiver, which, as you will see, is based on the "Record III"? In order to economise space, I have omitted the separately tuned aerial circuit. E. D. S.

We do not think that a receiver built to your circuit diagram is likely to prove very satisfactory. This is mainly due to the fact that the H.F. inter-valve circuit of the "Record III"—we presume that you intend to use the original values—does not make any very great contribution to the overall selectivity of the receiver, due to the fact that the capacity/inductance ratio is low.

If full advantage is to be taken of the high amplification afforded by the H.F. stage of this receiver, it is essential to use a double tuned input circuit.

o o o o

Doubled Anode Current.

I have just obtained a milliammeter, and find, to my surprise, that when it is connected in the common anode circuit of my push-pull output valves the current registered is almost exactly twice that stated by the manufacturers to be normal for a single valve. Is this right? I have always understood that one of the great advantages of the push-pull method of amplification is that it is economical in anode current. L. N.

It is a fact that if the "bottom bend" method of biasing is adopted the standing anode current of the output valves is low. However, it is generally preferred nowadays to bias push-pull valves to the mid-point of their characteristic; in other words, in the same way as if they were used in a conventional circuit. Consequently, the total anode current consumed by the output stage is double that required for a single valve.

o o o o

Gramophone and Radio.

My four-valve A.C. set (with 2 H.F. stages) has an almost completely silent background when it is used with a gramophone pick-up, but there is a distinct and annoying hum when the high-frequency valves are in circuit for the reception of wireless signals. Can you suggest a likely cause? T. A. J.

The most obvious suggestion to make is that insufficient smoothing is provided for the feed circuit to the H.F. valve anodes, but before attempting to improve matters in this direction we suggest that you should asure yourself that the heater-cathode interconnections of these valves are in accordance with modern practice, as exemplified in receivers recently described in this journal.

It is also possible that hum is being introduced by an automatic grid bias scheme (if used), and it would be worth while checking this point by temporarily substituting dry cells.

RULES.

(1.) **A query must be accompanied by a COUPON removed from the advertisement pages of the CURRENT ISSUE.**

(2.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(3.) *Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(4.) *Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(5.) *Practical wiring plans cannot be supplied or considered.*

(6.) *Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.*

(7.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed.*

Switching a Two-range Input Filter.

Will you please show me how to arrange a switching scheme for a two-range aerial input filter of which the individual circuits are coupled by common capacities? As the values of these coupling condensers are such that the necessary changes for the two wavebands cannot be obtained by connecting the capacities in series, the method of short-circuiting one of them is not applicable in my case, so it is impossible for me to adopt the arrangement of the "Band Pass Four." H. B. S.

A four-pole changeover switch will be required for making the necessary circuit alterations appropriate for either medium- or long-wave reception. The switch should be connected in the manner shown in Fig. 2, in which medium- and long-wave coils are marked respectively M.W. and L.W. The coupling condenser C is for the long waveband, while the other (C_1) comes into action when the long-wave loading coils are short-circuited by placing the switch blades in the "up" position.

To simplify matters we have added a diagram of the circuit without the complication of switching; in both cases the necessary screening is omitted.

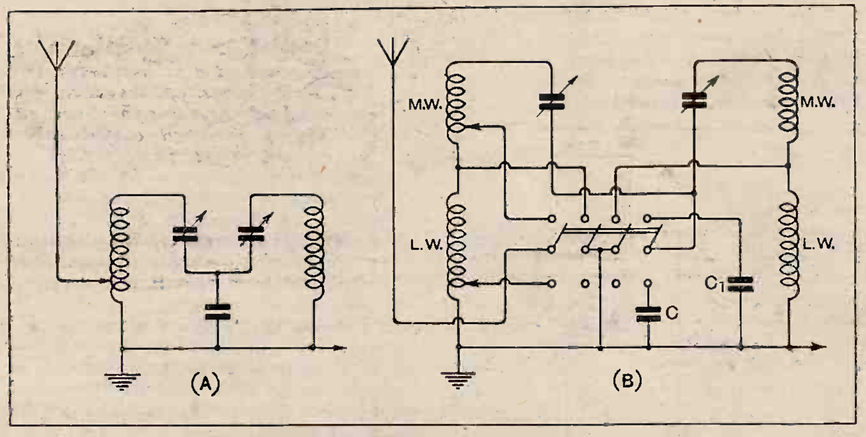


Fig. 2.—Conventional input filter circuit (A) and the same arrangement with waveband switching added (B).

The Electric Light Bill.

Can you give me an idea as to the probable cost of operating a three-valve set from a 240-volt D.C. supply at 6d. per unit? Two of the valves consume a filament current of 0.1 amp., while the other is rated at 0.25 amp. C. F. B.

With the most economical series or series-parallel connection, the filaments will consume a total of 0.25 amp. at 240 volts, making a wattage of 60. Another 10 watts might reasonably be allowed for anode current, making 70 watts in all. At this rate a unit (1,000 watt-hours) will feed the receiver for $\frac{1000}{70}$ hours, or 14 hours approximately.

Therefore the cost of current for operation of the set will be about 0.64d. per hour.

Unnecessary Generosity.

Would there be any objection in substituting LS5A output valves for those specified in the published description of the "Band Pass Four"? Although the output of the P625's would probably be great enough for my needs, I should like, if possible, to have some reserve of volume. D. C. V.

It is hardly to be expected that any advantage would be gained by using LS5A valves in a set where the output stage is fed direct from the detector without an intermediate L.F. amplifier. Although there is a more than ample margin of safety in the design of the "Band Pass Four" as it stands, overloading of the detector would almost certainly be produced long before it could be expected to give an output sufficient to load these valves, which can accept a grid swing more than four times as great as those for which the receiver is intended.

The "Capacity Click."

My H.F.-det.-L.F. receiver has developed a fault, and no signals whatever are audible. In an attempt to locate the cause by the "stage-by-stage" method, I inserted a pair of phones in series with the detector anode, connecting them in the position normally occupied by the transformer primary. With this alteration all is well, and I think you will agree that it is logical to assume that the transformer is faulty. But what I cannot understand is that this transformer, when tested with phones and a dry battery, seems to be in order, as a clearly audible click is produced when contact is made across either primary or secondary windings. This would seem to suggest that the transformer is not responsible: what do you think? J. B. S.

The tests you have made do not, of course, entirely preclude the possibility of a fault in the output valve itself or in the connections to it, but we think it very likely, as you yourself suggest, that the L.F. transformer is responsible for the trouble. When carrying out tests with the help of a pair of phones and a battery, certain precautions must be observed if misleading results are to be avoided. In your case, it seems likely that capacity effects may be responsible: if the transformer has a built-in condenser joined across its primary winding, the click heard in the telephones may merely be due to the flow of charging current into this condenser. Again, even though there may be no condenser, it is possible that a break has developed in the centre of the winding, thus leaving two sections isolated metallically, put with an appreciable capacity between them.

In either case, a conclusive test may be made by noting whether a click is produced on *breaking* the circuit. If it is not observed, it is safe to assume that conductivity does not exist, and that the transformer is faulty.

Common Feed Voltage.

I am about to buy an H.T. eliminator for my receiver, which is a modification of the original "Everyman Four." Would there be any objection to feeding the anodes of the H.F. and first L.F. amplifying valves from the same output terminal, as both these valves are rated by their manufacturers at the same maximum anode voltage? J. McK.

As the H.F. stage is coupled by a transformer (which does not pass on L.F. impulses to any appreciable extent), there should be no serious interaction between these stages, and so this method of connection should be in order.

To prevent motor boating, it is recommended that the detector anode should be supplied through a series decoupling resistance, and that some output device, such as a choke filter, should be provided for the output stage.

FOREIGN BROADCAST GUIDE.

KHARKOV (NKO 2)

(U.S.S.R.).

Geographical Position: 50° N. 36° 14′ E.
Approximate air line from London: 1,580 miles.

Wavelength: 427 m. Frequency: 702.5 kc. Power: 5 kW.

Time: Eastern European (two hours in advance of G.M.T.).

Standard Daily Transmissions.

05.00 B.S.T. relay of physical exercises from Moscow-Komintern; 18.30 relay of programme from Leningrad or Moscow. Main transmissions are broadcast through Kharkov-Narkompotschel (NKO 1) on 1,304 m. (q.v.).

Male and female announcers. Call: (Phon): *Rharlow* (thrice) *govoreet Kharkovska rahdee-owe-movna stant-see-ya.* At intervals between items: *Radio Kharkov.*

Interval signal: the striking of a gong.

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is :

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue : 13 consecutive insertions 5% ; 26 consecutive, 10% ; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on THURSDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on WEDNESDAY MORNING at the Branch Offices, 19, Hertford Street, Coventry ; Guildhall Buildings, Navigation Street, Birmingham ; 260, Deansgate, Manchester ; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. 000, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes ; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged ; on transactions over £10 and under £50, the fee is 2/6 ; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

"WIRELESS WORLD"

INFORMATION COUPON

This Coupon must accompany any Question sent in before

AUGUST 13th, 1930

For Particulars of Free Service, see Rules on page 135.

RECEIVERS FOR SALE.

APPLEBY'S.

WHERE Radio Part Exchange Began; a service under the patronage of notabilities and men of consequence all over the world which has accurately handled the requisitions of over 25,000 people, 84% of whom have repeated their first transaction.

THE Service is as Follows: We can supply practically all the leading lines of radio apparatus on the market at current list prices; if so desired we can accept in part exchange the reputable makes of the following apparatus: Receivers (domestic and portable), radio-gramophones, loud-speakers (cone and moving coil), cone units and chassis, battery eliminators and mains equipment components, battery chargers, remote control equipment, pick-ups and carrier arms, electric gramophone motors, H.F., L.F., and power chokes, condensers (variable, reaction, by-pass and smoothing), measuring instruments (high grade), L.F. transformers, slow motion dials (high grade), modern miscellaneous components; valves and tuning coils cannot be accepted in part exchange except by special arrangement

IN View of the Difficulty of Making Fair and Definite Offers for Material that we have not inspected, it is requested that apparatus tendered for part exchange be kindly forwarded to us for valuation; no business can be proceeded with in connection with part exchange until material tendered has been examined; in this connection there need be no fear, material is sent to us from all over the world, not a single item of customers' property has ever been lost or mislaid; rejected offers from Xmas last amount to only 3.

IN Order to Furnish a Guide, the part exchange allowance may be gauged as approximately 50% of the list price of the article or articles tendered; for some articles the allowance will be more, and for others somewhat less; the allowance is entirely determined by the demand for individual articles, considering also their condition and production age; amateur constructed receivers cannot be accepted in part exchange as receivers, their value lying wholly in the components contained in them; only modern apparatus in good condition is accepted in part exchange; material cannot be purchased by us for cash.

TERMS of Part Exchange Business: A minimum of 50% of the value of an order, plus carriage charge where due, is payable in cash, unless the value is below £1, when a minimum of 10s. is payable; should the part exchange allowance exceed 50% of the total value of new requirements, the difference will be credited against future orders; material may be deposited against a credit note, which may be utilised at a later date; the maximum amount allowed to stand to the credit of any one individual is £200.

THESE Terms Have Been Made to the Lowest Economic Minimum, to give the customer the best value possible, while enabling us to maintain the standard required of this business.

SPECIAL Notice is drawn to the fact that by stipulating a minimum of 50% cash payable on part exchange orders, which is the same as stating that the part exchange allowance is credited to an order for not less than twice the allowance, you are ensured always of the best offer, as obviously the more we allow you the more you ultimately spend with us, to utilise your credit, if for no other reason; note also the facility of depositing material against a credit note, it can be drawn upon as required, wherever you may be; credit notes worth many thousands of pounds have been duly honoured upon presentation; a credit note on Appleby's is saleable, should the necessity arise, providing notice of transference is lodged with us at the time of sale.

AS Soon as Apparatus is Discarded from Use, dispose of it, don't keep it; it is not only wasteful, but expensive; the longer you keep it the older it is, and the older it is the less value it is; exchange it for a part exchange credit note, the value of which is constant, and can be disposed of if necessary by the holder with greater ease and facility than an article or collection of articles can ever be.

YOU Will Do Well to Deal with Appleby's; there is more in part exchange than the mere allowance; there is that something which begets confidence, that care that makes for efficiency; in the recent words of an old customer: Quite an embarrassing aloofness of purpose and an almost monotonous accuracy; you will know that it is all British—British capital and British behaviour; you will know also by dealing there that you are helping to employ British people.

SINCE the Day This Service Started it has Steadily Grown, not on rash advertising or subscribed capital, but on the volume of attainment only; and in these days businesses do not grow by that means for nothing, therefore we are privileged to invite you to utilise this service, wherever you may live; if you send your material by a carrier, pack it well, carriers are only human, and it is better to be safe than sorry; if you live in London, call to see us, you will like the atmosphere, it savours more of sport and art than the searing curriculum of commerce.

APPLEBY'S, Chapel St., St. Marylebone, London (opposite Edgware Rd. Metropolitan Station, or 4 minutes from Marble Arch, Oxford St.). Tel.: Paddington 8828 (3 lines). [0340

SCOTT SESSIONS and Co., Great Britain's Radio Doctors.—Read advertisement under Miscellaneous. [0264

Receivers for Sale.—Contd.

BERCLIF D.C.2 All Mains Receiver, 200 to 250 volts D.C.; price £14/10; with valves and royalties, suitable for M.C. speaker; particulars free; trade inquiries specially invited.—Simmonds Bros., Shireland Rd., Smethwick. [8734

YOUR Old Receiver or Components Taken in Part Exchange for New; write to us before purchasing elsewhere, and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

SUPERHET, 10-valve, made by Sullivan, 5 units, tuner, coupler, oscillator, H.F. unit, L.F. unit, D.E.V. valves, with 4 spare valves, 40 coils; £7/10.—Ridley, 4, Hunter Rd., Wimbledon. [1128

PHILIPS Model 2514 3-valve Electric Receiver, 200 volts, for sale, nearly new; £15.—Refer, 8, Eaton Sq., S.W.1. Sloane 7182. [1120

NEW All-wave Four, push-pull output P625, Ferranti multi meter, transformers, A.F.5C, O.P.25/1, mahogany cabinet; long-short coils, complete with valves; cost over £22, price £14, less cabinet £10; deposit if desired.—Balfour, Mortehoe, Devon. [1135

ELSTREE Six for Sale, with specified components or better, 16 Dimic and Gambrell coils, Marconi 6v. valves; first reasonable offer accepted.—Box 7006, c/o *The Wireless World*. [1129

IMPROVED Osram S.G.3 Cameo M.M. Console, speaker fitted, eliminator, 240w. D.C. (optional); cost £18, offered £12.—A. G., 143, Rendlesham Rd., E.5. [1160

LAGRAPHONE Suitcase V, excellent tone, good range, complete, new; £6/17/6.—Gray, 55, Larkswood Rd., South Chingford. [1153

GECOPHONE 7-valve Superhet, with valves and frame aerial, Western Electric cone L.S., 2 Ferranti A.F.5s, Webster 1A and Woodroffe pick-ups, Mazda P.240, L.220, S.G.215, P.M.1H.F., all 3 weeks' use only; what offers?—Box 7030, c/o *The Wireless World*. [1154

ACCUMULATOR HIRE.

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MULLARD Valves, slightly used, few P.M.12s; 12/6.—Clayton's, High St., Hastings. [1132

COSSOR 2v. Pentone, 17/-; 2v. S.G., 17/-; S.G. (A.C. mains), 17/-; 210H.F., 9/-.—Bracey, 8, Graham Rd., Mitcham. [1147

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PLEASE Address Letters Bay View Hotel, Jersey. Clerkenwell office closed until August 16th.—M. A. Frost, Wire Specialist. [1158

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BELLING-LEE Panel Fittings are designed to give an expert finish to any home-constructed set; catalogue post free.—Belling and Lee, Ltd., Queensway Works, Ponders End, Middlesex. [0018

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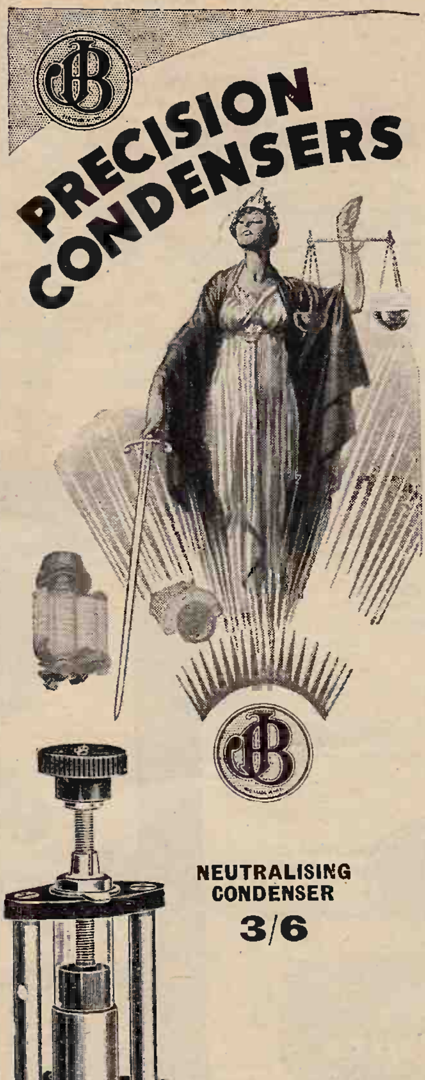

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MUST Have Up-to-date Experience in Designing Circuits and Production of Sets.

WRITE, giving full qualifications and where last employed, together with wages required, to Box 6997, c/o *The Wireless World.* [1123

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WANTED, mechanic-salesman, gramophone, wireless and electrical; state age, experience and salary required.—Box 7033, c/o *The Wireless World.* [1159

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FREE: Inventor's Guide on Patents.—T. A. A., 253 (W), Gray's Inn Rd., London, W.C.1. [6373

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WELL-MADE OFFICE FURNITURE,
12 mahogany Roll-Top, Pedestal and other Writing Tables, Lounge, Elbow and Standard Chairs, 5 Typewriters (Royal and Underwood), Universal Postal Franking Machine, Roneodex, All-metal Cupboards, Filing Cabinets, Nests of Drawers, 6 Axminster Carpets, and other effects.

FRANK G. BOWEN, LTD.,

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On View day prior and morning of sale. Catalogues may be had of the Senior Official Receiver in Companies Liquidation, 33, Carey St., W.C.2, and of the Auctioneers, as above.

INDEX TO ADVERTISEMENTS.

	PAGE
Adolph. Fredk.	6
Apollo Gramophone Co., Ltd.	10
Appleby, E. Hetherington	6
Baker's "Selhurst" Radio	8
Bowen, Frank G., Ltd.	9
Burton, C. F. & H.	Cover i.
Celestion, Ltd.	
Day, Will, Ltd.	
Dubilier Condenser Co. (1925), Ltd.	
Eastick, J. J., & Sons	
Edison Swan Electric Co., Ltd.	Cover ii. & p. 3
Electradix Radios	6
Exide Batteries	
General Electric Co., Ltd.	1
German Radio Exhibition	Cover ii.
H. and B. Radio	8
Hughes, F. A., & Co., Ltd.	
Jackson Bros.	9
Lyons, Claude, Ltd.	
Marconiphone Co., Ltd.	4
McMichael, L., Ltd.	Cover i.
M-L Magneto Synd., Ltd.	10
Mullard Wireless Service Co., Ltd.	Cover iv.
Paroussi, E.	7
Partridge and Mee, Ltd.	Cover iii.
Perseus Manuf. Co., Ltd.	8
Pertrix, Ltd.	
Radiogramophone Development Co.	5
Regent Radio Supply Co.	5
Rigby & Woolfenden	8
Rothermel Corporation, Ltd. (Centralab)	2
Six-Sixty Radio Co., Ltd.	5
Supremus Specialities, Ltd.	7
Telegraph Condenser Co., Ltd.	
Telsen Electric Co., Ltd.	Cover i.
Thomas, Bertram	2
Transformer Repair Co.	7
Tungsram Electric Lamp Works (Great Britain), Ltd.	
Ultra Electric, Ltd.	Cover i.
Vandervell, C. A., & Co., Ltd.	
Westinghouse Brake & Saxby Signal Co., Ltd.	Cover iii
Weston Electrical Instrument Co., Ltd.	Cover iii
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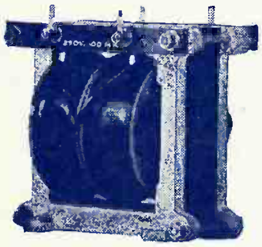

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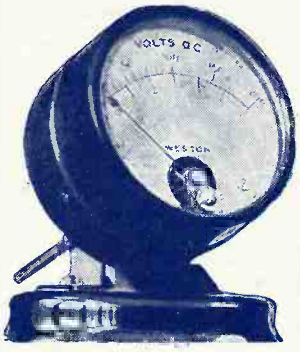

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THE REGIONAL ONE

The Wireless World AND RADIO REVIEW

4D

The Paper for Every Wireless Amateur

Wednesday, August 13th, 1930.

No. 572. Vol. XXVII. No. 7.

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The Wireless World AND RADIO REVIEW (18th Year of Publication)

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CONTENTS OF THIS ISSUE.

	PAGE
EDITORIAL VIEWS	137
THE REGIONAL ONE. BY W. I. G. PAGE	138
TESTING LOUD SPEAKER MAGNETS. BY T. A. LEDWARD	143
RADIO SERVICING	145
CURRENT TOPICS	147
LABORATORY TESTS ON NEW APPARATUS	148
KIT CONSTRUCTORS' NOTES	149
WIRELESS THEORY SIMPLIFIED. BY S. O. PEARSON	150
BROADCAST BREVITIES	153
CORRESPONDENCE	154
READERS' PROBLEMS	155

OUR TECHNICAL INFORMATION SERVICE.

FOR some considerable time past we have been concerned over the ever-increasing popularity of *The Wireless World* Information Service. When we say "concerned," we do not wish to imply anxiety for ourselves, because there could, perhaps, be no surer indication of the appreciation of the reader for the paper than the continual increase in the number of enquiries we receive on technical matters. Our concern is that the fullest service which our Information Department is able to give should be available to our regular readers, for whom alone the service is conducted, but the conditions under which it is carried out at present do not ensure that the service is exclusively theirs. We find that a great deal of our time is taken up in replying to questions from non-readers or from those who merely take a single copy of the paper in order to obtain the coupon which until the introduction of the present scheme has entitled them to a free reply.

Our aim, therefore, has been to devise some means of ensuring that the full energies of our Information Department are retained for our regular readers and are not diverted to those who have not the same call upon our assistance. We have decided, therefore, that from now on the service of our Information Department can be available only to regular readers.

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We define a regular reader as one who takes the paper regularly week by week. Therefore, we must stipulate that, to qualify as a regular reader, the reader must either be a direct subscriber at the regular subscription rates for a period of not less than six months, when he will receive copies regularly by post, or, if he prefers, he can obtain his copies through his local newsagent and thereby avoid the payment of the extra amount for postage. Under the latter arrangement the reader will be required to complete a registration form obtainable on application to the publishers, and pay to his newsagent, in advance, for copies over a period not less than six months. When *The Wireless World* receives such a subscription or completed registration form, the form will be returned to the reader with a registered number inserted. This number must be quoted with name and address in all future correspondence with our Information Department. Those readers who already subscribe direct will be given a registered number and advised accordingly. Unless this number is quoted, questions can no longer be dealt with through the information service. The rules of the information service, setting forth the nature of the questions which will be answered and other details, are to be found each week inserted on the page devoted to published replies to readers' queries. These published replies are a selection from amongst those which are considered to be of general interest.

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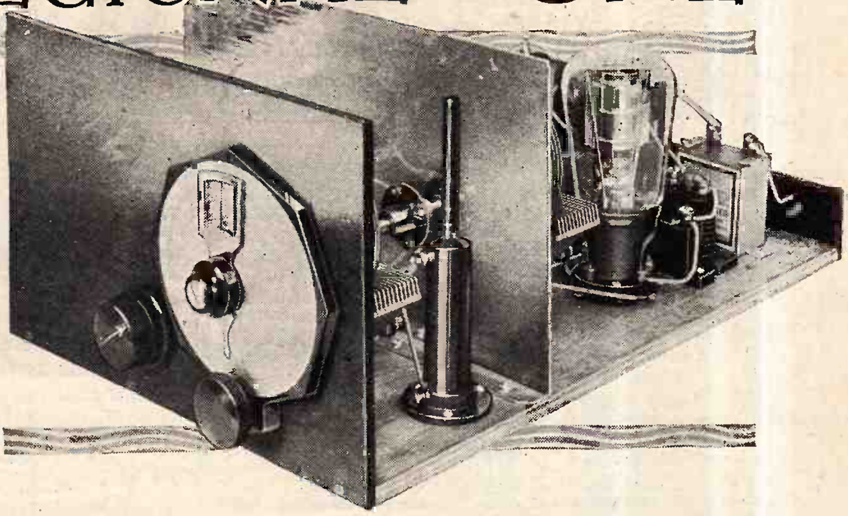
It will be seen that, to obtain the full advantage of the information service, the regular reader is involved in no extra cost in becoming a registered reader and obtaining the free services of *The Wireless World* technical Information Department so that we are still able to retain our ideal of a technical service which is "free."

We therefore ask all readers who in future wish to avail themselves of the services of *The Wireless World* Information Department to make application for a registration form to the Publishers of *The Wireless World*, and from the date of the present issue the new arrangement begins to operate.

THE REGIONAL ONE



A Batteryless One-valve Loud Speaker Receiver with Ganged Band-pass Filter.

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

IT was not very long ago that it required at least three valves to hear the local station at reasonable strength. Then came the pentode, which made the same result possible with two valves, and to-day, with the added assistance of more powerful transmissions, it is quite feasible to dispense with all but one valve. Progress in the design of indirectly heated A.C. valves and the development of a new form of detection have certainly been an indispensable factor in rendering this possible. The underlying principles of the single-valve loud speaker set having an indirectly heated pentode as power grid detector were given in last week's issue, and it remains to describe the construction of a receiver as already outlined.

The first important consideration is a tuning scheme which will give the necessary selectivity and good quality, taking into account the heavy load that the A.C. pentode imposes upon its grid circuit. A ganged capacity-coupled band-pass filter, as used in the "Band-pass Four" receiver, immediately suggested itself, and the resulting high selectivity and good quality soon showed that this choice was justified. The filter consists of two coils L_1 and L_2 separated by a vertical earthed screen. Their axes are at right angles, the only coupling between them being the common condenser C_m; in fact, if the latter be short-circuited, no signal should be heard.

When the common coupling condenser C_m is made large, the voltage across it is small and the coupling becomes loose, and vice versa. The looser the coupling the less evident becomes the "double-hump" in the tuning curve referred to later. As already explained in this journal,[1] the common capacity can be worked out from a formula, such that the resonance curve can be made to have almost a square top to fit the transmitted carrier wave, together with its full quota of sidebands. Actually the corners become upswept to produce two peaks, the distance apart of which should be about 10 k.c. if sidebands, and, therefore, high notes and overtones so necessary for clarity in speech and music are to be retained in their correct proportion.

SPECIFICATION.

The set, which is extremely simple to construct, is designed for local station reception, and embodies an indirectly heated pentode as power grid detector.

Ganged Band-pass Filter *with capacity coupling. Peak separation of 10 k.c. arranged at the middle of the medium broadcast band. High selectivity with retention of sidebands. One-dial tuning.*

Power Output *350 to 400 milliwatts.*

All A.C. Operation. *No applied grid bias needed.*

Reaction *controlled by differential condenser.*

Wave Range *200-630 metres.*

Eliminator *as separate unit. As intervalve couplings are absent, motorboating, hum and instability are entirely prevented with the minimum of smoothing equipment.*

That the capacity-coupled band-pass filter is susceptible to fairly simple mathematical treatment commends its use in favour of other two-circuit tuner arrangements. If properly designed the selectivity can be kept constant throughout the waveband, and so numerous are the advantages—not the least of which is one-dial tuning—that most of the elaborate sets in America incorporate such filters, and there is evidence that we shall see quite a number of them at Olympia this autumn. The price paid for the good qualities so far outlined is not great; the signal strength will not fall below 70 per cent. of the maximum attainable with two similar coils arranged to give signal strength at the expense of all the other essential factors. As there is no intervalve tuning to fill in the depression between the two peaks, it is advisable not to make the filter coils of too "low-loss" design, otherwise the peaks will be over-pronounced and the value of the filter nullified. It is an inherent property of such a tuning

[1] "Capacity Coupled Filters." By A. L. M. Sowerby, April 2nd and 9th, 1930.

The Regional One.—

scheme that the peaks, if correctly spaced at the middle of the waveband, will tend to coalesce at the shorter wavelengths, and sidebands will be cut unless the coils have sufficient H.F. resistance. The two inductances must be matched as nearly as possible, and the average dynamic resistance of each tuned circuit should not exceed about 120,000 ohms. Calculation shows that the largest coil in the circumstances should be just a shade over 2in. effective diameter, such as could be wound on a six-ribbed 2¼in. (overall) ebonite former. The two coils used in the receiver which are wound to the formulæ of S. Butterworth for minimum H.F. resistance, have the specifications shown in Table I.

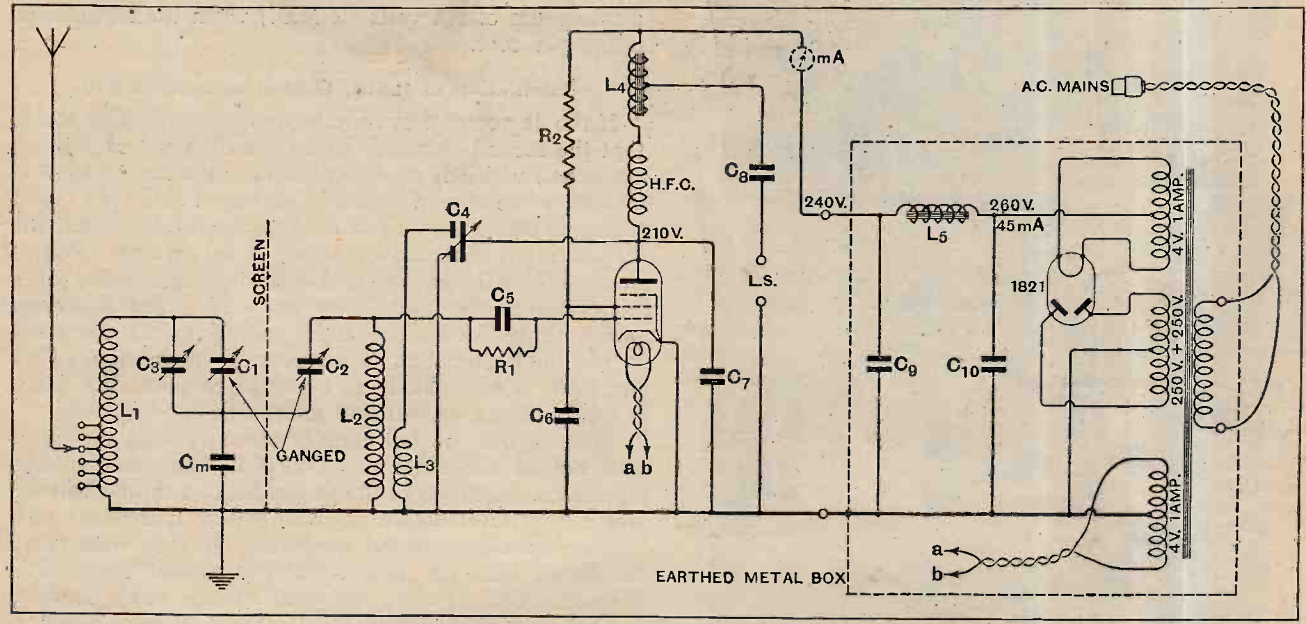


Fig. 1.—The circuit diagram. C_1 and C_2, ganged 0.0005 mfd. log. law variable condensers; C_3, trimming condenser 1.5 to 50 $\mu\mu$F; C_4, 0.0002 mfd. differential condenser; C_5, 0.0001 mfd.; C_6 and C_8, 2 mfd. 700 volt D.C. test; C_7, 0.001 mfd.; C_9 and C_{10}, 4 mfd. 700 volt D.C. test; C_m, 0.01 mfd. R_1, 0.5 meg.; R_2, 15,000 ohms; L_4, centre-tapped L.F. choke, 35 henrys inductance with 40 mA. D.C. resistance 410 ohms; L_5, L.F. choke, 22 henrys inductance at 45 mA.; D.C. resistance 430 ohms. The mains transformer has 3 centre-tapped secondary windings; 4 volt, 1.0 amp.; 4 volt, 1.0 amp.; 250 volt + 250 volt. Details of the coils L_1, L_2 and L_3 are given in the text.

The reaction coil L_3 is wound in the same direction as the inductance L_2. The coil data giving inductance, waveband covered, and "shape" for optimum H.F.

TABLE I.

Dia. of 6-ribbed ebonite former ..	2¼in. overall.
Effective dia.	2.05in.
No. of turns (wound touching) ..	80.
Wire	No. 26 D.C.C.
Winding length	2.2in.
Inductance	225 μH.
Waveband covered with 50 to 500 $\mu\mu$F. tuning capacity	200 to 630 metres.
Average dynamic resistance	120,000 ohms (approx.).
Aerial tappings, L_1	14, 18, 22, 26, 30 and 35 turns from earthed end.
Common coupling capacity C_m ..	0.01 mfd.
Peak separation of filter at 250 metres	Zero.
" " 350 "	11.9 kc.
" " 475 "	17.5 kc.
Reaction winding spaced 0.3in. from low-potential end of L_2	12 turns No. 34 D.S.C.

resistance, are obtained extremely easily from *The Wireless World* "Radio Data Charts"; these tables are almost indispensable for the scientific design of tuning circuits. The peak separation when using a filter of two 225 μH coils, as specified above, is given by the formula:

$$\text{Peak separation (cycles)} = \frac{\sqrt{\dfrac{1}{\omega^2 C_m^2} - r^2}}{2\pi L}.$$

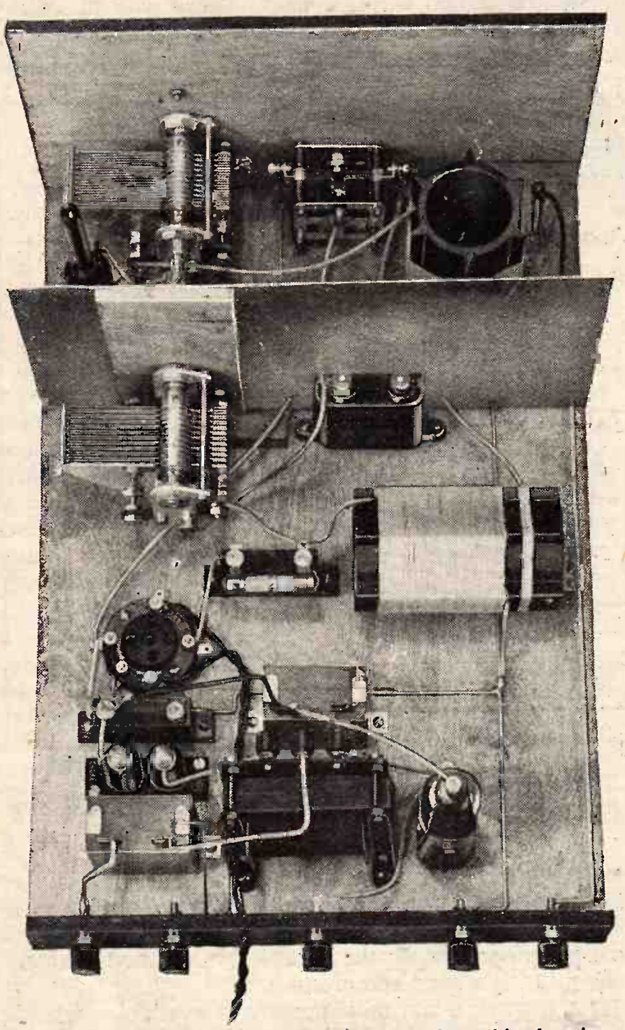
Somewhere below 300 metres the peaks merge together, but the sidebands are safeguarded by the increased H.F. resistance at this wavelength. Those who habitually listen to a station on about 250 metres would be advised to use a coupling condenser of 0.006 mfd., giving a peak separation of 10 k.c. according to the above formula at this wavelength. On the other hand, for receiving 5GB only, C_m could be made 0.02 mfd. For general alternative programme work the capacity value used, namely 0.01 mfd., is a good compromise.

If a 0-50 or 0-100 milliammeter is available for connection in the positive H.T. lead, the "double-hump" tuning can clearly be seen as a double kick downwards of the needle as a station above 300 metres is tuned through resonance. The London Regional Station, at whose wavelength the present filter provides a peak separation of about 12 k.c., causes the two peaks to be completed within approximately one degree on the 0°-100° scale of the tuning dial; this is roughly correct since the whole tuning scale embraces about 1,000 k.c., one degree representing 10 k.c. if the condensers had been of the S.L.F. type. The deviation from this is only small when log. law condensers are used. When reaction is pressed too far, one peak becomes

The Regional One.—

much higher than the other. With the aid of a meter it is easy to apply reaction correctly to tune accurately to the slightly increased reading half-way between the two peaks.

When ganging the two variable condensers C_1 and C_2, first adjust the trimming condenser C_3 to minimum, loosen the screws on one side of the universal joint, bring the two rotors approximately in line, and tune in a station of low wavelength. By tuning in a longer-wave station, using the trimmer and reganging on



That the set is simple to construct is evident from this plan view. The centre terminal is for the H.T + connection from the eliminator. The H.T. negative lead is joined to the earth terminal.

the lower wavelength, it will be found that the ganging holds over the complete waveband. The small trouble incurred is amply repaid with high selectivity and good signal strength.

A description of a set with a specialised detector would hardly be complete without an examination of the valve characteristic under working rectifying conditions, especially as excellent quality of reproduction is claimed. In Fig. 2 is given a dynamic curve for the preparation of which the writer is indebted to Mr. E. Y. Robinson, of the Mazda Valve Laboratories. The problems involved are complex, and little help can be derived from the ordinary anode current/anode volts curves so valuable for power output and distortion calculation with a valve performing the single function of amplifying. An intermediate step must be taken, assuming a resistance-coupling in the output stage, and from the detection characteristics so obtained, a transformer or choke coupling curve can be deduced.

This somewhat roundabout method is rendered necessary by the various depths of modulation which have to be considered. The final curve (omitting the intermediate stage) is given in the figure for a loud speaker impedance of 8,000 ohms when 200 volts are applied to the anode. The characteristic refers to the detection of a five-volt (R.M.S.) carrier-wave which will swing to a maximum of ten volts (R.M.S.) when the modulation is 100 per cent.

Calculation of Input, Output and Distortion.

If the degree of curvature be analysed it will be found that the second harmonic distortion does not exceed 4.5 per cent., which is unobjectionable. For a six-volt carrier-wave the second harmonic distortion is 10 per cent., which is clearly inadmissible, thus establishing that the largest input that can be accepted by an A.C./Pen as power-grid detector without distortion is a wave of 5 volts R.M.S. modulated 100 per cent. The measured power output for the safe input conditions just discussed is 760 milliwatts, but as an average modulation of 70 per cent. is more likely to occur in practice, the mean output will not exceed 400 milliwatts.

These figures do not conflict seriously with the input and output constants prophesied in last week's issue from a consideration of the properties of a three-electrode valve only, and before an examination had been made of the curve reproduced herewith. It may thus fairly be stated that the loud speaker volume from "The Regional One," when the grid of the valve is fully loaded from a local transmission, will be quite equal to that developed by the P.240 type of valve when giving of its best.

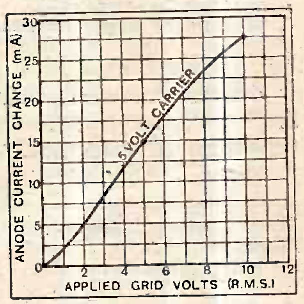


Fig. 2.—Dynamic detection characteristic of the Mazda A.C./Pen valve. The curve is for the maximum signal carrier voltage (R.M.S.) of 5 which when modulated to 100% will swing to 10 volts (R.M.S.). The curvature distortion does not exceed 4.5% second harmonic which is negligible. The depression of mean anode current should not be greater than 15 mA. when a loud signal is tuned in. The undistorted output is nearly 400 milliwatts.

The construction of the receiver should present no difficulty whatsoever, for, excepting the disposition of the band-pass filter components, the general layout need not follow any special plan, since in a one-valve set intervalve couplings do not exist! Each 0.0005 mfd. member of the ganged condenser is of the single-hole-fixing type, and relies on a vertical panel for support. A small rectangular piece of ¼in. plywood is, therefore, screwed to the vertical metal screen and to the baseboard to hold the secondary condenser.

Care must be taken to arrange a clearance

LIST OF PARTS.

RECEIVER.

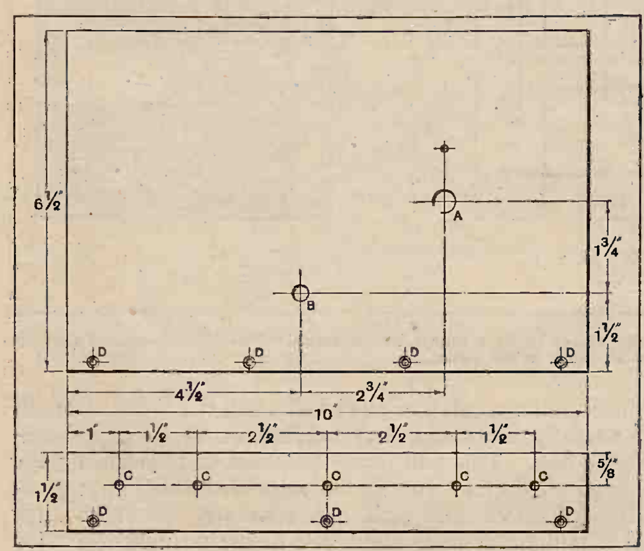
2 Ebonite coil formers, 6-ribbed, 2¼in. dia. overall, 3½in. long (Becol).
1 Ganged condenser, 2 members of 0.0005 mfd. log law, N.S.F. No. 335 (George Becker, Ltd., 39, Grafton Street, London, W.1).
1 Gang coupler, N.S.F. No. 344 (George Becker, Ltd., 39, Grafton Street, London, W.1).
1 Slow-motion dial, Type R-204A (Ormond).
1 Neutralising condenser, 1.5 to 50 μμF. (Type R-165, Ormond).
1 Fixed condenser, mica, 0.01 mfd. (Type B.775/1, Dubilier).
1 Fixed condenser, 0.0001 mfd. with grid leak clips (No. 620, Dubilier).
1 Fixed condenser, 0.001 mfd. (Type No. 620, Dubilier).
1 Differential condenser, 0.0002 mfd. (Magnum).
1 Grid leak, vacuum type, 0.5 meg. (Ediswan).
1 Valve holder, 5-pin (Lotus).
1 Resistance and holder, 15,000 ohms (Varley).
1 High-frequency choke, Binocular ("Junior," McMichael).
1 Low-frequency Pentode choke, centre-tapped ("Pentomite," R.I.).
2 Fixed condensers, 2 mfds., 700 volt D.C. test (Loewe).
5 Terminals, aerial, earth, H.T.+, L.S., L.S. (Belling-Lee).
Terminal strip, 10 × 1½ × 3/16 in.
Plywood panel, baseboard, wire, screen, screws, etc.

ELIMINATOR.

1 Screening box, 6½ × 6½ × 6in. (Magnum).
2 Fixed condensers, 4 mfds., 700 volt D.C. test (Loewe).
1 Low-frequency choke ("Hypercore," R.I.).
1 Mains transformer; state mains voltage and frequency when ordering (Type No. 27, Rich & Bundy).
1 Valve holder, 4-pin (W.B.).
Flex and lamp adaptor, etc.
Valve required for receiver, Mazda AC/Pen; for eliminator, Philips rectifier, No. 1821.

Approximate cost of receiver (without valve), £4.
Approximate cost of eliminator (without valve), £3.

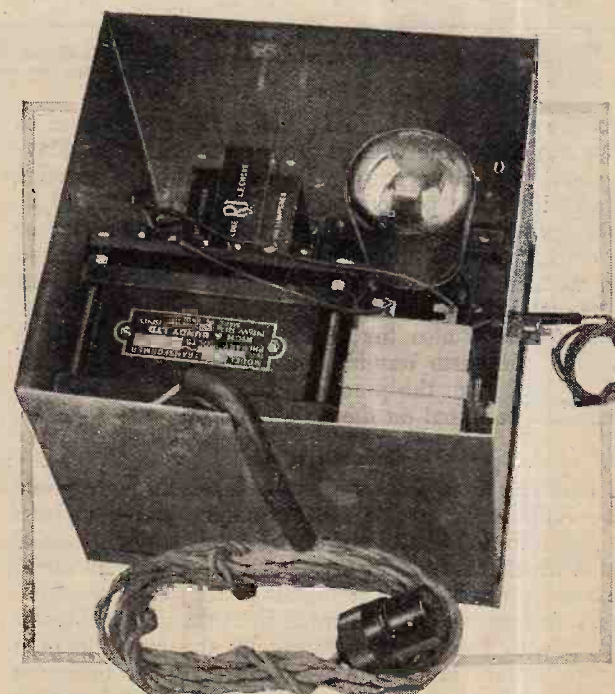
In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed, and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.



Dimensions and drilling data of the panel and terminal strip. A = 7/16in. dia.; B = 5/16in. dia.; C = 5/32in. dia.; D = 1/8in. dia. and countersunk for No. 4 wood screws.

between the common rotor spindle and the screen, for should these two come into contact with one another the coupling condenser C_m would be short-circuited. The differential reaction condenser C_4 is wired so that feed-back is increased by a clockwise rotation. Should the set not oscillate when this condenser is set at maximum, the reaction winding L_3 can easily be slipped along the former towards the tuning inductance L_2; however, to prevent alteration of tuning capacity with change of reaction setting, the reaction winding must be kept as far away from L_2 as possible.

The eliminator, which is housed in a standard H.F. screening box measuring 6½in. × 6½in. × 6in., has been made a separate unit, as it is felt that the reader would not want to tie up this equipment in a one-valve set. Furthermore, if he has A.C. mains it is likely that he already possesses such simple rectifying and smoothing components. The extremely small space occupied by the eliminator is due to the use of the new type of high-permeability choke, which is little larger than a matchbox and yet has an inductance of over 20 henrys when carrying 45 mA. D.C. It should be mentioned here that the "Pentomite"—a slight modification of the same type of choke—is used in the anode cir-



The separate eliminator unit housed in a small screening box The very minimum of equipment is required for smoothing.

The Regional One.—

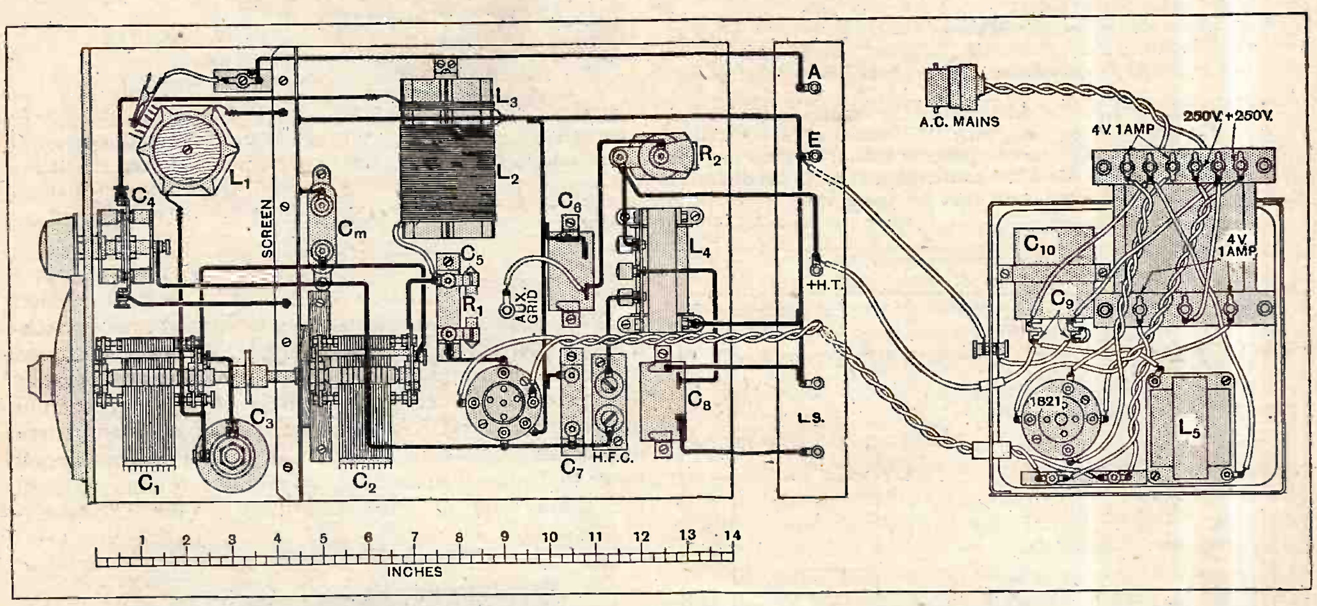
cuit of the A.C./Pen and considerably assists in the economy of space.

The smoothing condenser C_9 which follows the smoothing choke L_5 must not be less than 4 mfd., otherwise slight hum will be heard. The condensers C_6, C_8, C_9 and C_{10} must have been tested at 700 volts D.C., and therefore have a working pressure of about 300 volts. The new inexpensive Philips 1821 rectifying valve has been incorporated because with the maximum 250 volts R.M.S. applied to each of its anodes it will develop the necessary 260 volts unsmoothed D.C. across a 4 mfd. condenser (C_{10}) when the load is 45 mA.

The extremely compact design of the eliminator may suggest its use with sets other than "The Regional One." The mains transformer, without increase in overall dimensions, can be supplied by the makers with a 4-volt 3.0 amp. winding so that a well-decoupled three-valve A.C. receiver could be fed satisfactorily from the unit.

Operation.

Having completed the construction of the receiver, which should only take a few hours, it remains to give a few notes on operation. Connect the aerial crocodile clip to, say, the tapping at the 18th turn from the earthed end of the aerial coil, tune in the local station, and rotate



General wiring plan. The smoothing condenser C_{10} is held vertically above C_9 by a small metal strap. The dimensions of the vertical screen are the same as those of the panel.

As the smoothing choke L_5 has a D.C. resistance of about 430 ohms, the voltage dropped is nearly 20, leaving about 240 volts across C_9. A further drop of 30 volts is caused by the pentode output choke and the H.F. choke giving 210 volts actually applied to the anode of the detector. The eliminator components are screwed to a wooden baseboard which can be easily lifted out of the metal box. The earth terminal on the side of the latter, which is also the H.T. negative connection, is joined to the earth terminal on the receiver, while the H.T.+ lead from the junction of C_9 and L_5 is taken to the middle terminal on the terminal strip.

Construction.

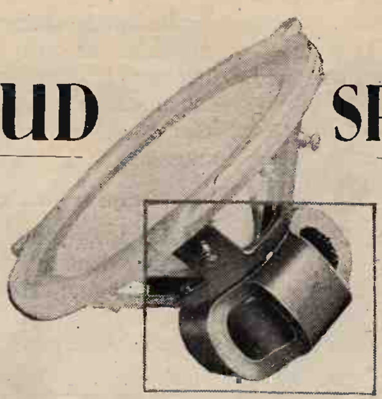
The heater leads from the set are taken through a hole in the eliminator box to two terminals, which in turn are joined to the ends of one of the 4-volt 1.0 amp. windings of the mains transformer. As a precaution all metal cases are earthed. The terminals of the primary of the mains transformer are prevented from making accidental contact with the metal container by the insertion of a strip of empire tape, and heavy-duty rubber tubing is used to avoid chafing of the H.T. positive and twisted heater leads where they pass through the screening box.

the reaction condenser clockwise until the signal strength is slightly increased, but not so far as to cause self-oscillation. This will have the effect of neutralising the negative reaction due to the inter-electrode capacity ot the A.C./Pen and will not adversely affect quality. If a milliammeter is employed in the position indicated in Fig. 1 a decided double kick (downwards) should be seen at resonance when tuning in stations with a wave-length greater than about 300 metres. With the London Regional transmission, for instance, the double hump should be completed within one degree on the 0°-100° scale of the slow-motion tuning dial. The depression of the current in the milliammeter should never exceed 15 mA. (see Fig. 2) at the tune point. A trial should be made with each aerial tapping to get the best compromise between signal strength and smooth reaction control. The trimming condenser will require slight adjustment for each change in aerial coupling.

The useful range of this receiver when an efficient outside aerial is employed can be stated to be about thirty miles from the more powerful transmitting stations.

This set and eliminator are available for inspection by readers at the offices of this journal, 116, Fleet Street, London, E.C.4.

TESTING LOUD SPEAKER MAGNETS



Measuring the Flux-Density—With the Aid of Simple Apparatus.

By T. A. LEDWARD.

THE writer was surprised to hear recently, on reliable authority, that there had been an argument between two well-known firms concerned with moving-coil loud speaker magnets as to the actual flux-density obtained in a certain type of magnet. It appears that the argument was eventually settled by a single magnet being tested by each of the firms in question and then by the National Physical Laboratory, whose figures agreed closely with those of one of the firms.

The usual methods of determining the flux-density depend upon the quantity of electricity passed through a ballistic galvanometer when a test coil, connected to the galvanometer, cuts the magnetic field. If the coil is caused to cut across the magnetic field quickly in a direction at right-angles to the field, the deflection of the ballistic galvanometer will be proportional to the total flux cut, and this can be determined from the known characteristics of the coil and galvanometer.

The flux-density can then be determined from the dimensions of the gap. If care is not taken errors may creep in due to the stray flux external to the gap if the test coil is allowed to cut this flux, and the most reliable results appear to be obtained by cutting a portion of the flux only in the gap proper.

However, few amateurs are provided with a suitable ballistic galvanometer, and the purpose of this article is to describe a simple and reliable means of making a test without the aid of such an instrument.

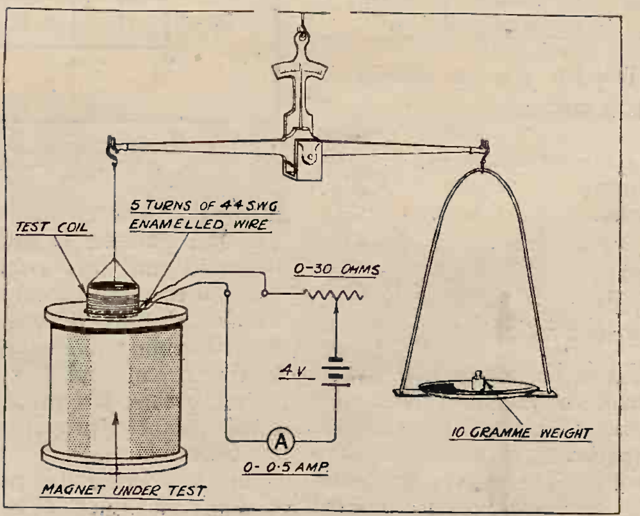


Fig. 1.—The arrangement of apparatus for the measuremen of flux-density.

The method requires only instruments of the type which most amateurs possess, namely, an ammeter, a variable resistance, an accumulator and a pair of scales.

The ammeter should preferably read 0 to 0.5 amp., though a lower reading instrument, say, not less than 0 to 50 mA., will serve. The accumulator may be 2 or 4 volts, and the variable resistance about 0 to 30 ohms. As regards the scales, the cheap type sold by photographic dealers are quite suitable, but gramme weights are desirable. A single 5- or 10-gramme weight is all that is required if the 0 to 0.5 ammeter is available. If a 0 to 50-milliammeter is to be used a smaller weight, say 1 or 2 grammes, will be required.

The method depends upon the fundamental principle of the moving-coil speaker itself, namely, that if a current passes through a wire placed in a magnetic field the wire will tend to move in a direction at right-angles to the field. The force acting on the wire depends upon the strength of the current, the length of the wire and the field strength (i.e., flux-density).

If, therefore, we wind a coil of a known number of turns and determine the pull exerted when this coil is placed in the gap, and a given current passed through it, we can calculate the flux-density in the gap.

The formula is:—

$$H=\frac{9810F}{Il}$$

where H = field strength (flux-density) in lines per square centimetre.

F = force in grammes.

I = current in amperes.

l = length of wire in centimetres.

$=\pi dt$, where d = diameter of coil and t = number of turns.

The apparatus should be set up as shown in the diagram Fig. 1. A suitable coil for most tests comprises 5 turns of 44 s.w.g. enamelled wire wound close together on a suitable former. The coil former may be of the type used for the actual speaker, but will require means for suspending it from the scales, as shown.

Testing Loud Speaker Magnets.—

The 44 s.w.g. wire should be brought out at connecting leads in two lengths of about 9in., as these will need to be as flexible as possible.

One of the scale pans must be removed and the test coil suspended in its place. The test coil should be a trifle heavier than the other scale pan and afterwards balanced carefully, before switching on the current, by placing pieces of wire or anything available in the scale pan.

Taking a Measurement.

This balancing should be done with everything in position and the connecting leads anchored to a suitable point. The height of the magnet should be adjusted to allow the coil to be at the middle of the gap when the system is in equilibrium.

All being ready, a weight (say 10 grammes) is placed in the scale pan, the current is switched on and adjusted by means of the variable resistance until a balance is obtained. The flux-density is then calculated from the formula already given, all the necessary figures being available.

Tests made in this way on five magnets gave the following results:—

TABLE I.

Magnet No.	Gap Width.	Gap Length.	Centre-pole Diam.	Flux-density Lines per sq. cm.
	mm.	mm.	mm.	
1	2.0	11.0	38.0	7,340
2	1.5	12.7	47.5	6,750
3	1.5	6.4	39.0	5,860
4	2.0	9.5	50.0	4,825
5	2.0	9.5	50.0	5,510

The complete figures for Test No. 1 are as follows:—

diameter of coil, 4.15 cm.
No. of turns, 5.
Length of wire $l = 4.15\pi \times 5 = 65.2$ cm.
Current I, 0.205 amp.
Force F, 10 grammes.

From which:—

$$\text{Flux-density } H = \frac{9810 \times 10}{0.205 \times 65.2}$$
$$= 7{,}340 \text{ lines per sq. cm.}$$

The magnet in this test was taken from a well-known commercial speaker. It had an energised field and consumed 5.4 watts at 6 volts. This was the nominal rating, and by way of experiment further tests were made at 2, 4, 8, and 10 volts. The figures are given in the form of a curve in Fig. 2, which indicates clearly that little would be gained by increasing the voltage beyond 10, though there is a substantial gain by the increase from 6 to 10.

As the power consumed at 10 volts is only 15 watts and the magnet is a very substantial one there is no likelihood of overheating.

Magnet No. 2 was from a set of parts sold to amateur constructors. This also had an energised field, but was smaller and lighter than No. 1. Though it consumed 20 watts (at 230 volts) and the gap was smaller, the flux-density was less. This clearly indicates that energy consumption alone is no guide as to field-strength. The other three (Nos. 3, 4, and 5) were permanent magnets.

Impromptu and Laboratory Methods Agree.

It is interesting to note that in the case of No. 5 the flux-density was measured by the manufacturers of the magnet, Messrs. Darwins, Ltd., before despatch, by a ballistic galvanometer method, and their figure agreed exactly with the one obtained by the above

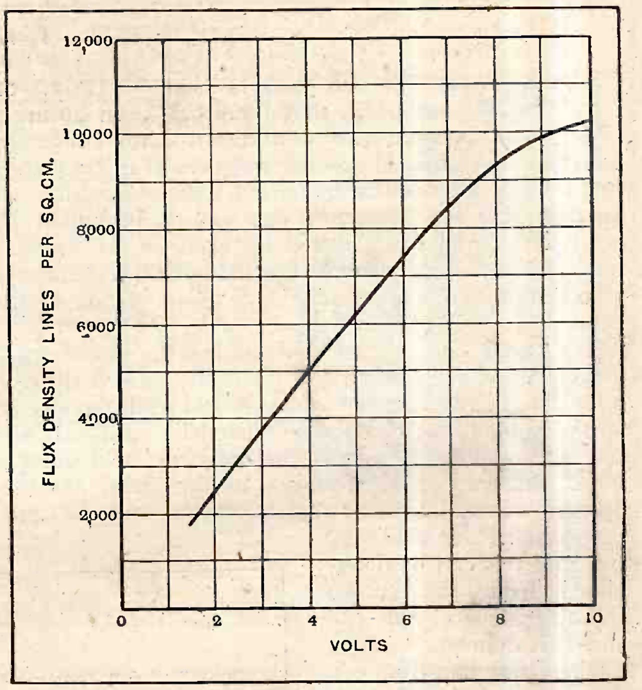


Fig. 2.—Curve showing the increase in flux-density by raising the field voltage.

method. In comparing magnets, the dimensions of the gap and diameter of the centre pole should, of course, be taken into consideration.

From the above formula it is clear that if we increase the diameter of the coil or the length of the gap (the latter enabling more turns to be used), the force for a given current and flux-density will be increased due to the greater length of wire. For direct current this force is directly proportional to the length of wire under consideration.

In considering the response to musical frequencies, however, we must, of course, remember that the larger coil would have a greater weight (tending to reduce the response at the higher frequencies) and a somewhat higher resistance. A compromise therefore becomes necessary.

It is beyond the scope of the present article to go further into the question of the best dimensions for the coil, but the latter remarks are given as a hint in comparing different magnets.

Radio Servicing

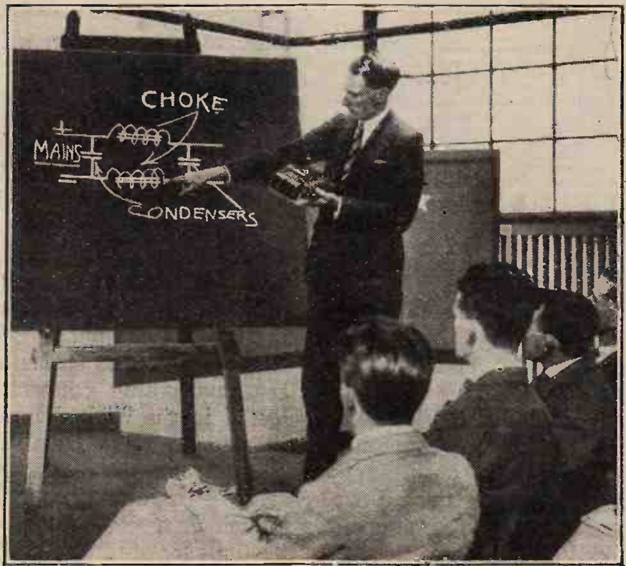
Activities of the Marconiphone Training School at Dagenham.

THE average cautious citizen hesitates before buying a rather complicated piece of apparatus—such as a wireless receiver—unless he himself understands it and feels competent to right any faults that may develop, or else is confident that someone is available to do this for him efficiently and at reasonable cost.

Naturally, every manufacturer worthy of any consideration has some sort of service scheme in operation at his works, but the ordinary customer who avails himself of it is, of necessity, faced with a fairly heavy bill for transport, and, more serious still, by the need for packing a somewhat fragile receiver with its accessories. Factory service, in its way, is well enough, but it should be supplemented by the efforts of someone "on the spot"; clearly, the fit and proper person to do minor repairs and adjustments is the local dealer.

One might reasonably expect that the average reader of this journal, who has sufficient technical knowledge to help himself, would display but a lukewarm interest in this question of wireless service. Actually the contrary is the case, and a deluge of letters expressing views on the subject have been received since attention was first directed to the subject.

Perhaps some of our readers' laments are provoked by the fact that they are growing weary of receiving a succession of S O S calls to act as amateur and unofficial repairers to friends and acquaintances, in the absence of a competent local professional. Be this as it may, there is admittedly room for improvement, and we are justified in looking forward to a happier state of affairs now that many manufacturers' have realised fully that the ultimate satisfaction of their customers is vital to the foundation of a stable business.



Theory is linked with practice at every stage. The principles of H.T. battery eliminators are being explained.

Prominent among these far-sighted makers of broadcast receivers is the Marconiphone Company, who have just inaugurated a scheme which offers free technical training to dealers (or their assistants) who handle the company's products. Under existing arrangements there are three distinct courses of instruction.

"A." Standard short full-time course of one week at the Marconiphone Works at Dagenham, Essex.

"B." Comprehensive course occupying three weeks (full time), also at Dagenham.

"C." Evening course of sixteen sessions, taking place during two evenings per week at the Marconiphone Headquarters in London.

We are primarily concerned here with Courses A and B, as, by the courtesy of the company, a representative of *The Wireless World* was recently given an opportunity to wander at will through the Dagenham School and to see exactly how instruction was imparted and what progress was being made by students.

The students themselves deserve a word, if only because we generally regard those engaged in the

Radio Servicing.

painful process of assimilating knowledge with some sympathy—which in this case would seem to be misplaced. They range from middle-aged proprietors of well-established businesses to assistants still in their teens; there are no restrictions as to age or even as to sex. A cheerful atmosphere of keenness pervades the place, and must go a long way towards instilling confidence in those who feel diffidence in beginning their schooldays over again.

The first day of Course A is devoted to study of the fundamental principles of radio, including sound reproduction. Even at this early stage the students are introduced to the theoretical circuit diagram, and to the conventional symbols used in drawing it. The functions of individual components are explained and practical methods of testing them are discussed. The tedium of this rather terrifying day's work is relieved by a tour round the adjoining factory.

On the following day the first subject to be treated is that of valves, including practical applications and testing, which is followed by an explanation of the principles of typical receiver circuits.

After this groundwork has been covered the student passes on to actual Marconiphone receivers, beginning with the Type 39, a comparatively simple three-valve H.F.-det.-L.F. set. He listens to a lecture on this model, during the course of which he has an opportunity of examining its component parts and also of seeing receivers in various stages of assembly. From the lecture room he goes straight to the benches for practical work on this type of set, and is faced with the task of tracing faults that have been deliberately introduced. This is the keynote of the system of instruction; no time is wasted in allowing the students to apply their newly acquired knowledge.

Faults, and How to Find Them.

When the writer tip-toed into the lecture room the subject under treatment was the Type 55 Portable, a five-valve self-contained set on fairly conventional lines. The lecturer was dealing with its two-stage aperiodic H.F. amplifier, explaining the functions of H.F. chokes, coupling condensers, and leaks, and then going on to possible faults, their effects, location and cure. Individual grid and plate circuits were traced out; it was shown that the coupling condenser was common to both, and that this fact should be taken into account when making systematic tests. It was reassuring to see that haphazard or purely mechanical rule-of-thumb methods were not recommended.

It was interesting to stroll around the test benches and to see how quickly some of the more difficult faults were traced. A large proportion of "dud" valves and batteries are distributed, so nothing can be taken for granted, and the wily student, particularly if he is fairly well advanced, does not even "go through the movements" of trying vainly to obtain signals before checking circuits and accessories for continuity and insulation.

Simple apparatus is advocated for use in the location of troubles, and a great deal of work is done with the help of 'phones and dry batteries. Voltmeters and milliammeters are used where necessary.

Students seem to take a pride in clearing their allotted quotas of faults without assistance, but, as they work in quite small groups, an instructor is always at hand to prompt them with suggestions as to procedure. The syllabus of the three weeks' course is rather more extended in every direction but is on similar lines, although it embraces extra subjects, such as elementary electricity and magnetism. The evening classes, mainly intended for dealers in the London area, are arranged to cover the same ground as Course A.

Problems of fault finding; a preliminary demonstration.

Superior people may scoff at the idea of gaining sufficient knowledge for "servicing" domestic broadcast receivers in one week, three weeks, or even in three months, but they would modify their views after visiting the Marconiphone School and seeing the successful work done by its students. It would be idle to suggest that everything connected with the subject can be learnt in the limited time available, but, at the worst, those who have been through the courses can fairly claim to be specialists with regard to several types of sets. In addition, they have acquired the foundations on which a deeper knowledge of radio technique can be built by studying text-books and technical journals. The success of the training scheme cannot be questioned, and all who have the interests of broadcasting at heart will congratulate those responsible for its inception.

CURRENT TOPICS

Events of the Week in Brief Review.

IDEAS FOR WIRELESS POSTERS.

Original poster designs for wireless sets and loud speakers are among the items displayed at the Royal Society of Arts Exhibition, now being held in connection with the 1930 Competition of Industrial Designs. The exhibition, which is being held at the Imperial Institute (East entrance), South Kensington, London, S.W., will remain open daily from 10 a.m. to 5 p.m. until August 31st. Admission is free.

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PRIZES FOR ITALIAN RADIO MANUFACTURERS.

To stimulate the home radio industry the Italian Government is instituting an annual competition among manufacturers for the production of the most suitable sets for public use. The winner of each competition will be awarded a one-year contract for the supply of 1,000 three-valve sets and 400 smaller instruments each month. These are to be made available to the public on the instalment plan.

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B.B.C.'S INCOME TAX.

The Sword of Damocles hangs over the head of the B.B.C. in the shape of an enquiry regarding the corporation's liability to income tax. In a written answer in the House of Commons Mr. Pethick-Lawrence, Financial Secretary to the Treasury, has stated that the matter is at present *sub judice*.

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TRANSPORTABLE BROADCASTING STATION.

What locality will be chosen for the new Radio-Branly broadcasting station in France is a question which has been agitating the minds of many French listeners, according to our Paris correspondent. Early reports that the station would be situated in the Eure Department are contradicted by an apparently authoritative announcement that Radio-Branly will flourish either on a motor car or a yacht. The station will be owned by the well-known perfumer, M. François Coty.

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GLOBE-TROTTING WITH A PORTABLE.

How the obstacles to the use of a portable set in a ship's steel cabin were overcome, with striking results, are related in a letter received by Messrs. Whittingham Smith and Co. from a user of one of their Portadyne S.G.4 receivers in a voyage from Australia to England.

The screening effect of the cabin necessitated the use of an aerial. This was of the "L" pattern with a span of 16ft., a down lead of 21ft., and a horizontal lead-in of 8ft.

At Brisbane the Melbourne station, 700 miles distant, was heard at nearly full loud speaker strength without the use of reaction. In the Australian Bight signals could still be heard from Sydney, 1,440 miles away, and Perth had not entirely faded out when the ship was 800 miles away in the Indian Ocean. These results were achieved after sunset. In the Mediterranean the set picked up Rome at good strength at a distance of 1,100 miles, and at Marseilles good reception was obtained from Daventry, 5XX. The British programmes were received comfortably all day in the Bay of Biscay.

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NO PRIZES OFFERED.

Last week a Clerkenwell reader received from a customer the following order, written on a piece of scrap paper:—"50,000 dome wire round resilence." What *does* it mean?

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HOW THEY LISTEN.

Licensed listeners in Denmark at the end of June numbered 374,445. In Sweden the total was 461,616. Switzerland has nearly 92,000 licences in force.

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NEW MARCONI AIRCRAFT SET.

A new type of receiver employing a screened grid H.F. amplifying valve is incorporated in the Marconi Aircraft set, Type AD6m, which the Air Ministry has now approved for use. The transmitter is of 150 watts power and can be used for either telegraphy or telephony.

The new model meets the requirements of the Washington Convention with regard to covering the wavelengths allotted to aircraft, the transmitter and receiver being adjustable to any wavelength between the approximate limits of 550-1,550 metres on machines having a normal electrical capacity. The usual transmitting wavelength of 900 metres and alternative wavelengths of 870 or 930 metres, or any two other wavelengths differing by approximately 3 per cent., can be selected at will by means of a remote control unit.

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RADIO SHOW IN BUCHAREST.

Rumania's Second International Radio Exhibition will be held in Bucharest from September 7th to 28th next.

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R.C.A. SECURES KAROLUS CELL PATENT.

Patent rights in the U.S.A. in respect of the Karolus light cell have been assigned to the Radio Corporation of America, according to a Washington report. Dr. E. F. W. Alexanderson regards the Karolus valve as the latest advance in television, since it is able to produce clear figures on a screen six feet square. The Karolus device displaces the neon tube as the light source, making it possible to project the received light impulses at the rate of 40,000 per second.

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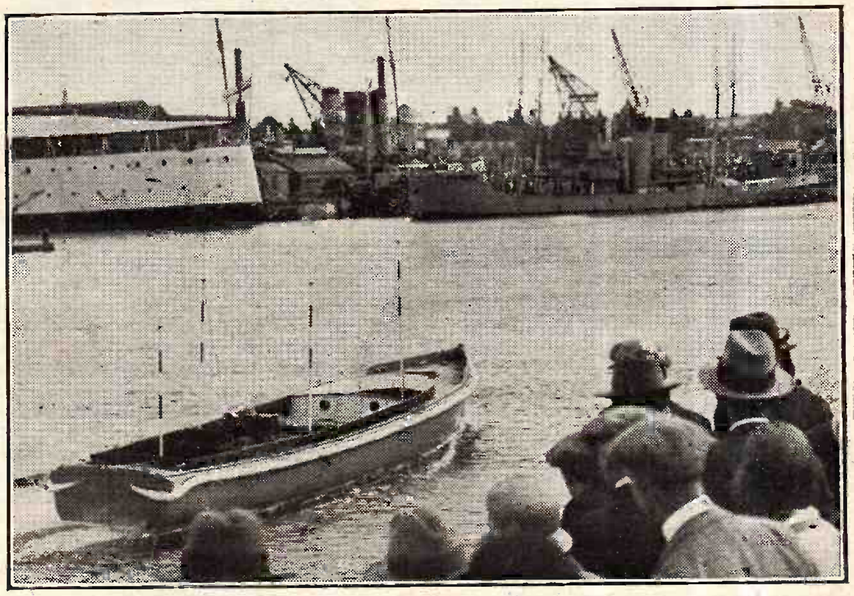
GERMAN APPARATUS IN BELGIUM.

German trade supremacy in the cheaper grades of wireless apparatus on sale in Belgium is referred to in a report for 1929 issued by the Commercial Secretary to the British Embassy, Brussels. Components of British manufacture have very little sale at present, and it is stated that no British receiver quite meets the needs of the Continental buyer. On the other hand, cheap German sets are abundant, together with inexpensive loud speakers. High-grade loud speakers of British make are in fair demand.



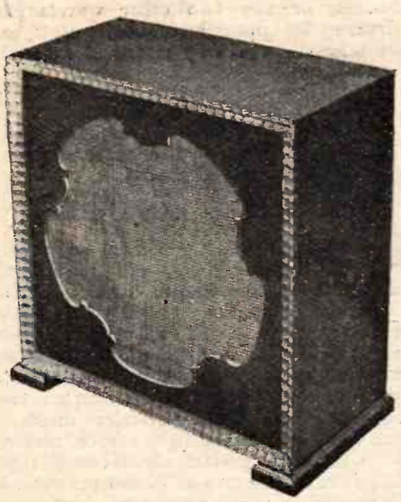
TELEARCHICS IN THE NAVY. A wireless-controlled motor boat which created a stir at Portsmouth during Navy Week. This photograph will recall to many readers the exploits of "The Wireless World" radio ship "Telearch I," described in our issue of October 27th, 1926.

LABORATORY TESTS.

New Apparatus Reviewed.

TWO NEW AMPLION LOUD SPEAKERS.

Type A.C.8.—Known as the Amplion Two-guinea Cone, this model displaces the older type A.C.4 Junior Cabinet Cone. It is of compact dimensions ($13\frac{1}{2} \times 12\frac{3}{4} \times 6\frac{5}{16}$in.) and simple design, and is available in standard oak finish. In spite of its small size the reproduction in the bass and lower middle register is excellent. Actually the highest output is between 300 and 400 cycles, but there is little diminution up to 1,500, after which the response continues at a lower level up to 4,000 cycles, and then falls away rapidly up to 6,000 cycles. The unit has the following impedance values at various frequencies under working conditions :—



Amplion Two Guinea Cone, Type A.C.8.

Frequency.	Impedance (ohms).
50	1,260
100	2,500
200	2,430
400	3,820
800	7,270
1,600	12,100
3,200	22,300
6,400	18,460

The sensitivity is above the average, and the A.C.8 is admirably suited for use in conjunction with simple two- or three-valve sets with, say, a 2-volt power or super-power valve in the last stage.

Type A.B.41 Senior Balanced Armature Cabinet Speaker.—Of similar construction to the type A.B.6 Standard Balanced armature speaker, the unit in this model is designed to handle still higher power. The unit is adjustable, and during the course of the tests handled 1,150 milliwatts at 100 cycles without overloading. This power was the highest measurable with the instruments available, but the indications were that considerably more power could be used if necessary.

Terminals are provided to give two ranges of impedance as follows :—

	Impedance (ohms).	
Frequency.	Low.	High.
50	547	2,260
100	926	3,490
200	1,430	5,430
400	2,560	9,200
800	4,180	15,700
1,600	7,000	29,500
3,200	12,100	52,900
6,400	10,700	—

The reproduction in the bass is excellent, and at 50 and 100 cycles is comparable to that of a moving coil. The output increases still further as the frequency is raised to 200 cycles, and then falls to the 100-cycle level at 500, and maintains this up to 1,500 cycles. At the latter frequency there is an appreciable drop, but the output continues at the new level without further diminution up to 6,000 cycles. The general effect is to give a low-pitched quality to speech, but the reproduction of music is satisfactory.

Amplion Senior balanced armature cabinet loud speaker, Type A.B.41.

The cabinet is of similar design to that used in the "Lion" range of loud speakers, and the price of the complete instrument is £5 15s. in oak and £6 6s. in mahogany.

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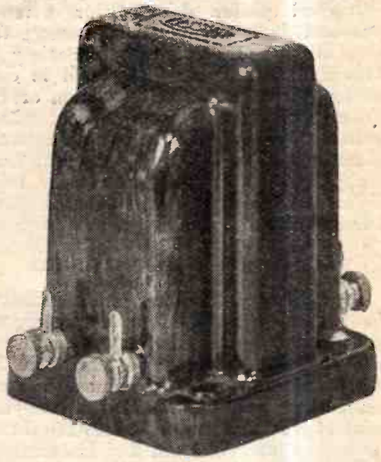
LISSEN "HYPERNIK" TRANSFORMER.

The core of this transformer is constructed from a new nickel-iron alloy, a feature of which is a high permeability, and as a consequence it has been possible to effect an all-round reduction in the size of the component. Its dimensions are 2in. $\times 2\frac{1}{4}$in. $\times 2\frac{3}{4}$in. In spite of its diminutive size, it has a ratio of 4 : 1, and shows a comparatively high primary inductance when passing small values of D.C.



Lissen "Hypernik" L.F. transformer with nickel-iron alloy core.

The inductance is affected considerably by the value of the steady D.C. flowing in the primary, and for best results it would be advisable to keep this as small as possible. The measured inductance of the primary at 50 cycles, and with different values of D.C. flowing, was found to be as follows :—

D.C. in mA.	Inductance in Henrys.	Superimposed A.C. in mA.
0	80.7	0.48
1	63.3	0.6
2	52	0.73
3	44	0.86
4	37.4	1.0
5	32.7	1.11

As the impedance of the primary at 50 cycles and with 2 mA. of D.C. flowing is of the order of 19,000 ohms, a suitable valve to precede the transformer would be one having an A.C. resistance not greater than 20,000 ohms. Little advantage will accrue by using a valve of lower A.C. resistance, as the anode current will rise, and this will result in a considerable reduction in the impedance of the primary. At 5 mA. the impedance is approximately 10,000 ohms at 50 cycles.

Since an inductance of 80.7 henrys is available when no D.C. is flowing in the primary, it would be worth while to use the resistance-capacity feed circuit, in which case the primary and secondary windings might be connected in series, thus forming an auto-transformer with a step-up ratio of 5 : 1.

The price of this component is 12s. 6d., and the makers are Lissen, Ltd., Lissenium Works, Worple Road, Isleworth, Middlesex.

KIT CONSTRUCTORS' NOTES

Next Season's Osram Music Magnet.

WE have just had an opportunity of examining the new four-valve Osram Music Magnet, which replaces the popular three-valve home constructor's set of the same name. The outstanding difference between the old and new receivers is that the latest model has two H.F. amplifying stages instead of one. In explanation of this sweeping change, the manufacturers state that the conventional H.F.-det.-L.F. set is insufficiently selective for present-day conditions if reception of distant stations is desired. They are probably right, and in any case a minimum of three tuned circuits—either as intervalve couplings or as parts of a filter—is now considered as almost essential for a receiver intended for long-range work.

In essentials, the circuit arrangement of the "Music Magnet Four" is as given in the accompanying diagram, from which such complications as wave-range switching and filament connections are omitted. Double-wound transformers are used as intervalve couplings, their medium- and long-wave sections being connected in series in the conventional manner, with a "shorting" switch in shunt. The aperiodic aerial-grid coil is similar.

A grid detector is followed by a single transformer-coupled L.F. stage; this part of the receiver is similar to the old model, but the reaction circuit is entirely changed by the substitution of a special system which employs a differential condenser with earthed rotor. An input volume control is in the form of a variable series aerial condenser, which also serves for adjusting selectivity to meet varying conditions. Single-knob control for tuning the three circuits is provided, the variable condensers being mounted as a single assembly; each unit is fitted with a built-in trimming plate, which is operated through a disc protruding through the screening case in which the assembly is housed. A friction gear for rotating the condensers is worked by a knob projecting through the side of the containing cabinet, which, incidentally, is supplied with the kit in parts ready for assembly.

Externally, the new set is rather similar to the old in appearance, but its front panel has been "cleaned up" by mounting most of the control knobs on the sides. Inter-circuit screening is provided by three pressed-metal covers which fit closely over trays in which each group of H.F. components is mounted.

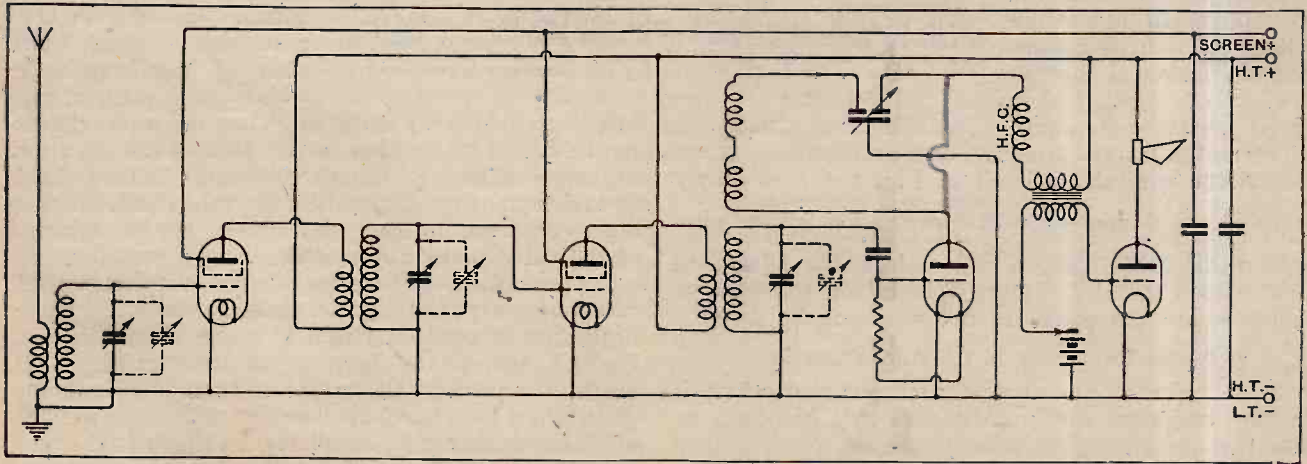
Direct Calibration for Easy Operation.

In addition to the normal 100-degree condenser scale, a dial strip is provided with the names of all the more popular stations printed on it, thus affording direct calibration when its position has once been determined after tuning the set to a known transmission.

Assembly and wiring would appear to be easy, particularly as the chart supplied is printed in such a way that the destinations of leads passing through the baseboard can be readily traced by holding the sheet against the light.

Anode current consumption is stated to be in the neighbourhood of 17 or 18 milliamperes; special batteries capable of sustaining this rather heavy load are being produced by the G.E.C., although ordinary cells of reasonable capacity would serve. It is pointed out that the receiver can be fed from an eliminator, and an examination of the circuit diagram suggests that this source of supply should be entirely satisfactory.

It is hoped that a detailed review of this most interesting set will shortly be published in this journal.



Simplified circuit diagram showing essential features of the new receiver. Trimming condensers are drawn in dotted lines.

WIRELESS THEORY SIMPLIFIED

By
S. O. PEARSON,
B.Sc., A.M.I.E.E.

(Continued from page 125 of previous issue.)

The Three-electrode Valve as a Voltage Amplifier.

IT has been explained that when a small alternating voltage V_g is applied to the grid of a three-electrode valve with the anode voltage and mean grid potential adjusted so that the valve operates on the straight parts of its characteristic curves its effect on the anode current is exactly the same as would be produced by an alternating E.M.F. of μV_g volts introduced into the anode circuit, with the grid maintained at constant potential. As before, the symbol μ stands for the amplification factor of the valve. We know also that the resistance offered to the alternating component only of the anode current is more or less constant, being the A.C. or differential resistance R_a of the valve.

Knowing these facts, we may look upon the anode circuit of a valve as being equivalent to a simple A.C. circuit provided we take into account only those constants and factors which apply to the *alternating* components of current and voltage in the anode circuit. The D.C. components in the actual valve circuit only play an indirect part; they merely serve to put the valve in the right condition so that it will respond in a suitable manner to any voltage variation at the grid.

Fig. 1 shows how the anode circuit of a valve with no external "load," that is to say, with no impedance connected externally to the valve, can be represented by a simple closed A.C. circuit consisting of a source of alternating voltage μV_g and a fixed resistance R_a ohms. The alternating component of current in the anode circuit, or the alternating current round the equivalent circuit of Fig. 1 (*b*), is simply equal to $\frac{\mu V_g}{R_a}$ amperes. This expression ignores altogether the D.C. components, and in the equivalent A.C. circuit the H.T.-battery voltage and space-charge effect within the valve are not represented.

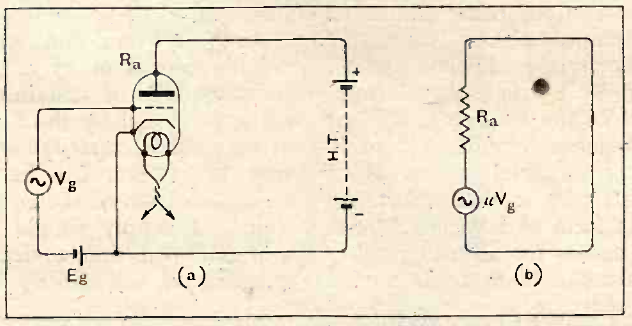


Fig. 1.—(a) A three-electrode valve with zero impedance in the external anode circuit and with a small alternating voltage V_g applied to the grid. (b) Simple circuit equivalent to the anode circuit in so far as the alternating components are concerned.

Series Impedance in the Anode Circuit.

But current in any part of a circuit where there is neither resistance nor impedance of any kind has no effect whatever—there is no generation of heat, and no potential difference is set up between its ends. Thus in the circuit of Fig. 1 (*a*) no effects other than the mere presence of the alternating component of current will exist in the external part of the anode circuit. Now, in an actual receiving circuit a valve is normally employed to fulfil one of three different functions, namely, (*a*) to act as an amplifier or intensifier of electrical voltage variations, passing the amplified variations on to the grid circuit of a succeeding valve, which itself may be performing the same function or either of the other two; (*b*) to act as a detector or rectifier of high-frequency variations; or (*c*) to operate a loud speaker or other electro-mechanical device. To effect any one of these three actions it is necessary that the alternating voltage applied to the grid of the valve shall cause a corresponding variation of the voltage across some part of the anode circuit external to the valve. This means that under operating conditions an impedance of some kind must be connected in series with the anode circuit, and the nature of this impedance depends on the function which the valve is to perform.

So far we have considered the behaviour of the valve under conditions where the anode potential is maintained constant. But when an impedance is connected between the H.T. battery and the anode any change in anode current will cause a change in potential difference between the ends of this impedance, with a consequent change in voltage at the anode itself. Thus the static characteristic curves which have been explained will not apply to the valve under working conditions; but they enable us to determine the constants of the valve, and, knowing these constants, we can predetermine the performance of the valve under any new but known conditions.

Suppose, then, that we consider the simplest possible case where a pure resistance (inductance and capacity negligible) is connected in the anode circuit between the H.T. battery and the plate, as shown in Fig. 2 (*a*), where R represents the added resistance. Our immediate object is to find how the voltage between the ends of this resistance vary as the grid voltage is changed.

If I_a denotes the value of the current in amperes

Wireless Theory Simplified.—
round the anode circuit for some particular value of grid voltage, the potential difference between P and Q will be, by Ohm's Law, $E_r = I_aR$ volts, and if E denotes the voltage of the H.T. battery it is clear that the actual potential of the anode relative to the cathode will be $E - I_aR$ volts, because P is at a lower potential than Q. The fall of potential I_aR in the series resistance is commonly referred to as the "voltage drop" across the resistance or in the resistance.

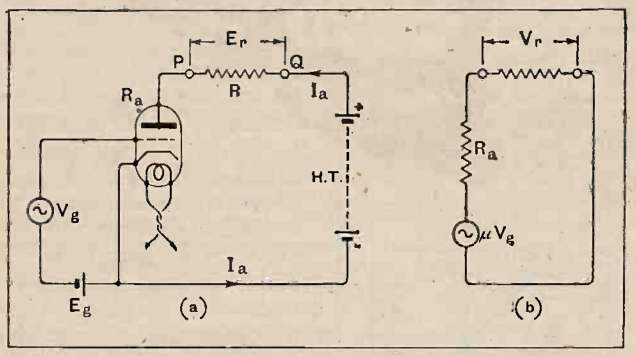


Fig. 2.—(a) A three-electrode valve with a resistance R in the anode circuit. The voltage E_r developed across R is proportional to the anode current. (b) Equivalent circuit relating to the A.C. components in the anode circuit when the grid voltage has an alternating component. V_r is the A.C. component of voltage developed across R. Voltage amplification $n = \frac{V_r}{V_g} = \frac{\mu R}{R+R_a}$.

On changing the grid voltage slightly the value of I_a will change in response, thereby causing the voltage drop across the resistance R to alter, with consequent change of anode potential. Obviously, then, the inclusion of the series resistance has converted what was a constant quantity in the circuit of Fig. 1 (*a*) into a variable one, namely, the anode voltage; so now we have both the anode voltage and the anode current dependent on the grid voltage. A change in grid voltage towards a more positive value causes a rise in anode current and at the same time a fall in anode potential, which partly offsets the change of anode current; in other words, the rise of anode current is less than it would be if the series resistance R were not present.

Although, as will be shown later, the variation of voltage across the resistance R can be expressed in terms of the grid voltage variation, the constants of the valve (amplification factor and A.C. resistance) and the value of R itself, it is instructive to draw a set of static grid voltage/anode current curves for the valve, with different values of resistance connected in the anode circuit. Such curves can either be measured experimentally or deduced from the grid voltage/anode current and the anode voltage/anode current characteristic curves of the valve.

In Fig. 3 the grid voltage/anode current curves are given for the same valve as considered previously, but with different values of fixed resistance connected in the anode circuit, as indicated on the curves themselves. The curves are those corresponding to a constant high-tension battery voltage of 200, so that the upper curve with zero resistance in the external circuit is the same as that of Fig. 4 on p. 109, July 30th issue, being the normal anode characteristic curve of the valve for a fixed plate voltage of 200. The A.C. resistance of the valve was found to be about 13,400 ohms, and the two lower curves of Fig. 3 give the anode currents for external resistances equal to the A.C. resistance of the valve and three times this figure respectively.

The Dynamic Characteristic.

These curves provide us with important information regarding the action of the valve under operating conditions. In the first place, the insertion of resistance results in a reduction of the anode current for any given value of grid voltage, this effect naturally being expected because the voltage at the anode is less than that of the H.T. battery by the amount necessary to drive the current through the added resistance. Secondly, *all the curves reach the zero line at the same negative value of grid voltage*. This must be so because when the grid voltage is sufficiently negative to make the plate current zero there is no current in the resistance R and therefore no voltage drop associated with it, so that the full H.T. voltage exists at the anode. This is a very important point, because it means that the negative grid bias required to operate the valve just above the bend of the particular curve in use is the same for all values of added resistance in the anode circuit. The necessary grid bias is determined alone by the voltage of the H.T. battery or battery eliminator (except when a decoupling resistance and condenser are provided).

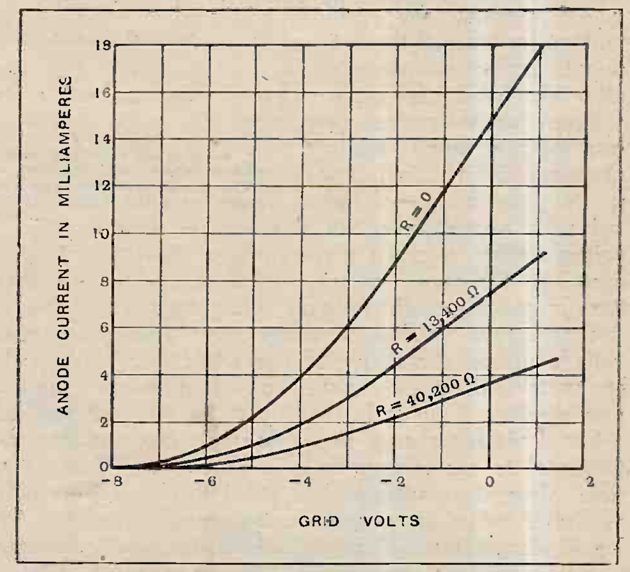


Fig. 3.—Curves showing how resistance inserted in the anode circuit affects the anode current of a valve. The A.C. resistance of the valve is 13,400 ohms and its amplification factor 36. The curves correspond to 200 volts H.T. supply throughout. The numbers attached to the curves indicate the resistance connected in the anode circuit.

It is also evident that the greater the value of the series resistance in the anode circuit the less steep becomes the anode current curve and, further, that the bend in the curve becomes less pronounced; the adding of resistance has a straightening effect on the curve.

Wireless Theory Simplified.—

Numerical Example.

As explained above, the anode voltage is given by $E - I_a R$ where E is the H.T. battery voltage and I_a the anode current in amperes. Now, in the particular case under consideration $E = 200$ volts and we have chosen two different values of anode series resistance, namely, $R = 13{,}400$ and $R = 40{,}200$ ohms respectively. Thus, taking one of these at a time and reading off from the appropriate curve of Fig. 3 the values of anode current for different values of grid voltage we can calculate the actual voltage at the anode for corresponding values of grid voltage. For instance, with 13,400 ohms in the anode circuit and -2 volts on the grid the anode current (from the middle curve) is 4.4 milliamps, or 0.0044 amp. The voltage drop across the anode resistance is therefore $0.0044 \times 13{,}400 = 59$ volts approximately. The actual voltage at the anode is thus $200 - 59 = 141$ volts. By repeating this process for different values of grid voltage and plotting the anode voltages thus obtained against the grid voltage for each of the two anode resistances we obtain the curves of Fig. 4.

From these curves we can obtain some really practical information regarding the action of the valve as an amplifier of voltages when a given non-inductive resistance is connected in the anode circuit. First of all, we see that the curves are straight for grid voltages ranging between -3 and zero, the same range over which the grid voltage/anode characteristic curve for the valve with 200 volts on the plate was seen to be moderately straight. The significant point is that over the straight part of either curve *the change in anode voltage is exactly proportional to the change in grid potential.* Thus, if a small alternating voltage is applied to the grid so that the latter varies about some mean value determined by a grid-bias battery, E_g in Fig. 2 (*a*), *the anode voltage will vary in exact accordance with the variations at the grid.* Since the potential of the positive terminal of the H.T. battery in Fig. 2 (*a*) is constant, it follows that the variations of voltage at the anode of the valve are equal to the variations of voltage between the ends of the resistance R, that is, between the points P and G.

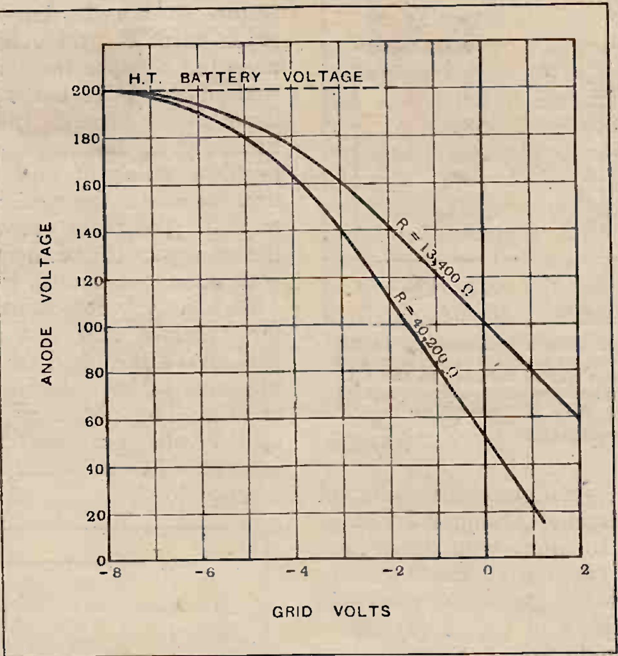


Fig. 4.—Curves showing how the anode voltage varies with grid voltage when two different values of resistance are connected in the anode circuit. The variation of anode voltage for 1 volt change of grid voltage gives the actual voltage amplification obtained.

Actual Voltage Amplification.

From Fig. 4 it will be seen that a change of one volt in grid potential produces a change of 18 or 20 volts in anode voltage with 13,400 ohms in circuit and 28 or 30 volts with 40,200 ohms. Thus if an alternating voltage whose R.M.S. value is one volt is applied to the grid of the valve the voltage across the resistance R will have an alternating component roughly 20 times or 30 times as great respectively. These figures give the actual voltage amplification obtained with the corresponding anode resistances in circuit and provided the valve is operated over the straight portions of its characteristic curves. This amplified voltage variation can be passed on to the grid circuit of a succeeding valve for further amplification if necessary.

It is evident from the relative slopes of the straight parts of the two curves of Fig. 4 that with the higher anode resistance the actual voltage amplification is greater. It will be remembered that the *amplification* factor of the valve was found to be about 36, and now we see from our graphical consideration that the actual voltage amplification is somewhat less than this, but approaches closer to it as the added anode resistance is increased in value. With no anode resistance in circuit there is no voltage amplification at all, because there is no voltage variation produced in any part of the anode circuit.

The voltage amplification obtained with a given valve and anode resistance can be simply calculated in terms of the valve constants and the value of the anode resistance. The formula is most easily obtained from a simple circuit equivalent to the anode circuit of Fig. 2 (*a*), as shown at (*b*) in the same figure, where R_a represents the A.C. resistance of the valve and R the added resistance. The equivalent circuit at (*b*) is that which applies to the alternating components only of the current and voltages, as in the case of Fig. 1. If V_g is the alternating voltage applied to the grid of the valve an equivalent voltage μV_g is brought into action in the anode circuit. This in turn produces an alternating component of current equal to $\mu V_g / R + R_a$ amperes (by Ohm's Law) in the anode circuit or round the equivalent A.C. circuit. This alternating current flowing through the resistance R sets up between its ends an alternating component of voltage equal to the product of current and resistance, being therefore $V_r = \frac{\mu V_g}{R + R_a} \times R = \mu V_g \frac{R}{R + R_a}$ volts. The actual voltage amplification n obtained is the ratio $\frac{V_r}{V_g}$, or $n = \mu \frac{R}{R + R_a}$ times.

(*To be continued.*)

BROADCAST BREVITIES

By Our Special Correspondent.

Summer Programme Difficulties.—" Proms " Broadcast Nightly.—Interference by Amateur Transmitters?

"Proms" to the Rescue.

The holiday hush is very noticeable at Savoy Hill just now. Half the familiar faces are missing, and the other half are so buried in extra work that the news-seeker hesitates to rush in where angels fear to tread.

Probably the greatest strain is being felt in the Programmes Department, but a blessed relief is at hand in the shape of the Promenade Concerts, which fill up many yawning gaps.

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A Nightly Feature.

During the present month listeners can tune in a Promenade Concert every night, either the National or the Regional transmitters being linked up with the Queen's Hall at every concert. I wonder whether this fact will be appreciated by the majority of listeners? Time was when two "Proms" a week was the maximum that the indulgent authorities were inclined to bestow on the vulgar multitude outside the hall.

oooo

Stabilising the B.B.C. Symphony Orchestra.

No permanent conductor has yet been appointed by the B.B.C. to direct its season of symphony concerts which opens at the Queen's Hall on October 22nd, but it is expected that the concerts will be arranged in series of two or three under the same baton, instead of having a change of conductor at each concert. This will enable the orchestra to become "stabilised" under a few of the greatest conductors of our time.

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A Hopeful Chorus.

Rumours that the proposed Probationary National Chorus will never materialise are strongly denied at Savoy Hill. Indeed, I hear that the autumn will see this aspiring body well on its feet—probably on tiptoe. Each of its 100 members will serve in the joyful hope of a summons to join the regular National Chorus.

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Interference by Amateur Transmitters?

The complaint of certain listeners in the West of England that their reception is being interfered with by amateur transmitters is distressing in one sense, but it is also a striking reminder of the rarity of such complaints. Transmitters as a body are very jealous of their privileges, and are not inclined to jeopardise the rights conferred on them by the P.M.G.

oooo

Not Proven.

Bristol is the district in which the offences are said to occur, and certain transmitters there are accused of using the ether during broadcasting hours for the purpose of boosting their radio wares. But the case is not proven, and I continue to hope that the charges are unfounded.

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"Say I'm Out."

As a class, wireless "pirates" are fairly resourceful when confronting the magistrates; not often, however, does one come across such sheer audacity as that of a Yeovil listener who was recently fined for operating his set without a licence. After inveighing against the Post Office for their methods of detection, he declared that listeners should be informed as to the date on which the P.O. men intend to call.

oooo

A Relay from Ostend.

Two artistes who are famous on the Continent will be heard in the symphony concert to be relayed to British listeners from the Kursaal, Ostend, on Sunday next, August 17th. The vocalist is Marcel Journet, of the Paris Opera and La Scala, Milan, and the solo violinist is Henry Gadeyne.

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"Ingredient X."

Probably one of the finest examples of microphone technique was "Ingredient X," by L. du Garde Peach, a "thriller" which was written specially for broadcasting, and first produced in a London studio a year ago. It is to be heard again by National listeners on September 9th, and by London Regional listeners on September 8th.

The story concerns a new Synthetic Rubber Company, whose fortunes depend upon a mysterious ingredient known as "X," and the changing scenes, from the board-room of the company's London offices, to a Mayfair mansion, to African forests and the deck of a tramp steamer, are amazingly realistic. On several occasions since the first broadcast listeners have asked for repeat performances.

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A False Impression.

An article in the provincial Press recently drew attention to the immense sum which the B.B.C. are putting down for the purchase of "Broadcasting House." Readers of *The Wireless World* will shed no tears on behalf of the broadcasting authorities, being already aware that house purchase will cost the B.B.C. exactly nothing.

oooo

B.B.C. as Tenants.

"Broadcasting House" will remain the property of the syndicate which is building it, and the B.B.C. will pay rent for the new premises just as they now pay the Duchy of Lancaster in respect of their tenancy of Savoy Hill.

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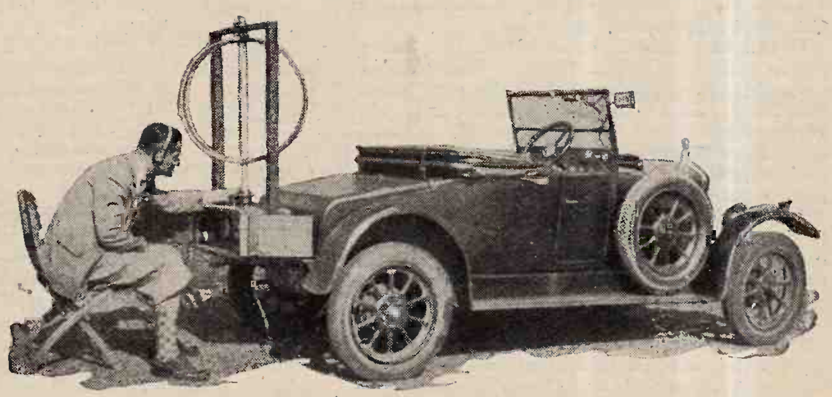
An Unlikely Event.

What would happen if the B.B.C. moved out of "Broadcasting House"? No doubt the owners are not overlooking such a possibility, however remote it may seem, and are wondering what other uses could be found for a building designed on the principle of a thermos flask. Although in outward appearance the structure will resemble several of London's new "modern" buildings, its interior will be, to say the least, peculiar. The sound-insulated central tower might provide a silent retreat for jaded listeners.



CAR WIRELESS FOR FIELD-DAYS. Mr. Maurice Child's D.F. receiver mounted on his car at a recent field-day held in Epping Forest by the Golders Green and Hendon Radio Society in conjunction with societies from Muswell Hill, North Middlesex and other London districts. The receiver incorporates a screened grid H.F. stage.

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, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

EMPIRE BROADCASTING.

Sir,—Mr. McInnes, in his letter in your issue of July 9th, has rather unkindly segregated from its context one phrase in my letter. The question arose out of the proposal that the "Empire" short-wave station should not be financed out of the funds provided by licence payers in Great Britain. In other words, the idea is that such a station, the desirability of which is admitted, should be paid for directly or indirectly by Overseas listeners.

Now I, as a resident abroad, disagree with this, and what my letter was intended to convey was that licence payers at home already get, in the shape of P.C.J., Zeesen, etc., a *quid pro quo* for anything they may contribute towards the cost of G5SW. If, on the other hand, we abroad are to support the "Empire" station, then the home listeners will be getting something for nothing. Perhaps I can make my contention clear by stating the case in another way. If a Britisher resident in Germany or Kenya, say, is to subscribe to G5SW as well as pay for his local licence or subscription to Zeesen or 7LO respectively, what will then be the relative position of the listener at home who "reaches out" to those stations? One would have expected that instead of the niggardly objections raised against the outlay of something less than £50,000 on an Empire station, English listeners would have desired to see Great Britain ahead of other nations, instead of behind the times, especially as it is not intended to increase the price of the licence. Captain Ian Fraser's recent letter to *The Times* expressed the case very clearly, except for this point of the desirability of Great Britain having a short-wave station without asking someone else to pay for it. Personally I pay both a Spanish licence and an English licence, so my conscience is clear either way.

G. L. BOAG.

Aguilas, Spain.

SALESMANSHIP.

Sir,—I observe in your issue of July 23rd that one of your correspondents writes: "The man who knows little or nothing about wireless is the best salesman for the general public." I am of opinion that the exact opposite is the case, namely, that the best salesman is he who knows his subject best.

Hindhead. ARTHUR HOARE.

BROADCAST PROPAGANDA.

Sir,—Mr. Bertram Munn's bombshell in your issue of July 30th made my cone chatter like the deuce. But then I remember Mr. Munn is a supporter of the exponential, and he will be glad.

His Vitaline miniature is too awful to contemplate. He accuses the B.B.C. of soporific programmes, and imagines that Vitaline and Co. are going to put out such a lively programme that their nightcap will not work.

It can be assumed, nevertheless, that the sponsors will set out to please the largest public. That means that, with slight variations, the programmes will be very much of a muchness. Now as a rule I hate great pianists, lady warblers and farmyard imitators, but I see no earthly reason why those who enjoy them should not be pleased occasionally. If Vitaline and Co. included my pet aversions I would rather eat a condenser than choke on their products.

Let us bring Guinness back to the subject. Let us assume he broadcasts chamber music because it is good for us; will not the majority of listeners switch over to Bass because they prefer it? Bass is probably vaudevilling.

And what will Guinness get out of that? Not much—he would vaudeville also.

If we are to maintain programmes that please everybody some time, and not those that please somebody all the time, then we must exclude advertisers altogether.

I heartily agree with Mr. Munn, however (cheers!) when he says that the B.B.C. need more money. Incidentally I disagree with you, sir, on the same point For proof we have N. Ginea's letter in the same issue, where he remarks on our so-called alternative programmes. They certainly are a farce; indeed they are not much to boast about anyway. But more money *must* come from the P.M.G., and from a source I shall indicate presently. The best method of economising is by relaying—I think an unnecessary amount of fuss is made about this. Admitted that certain relays are entirely spoilt, from the quality point of view, by fading, atmospherics, land-line loss, land-line noises and by other causes, but they should be overcome; they ought to be overcome. It is up to the B.B.C.

As regards the Empire transmitter, the members of the Home Country must pay for its upkeep—for their own benefit. That the Empire Marketing Board should bear part of the cost is an excellent suggestion. It might be a good thing to introduce sponsored programmes here—later on, when the station is in full and continuous working order. But in the meantime it is vital to acquire a certain amount of "caste."

When the regional scheme is completed there should be a larger amount of money available for programmes, and an additional amount from the large number of new listeners that may confidently be anticipated. Of course a lot of money will have to be put by for some new scheme, while the race for "power" will draw considerable quantities. Let us hope we have the courage to ignore it.

Would that I had the courage to ignore Mr. Munn's letter!

But no! I think of the lonely bachelor returning to his humble flat and baked beans; I think of the criminal confined to bread and water; I think of the shipwrecked and the vegetarian by compulsion; all listening! And then I think of the announcer and the artists preparing to go home to their seven-course dinners.

They sing of Epicurean delights,, and then the announcer arises. He quotes portions of Charles Lamb's famous essay on Roast Pig—"and just as it was then so it is to-day." He portrays vividly the glories of the Pig and Pig Co.'s Pork, done nicely to a turn. . . .

Suddenly he stops—the criminal has escaped.

Mr. Munn's exponential will do nicely for a coffin.

Shortlands, Kent. HUGH A. RAMPTON.

Sir,—May I quote a paragraph, for the benefit of Mr. Munn, from the inaugural address of Dr. Lee de Forest, president of the Institute of Radio Engineers, delivered at New York on January 8th last:—

"As the so-called 'Father of Radio Broadcasting,' I wish again to raise my voice in most earnest protest against this revolting state of affairs (advertising over the air). The present all too marked tendency of the broadcast chains and of many individual stations to lower their bars to the greed of direct advertising will rapidly work to sap the lifeblood and destroy the greatest usefulness of this magnificent new means of contact which we engineers have so laboriously toiled to upbuild and to perfect. If this stupid venality is not suppressed, if this reptile of ætheric advertising is not scotched, we may well resign ourselves to a rapid decadence of a noble institution. Frankly, and in all seriousness, I attribute a part of the present undeniable slackening in radio sales to the public as actually due to this one cause. The radio public is, I believe, becoming nauseated by the quality of many of the present programmes. Shortsighted greed of the broadcasters, station owners and advertising agencies, is slowly killing the broadcast goose—layer of many golden eggs. . . . We should, I maintain, take active steps (in Washington if need be) to rid ourselves of this stupid, this killing avarice, which is destroying the most splendid and potent means for entertainment, culture, and education which mankind has yet devised."

In view of these weighty words we can, as a nation, indeed be proud of our British Broadcasting Corporation, and grateful in the fullest degree to those farsighted men who ordained that advertising should never be allowed.

Dorking. E. T. SOMERSET.

READERS' PROBLEMS.

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Negligible Voltage Loss.

In calculating values for voltage-absorbing resistances in an eliminator, is it necessary to take into account the losses due to the presence of H.F. choke in the anode circuits of high-frequency amplifying valves?
J. H. P.

D.C. voltage losses in H.F. chokes can almost always be ignored. Taking your own case, it can be assumed that an H.F. valve is most unlikely to pass much more than 3 mA. in its anode circuit, while the choke resistance will certainly not be in excess of 500 ohms. Working on these figures, we see that the loss amounts only to 1.5 volt.

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Series for Safety.

Although I realise that a series connection would be more economical, I find it convenient to run the filaments of my H.F.-det.-L.F. three-valve set in parallel from my 100-volt house-lighting battery. The arrangement works quite satisfactorily, but I am told that it would be much safer to join the filaments in series. Will you please say if this is correct, and, if possible, give a simple explanation as to why the parallel connection is likely to be dangerous?
E. C. M.

If we can assume that your filament circuit is arranged in the conventional way, with a single resistance for "breaking down" the supply voltage to that at which the valves are rated, it is true to say that the series method of connection is much safer than the alternative parallel scheme.

The danger of damaging parallel valves when connected in this way to a high-voltage source of filament current supply is made obvious by applying Ohms Law to a circuit such as that shown in Fig. 1, which represents what we presume to be your own existing arrangement. We will imagine that you are using two-volt valves, V_1 consuming 0.15 amp., V_2 0.1 amp., and V_3 0.25 amp., totalling 0.5 amp.

Under normal conditions the resistance across the battery input comprises R, which must be of 196 ohms, plus the parallel filaments, which have an effective value of 4 ohms, equal in all to 200 ohms.

Now imagine that the filament of V_3 is broken, or even that this valve is merely removed from its socket. Effective resistance of the filament circuit now rises to 8 ohms, but R remains constant at 196 ohms, giving a total of 204 ohms.

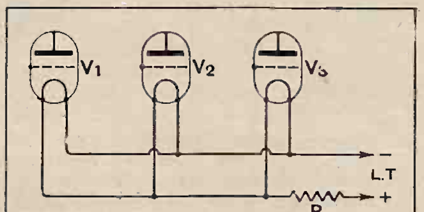

Fig. 1.—Illustrating the danger of over-running filaments when they are connected in parallel across a high-voltage source of supply.

The 100-volt battery will now drive a current of $\frac{100}{204}=0.49$ amp. through the remaining filaments; this is nearly 100 per cent. in excess of their combined rated consumption of 0.25 amp., and so serious damage will be done to them.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(3.) *Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(4.) *Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given: under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(5.) *Practical wiring plans cannot be supplied or considered.*

(6.) *Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.*

(7.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.*

Output Transformer Alterations.

I have been using a pair of parallel output valves in conjunction with a low-resistance moving-coil loud speaker, which, of course, is coupled by a step-down transformer. I am now thinking of changing over to the push-pull method of amplification, and should like to know if it will be possible still to use the existing output transformer if I add a centre tap to its primary winding. It seems that it should be quite an easy matter to do this, as the primary is wound in two sections, and the junction between them is easily accessible when the metal shroud is removed.
C. R. L.

We take it that you propose to use your existing output valves in the push-pull amplifier, and if this is so we fear that your present transformer will no longer serve, even if it is modified in the way suggested. As compared with your present arrangement, the anode circuit impedance of the push-pull amplifier will be four times greater, and so the load imposed by the transformer primary is unlikely to be adequate.

We make this statement, of course, on the assumption that the transformer is at present properly matched to the output anode circuit; if it so happens that its impedance is unnecessarily high, there is a possibility that your scheme would work quite well, and it would perhaps be worth while to try it.

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Calculating Condenser Reactance.

In choosing resistance and capacity values for "decoupling" purposes, I believe it is essential that the by-pass condenser should have a very low reactance (over the band of frequencies to be dealt with) when compared with the value of its associated feed resistance. Will you please tell me how the reactance of a given condenser may be ascertained?
L. J. R.

The reactance of a condenser (in ohms) is given by the formula:

$$\frac{10^6}{2\pi fc}$$

where f is frequency in cycles per second and c is capacity of the condenser in microfarads.

Double-humped Tuning.

I have just completed the construction of a four-valve 1-v-2 receiver with a capacity-coupled aerial input filter (of which both tuning condensers are ganged), and with a separate control for tuning the H.F. inter-valve coupling. Great care has been taken in adjusting the filter, and I believe that it is working correctly, but I am puzzled by the operation of the H.F. tuning condenser. When the combined input circuits are accurately tuned to a transmission, it seems that there are two distinct points, separated by two or three degrees, on the H.F. tuning dial, which give maximum signals. Is there a simple explanation for this puzzling effect, and does it indicate any fault in the apparatus? A. C.

An effect of this sort is by no means uncommon, and if the separation between the tuning peaks of the intervalve circuit is not unduly great, we do not think there is any reason to suspect that your filter is not working properly.

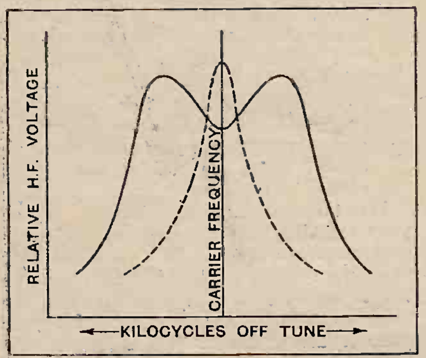

Fig. 2.—Resonance curves of a filter and of a single-circuit intervalve coupling.

What is taking place is indicated in Fig. 2, in which the tuning curve of the combined filter circuits is shown by a full line, while that of the H.F. coupling is shown by a dotted line. When the latter circuit is adjusted to a frequency corresponding with either of the two resonant points of the filter, it is natural that signals would be at a maximum. The correct procedure is to tune midway between these points.

Of course, there exists the possibility that the peaks of your filter tuning curve are too widely separated, and it would be worth while trying the experiment of loosening the coupling between its individual circuits by connecting an extra capacity across the existing mutual condenser.

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Galvanometer Tests.

I have just bought an ex-Government "detector galvanometer." Is this instrument suitable for use in testing fixed condensers, and, if so, how should it be used? T. P. R.

A fairly sensitive galvanometer of this kind, used in conjunction with a battery of sufficient voltage to give a full scale deflection, is a useful aid in testing the insulation of fixed condensers. It is merely connected (in series with a battery, of course) across the terminals of the component under suspicion, when any leakage will be indicated by a deflection of the needle. It should be emphasised that the needle will generally move when the testing circuit is first completed; this movement is due to the flow of charging current, and will be most pronounced when dealing with large capacities.

After having made the first test, an additional check may be obtained by joining the condenser directly across the galvanometer terminals; if the charge has been retained (due to good insulation) another flicker of the needle will be produced. This effect will only take place when dealing with capacities in the order of microfarads.

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More Economical Power Grid Detection.

By using a choke in place of a resistance in the anode circuit of a power grid detector coupled to a succeeding L.F. amplifier by a parallel-fed transformer, it should be possible to operate a rectifier of this kind from a fairly normal source of H.T. voltage, as the heavy potential drop which normally occurs in a feed resistance would not take place. This matter has been touched upon in your pages, but no practical details have been given; is it likely that information on the subject will be published in the near future? W. D. M.

The question of using choke feed for the detector-L.F. intervalve coupling transformer is not quite as simple as would first appear, but the scheme has obvious attractions, as it would allow advantage to be taken of the benefits of power grid detection in cases where unusually high anode voltages cannot conveniently be obtained. Incidentally, the same applies to the use of directly connected L.F. transformers, specially designed for carrying a heavy primary current, which are now being produced commercially.

It is hoped that the subject will be treated at length in the near future.

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The "Wireless World Five" Up to Date.

My receiver is the "Wireless World Five," as described in January, 1927. In spite of its relative antiquity, this set gives an excellent performance, even when judged by modern standards, but I should like, if possible, to replace the existing battery valves with those of the indirectly heated A.C. type. Do you consider that it would be possible to do so successfully? I can hardly expect you to go to the length of giving detailed suggestions for this conversion, but any hints would be welcomed. L. D. H.

We ourselves have not attempted to modify this receiver for use with modern valves, but with great care it should be possible to do so. After having made the obvious modifications to filament-cathode circuits, we advise that you should next remove two or three turns from each of the transformer primary windings.

It would certainly be wise to insert decoupling resistances and condensers in each anode feed lead, and, in addition, we strongly recommend you to omit one of the existing L.F. stages. There is no reason why a pentode should not be used as an output valve.

In the event of H.F. instability it may be found necessary to remove an even greater number of primary turns than suggested above; in any case, the neutralising winding must be reduced to the same extent as the primary.

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Long-Wave Inductances.

I have a quantity of No. 30 gauge enamelled wire, and, if possible, should like to use it for making section-wound coils for the long wave band. The windings would be carried in slots cut in ribbed ebonite formers. Would you advise me to use this wire? H. D. B.

Enamelled wire is not usually specified for windings of this sort, because there is a very real risk of introducing short circuits between adjacent turns. Double silk-covered wire is generally recommended.

FOREIGN BROADCAST GUIDE.

MADRID (EAJ 7)

(Spain).

Geographical Position: 40° 25′ N. 3° 43′ W.
Approximate air line from London: 800 miles.

Wavelength: 424 m. Frequency: 707 kc. Power: 2 kW.

Time: Greenwich Mean Time.

Standard Daily Transmissions.

14.00 B.S.T. orchestra; 18.15 dance music; 20.15 news, concert; 22.15 main evening programme; 24.00 dance music, concert, opera or relay of dramatic performance. Transmissions are frequently extended to 00.30 and 01.00.

Time signal and chimes from the Home Office Buildings at 13.00, 19.00 and 23.00.

At irregular dates relays of programmes are taken from Barcelona (EAJ 1) and also from foreign stations.

Male announcer only. Call: EAJ 7 (phonetic: *Ay-ah-rhota-see-ett-ay*) *Union Radio Madrid*. Transmissions open with the playing on a piano of Siegfried's Bugle call (Wagner), as under:

Closes down with usual Spanish formula: *Buenas Noches Senores, hasta manana,* followed by the National Anthem.

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is:

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on THURSDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on WEDNESDAY MORNING at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 260, Deansgate, Manchester; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

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For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. 000, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors.—Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

MARCONIPHONE 8-valve Type 81 Receiver, with brand new Magnavox Xcore moving coil speaker; £12 the lot, bargain.—Thompson, Cranmere, Tavistock. [1182

BEL-CANTO Outfit, complete H.T. and L.T. generator, 220 volt input, amplifier, twin turntables, 2 loud-speakers and accumulators, splendid condition; £70, or offer.—Mile End Cinema, 44, Mile End Rd., E. [1184

MARCONI All-power Unit, A.C.1, perfect condition; would accept £4/10, or good vest pocket camera.—Box 7034, c/o *The Wireless World.* [1161

Receivers for Sale.—Contd.

APPLEBY'S.

WHERE Radio Part Exchange Began; a service under the patronage of notabilities and men of consequence all over the world which has accurately handled the requisitions of over 25,000 people, 84% of whom have repeated their first transaction.

THE Service is as Follows: We can supply practically all the leading lines of radio apparatus on the market at current list prices; if so desired we can accept in part exchange the reputable makes of the following apparatus: Receivers (domestic and portable), radio-gramophones, loud-speakers (cone and moving coil), cone units and chassis, battery eliminators and mains equipment components, battery chargers, remote control equipment, pick-ups and carrier arms, electric gramophone motors, H.F., L.F., and power chokes, condensers (variable, reaction, by-pass and smoothing), measuring instruments (high grade), L.F. transformers, slow motion dials (high grade), modern miscellaneous components; valves and tuning coils cannot be accepted in part exchange except by special arrangement

IN View of the Difficulty of Making Fair and Definite Offers for Material that we have not inspected, it is requested that apparatus tendered for part exchange be kindly forwarded to us for valuation; no business can be proceeded with in connection with part exchange until material tendered has been examined; in this connection there need be no fear, material is sent to us from all over the world, not a single item of customers' property has ever been lost or mislaid; rejected offers from Xmas last amount to only 3.

IN Order to Furnish a Guide, the part exchange allowance may be gauged as approximately 50% of the list price of the article or articles tendered; for some articles the allowance will be more, and for others somewhat less; the allowance is entirely determined by the demand for individual articles, considering also their condition and production age; amateur constructed receivers cannot be accepted in part exchange as receivers, their value lying wholly in the components contained in them; only modern apparatus in good condition is accepted in part exchange; material cannot be purchased by us for cash.

TERMS of Part Exchange Business: A minimum of 50% of the value of an order, plus carriage charge where due, is payable in cash, unless the value is below £1, when a minimum of 10s. is payable; should the part exchange allowance exceed 50% of the total value of new requirements, the difference will be credited against future orders; material may be deposited against a credit note, which may be utilised at a later date; the maximum amount allowed to stand to the credit of any one individual is £200.

THESE Terms Have Been Made to the Lowest Economic Minimum, to give the customer the best value possible, while enabling us to maintain the standard required of this business.

SPECIAL Notice is drawn to the fact that by stipulating a minimum of 50% cash payable on part exchange orders, which is the same as stating that the part exchange allowance is credited to an order for not less than twice the allowance, you are ensured always of the best offer, as obviously the more we allow you the more you ultimately spend with us, to utilise your credit, if for no other reason; note also the facility of depositing material against a credit note, it can be drawn upon as required, wherever you may be; credit notes worth many thousands of pounds have been duly honoured upon presentation; a credit note on Appleby's is saleable, should the necessity arise, providing notice of transference is lodged with us at the time of sale.

AS Soon as Apparatus is Discarded from Use, dispose of it, don't keep it; it is not only wasteful, but expensive; the longer you keep it the older it is, and the older it is the less value it is; exchange it for a part exchange credit note, the value of which is constant, and can be disposed of if necessary by the holder with greater ease and facility than an article or collection of articles can ever be.

YOU Will Do Well to Deal with Appleby's; there is more in part exchange than the mere allowance; there is that something which begets confidence, that care that makes for efficiency; in the recent words of an old customer: Quite an embarrassing aloofness of purpose and an almost monotonous accuracy; you will know that it is all British—British capital and British behaviour; you will know also by dealing there that you are helping to employ British people.

SINCE the Day This Service Started it has Steadily Grown, not on rash advertising or subscribed capital, but on the volume of attainment only; and in these days businesses do not grow by that means for nothing, therefore we are privileged to invite you to utilise this service, wherever you may live; if you send your material by a carrier, pack it well, carriers are only human, and it is better to be safe than sorry; if you live in London, call to see us, you will like the atmosphere, it savours more of sport and art than the searing curriculum of commerce.

APPLEBY'S, Chapel St., St. Marylebone, London (opposite Edgware Rd. Metropolitan Station, or 4 minutes from Marble Arch, Oxford St.). Tel.: Paddington 8828 (3 lines). [0340

FELLOWS 4-valve Pedestal Set, complete installation, marvellous tone, cost £16, as new, £8; also £6 kit parts for super 2-valve short wave experimental receiver, with valves, coils, etc., bargain £4/10.—72, Holmewood Gardens, S.W.2. [1166

Receivers for Sale.—Contd.

McMICHAEL Transportable, as new, fitted ultra-chrome speaker, really first class receiver; private owner; 20 guineas.—Box 7035, c/o *The Wireless World*. [1162

BERCLIF D.C.2 All Mains Receiver, 200 to 250 volts D.C.; price £14/10; with valves and royalties, suitable for M.C. speaker; particulars free; trade inquiries specially invited.—Simmonds Bros., Shireland Rd., Smethwick. [8734

YOUR Old Receiver or Components Taken in Part Exchange for New; write to us before purchasing elsewhere, and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

2-VALVE Set, very selective, 200-2,000 metres, complete with Osram valves; cost £10, sell £3; brand new.—Priestley, 8, Grosvenor Gardens, Muswell Hill, London, N.10. [1204

ACCUMULATORS—BATTERIES.

ZINCS.—Best quality (wired), No. 1, 8d. per doz.; No. 2, 9d. per doz.; order valued 5/- carriage paid, otherwise 6d. for postage.—British Battery Co., Clarendon Rd., Watford, Herts. [0258

ACCUMULATOR HIRE.

DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more, we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms, from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5 'Phone: North 0623 (3 lines). [8751

CHARGERS AND ELIMINATORS.

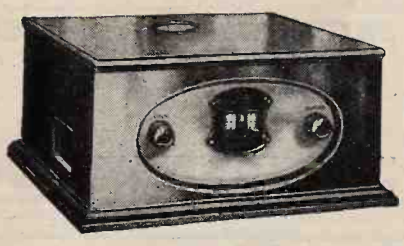
TANTALUM and Lionium for A.C. Rectifiers; for inexpensive chargers; blue prints for H.T. and L.T., 1/- each; Lionilum electrodes, 2-3 and 5-8 amps.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [8298

ELIMINATOR Kit Ready for Wiring.—The Westinghouse 20 milliamp, 120 volt model kit consists of transformer, choke, Westinghouse rectifier, 8 mfd.'s of condensers, 2 resistances for S, G, and detector.
ELIMINATOR Kits, transformer, choke, condensers, valve, valve holder, resistance, terminals; 36/-, post free.
SUPPLIED, screwed to baseboard and safety plugs and sockets mounted.
CRACKLE-ENAMELLED Metal Case is Supplied Ready to Screw to Baseboard.
ONLY Requires Wiring to Drawing Supplied, and can be used within 15 minutes.
100 Metal Cases, suitable eliminators, blue crackle enamel, size 9½x7x5½in., 4/-, post free.
GUARANTEED for 12 Months, and sent on 7 days' approval against cash; no risk whatever; the postage is paid, and the whole outfit ready to wire is 60/-.—Fel-Ectric Radio, Garden St., Sheffield. [9963

PHILIPSON'S Safety High Tension Supply Units for A.C. and D.C. Mains, 200-250 volts 40-60 cycles, also 230 volts 25 cycles.
10/- Down and Small Monthly Payment Secures the Finest H.T. Supply Available.
PHILIPSON'S Safety H.T. Units are Guaranteed for 12 Months Against All Defects.
ALL Models Sold on 7 Days' Approval to Ensure Complete Satisfaction.
PHILIPSON'S Safety H.T. Units are the Cheapest to Install and the Cheapest to Run; £1/17/6 to £6.
WRITE for Our Booklet, "Radio Power," which gives illustrations and full particulars.
PHILIPSON'S Safety Loud Speaker Output Filters for All Receivers, power valve, or Pentode; a remarkable output filter at a very low price; 16/6.
PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038 Bolton. [0318

COMPLETE Kits of Components for Making Your Own H.T. Eliminator, output 150 volts 30 mA., suitable for almost any 3-valve set, kit comprises transformer, choke, Philips 1801 valve, 7 mfd. condenser block, resistograd, etc., and full instructions; price, including royalty, 50/-; state your mains voltage when ordering; we can also make any special transformer with outputs up to 1 kW for all purposes; send us your enquiries; very keen prices for quantities.—Ellison Manfg. Co., Ltd., Dragon Works, Harrogate. [1190

What do you look for in a Wireless Set?



Performance? Appearance? Low Running Costs?

On each of these points, the Lotus 3-valve S.G.P. All Electric Receiver scores full marks. Unequalled for width of range, giving perfect trouble-free reception under all conditions — ample volume, highly developed sensitivity and selectivity (enabling unwanted stations to be cut out with ease) and crystal clarity of tone.

In appearance, an elegant piece of furniture of which you can be proud—not merely a cabinet.

Running costs practically nil. No batteries needed—all power being taken direct from the electric light mains.

Price, £21 cash or 12 monthly payments of £1 : 19 : 9.

Ask your dealer for a free demonstration and full details of this remarkable set.

LOTUS

ALL ELECTRIC RECEIVER

Garnett, Whiteley & Co., Ltd.

(Dept. W.W.10)

Lotus Works, Mill Lane, Liverpool.

Causton

Chargers and Eliminators.—Contd.

CHESTER BROS.—All types of mains transformers and chokes to any specification.—Chester Bros., 244, Dalston Lane, London, E.8. [9798

PHILIPS 450 Charger (200 A.C.), 1.3 amp.x2-6 volts, as new; 30/-, or nearest.—Faulkner, 175, Station St., Burton-on-Trent. [1168

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.
SAVAGE'S.—Transformer laminations and Bakelite bobbins; intending home constructors should write for list.
SAVAGE'S.—Reliable smoothing condensers, 1,500 volt D.C. test, 1 mfd., 2/-; 2 mfd., 3/-; 4 mfd., 5/3; 500 volt D.C. test, 1 mfd., 1/6; 2 mfd., 2/3; 4 mfd., 3/9.
SAVAGE'S.—Super smoothing and output chokes, many types available; write for list.
SAVAGE'S.—Mains transformer for Westinghouse H.T.4 unit, with additional winding, 4 volts centre tapped 3 amps, 23/-; transformers for other Westinghouse units available.
SAVAGE'S.—Mains equipment for new Foreign Listeners Four, transformer, N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke C32O, 20/-.
SAVAGE'S.—Mains equipment for Power Pentode Two transformer, P.P.2, 33/-; output choke, L.C. 36P.G., 19/6; smoothing choke, L.C.36G, 18/-.
SAVAGE'S.—Mains transformer B.T.4, 500-0-500 volts, 120 m. amps, 7½ volts 3 amps., 6 volts 3 amps, 4 volts 2 amps., 4 volts 1 amp, 4 volts 1 amp., all centre tapped, specially developed for automatic bias; 57/6.
SAVAGE'S.—Mains transformers and power chokes are carefully and individually constructed from first class materials, with an exceptionally generous margin of safety.
SAVAGE'S, 146, Bishopsgate, London, E.C.2. 'Phone: Bishopsgate 6998. [9165

CABINETS.

CABINETS for All Requirements.—F. W. Ramsey, 63, Shaftesbury St., London, N.1. Clerkenwell 7139. [9736

DIGBY'S Cabinets.—Table models in solid oak and mahogany; from 11/6 to 71/-.
DIGBY'S Cabinets, fitted with Radion or Resiston ebonite if required.
DIGBY'S Cabinets.—Pedestal model, with separate battery components; from 56/- to £12.
DIGBY'S Cabinets Made to Customers' Own Designs.

DIGBY'S Cabinets.—Write for new 16-page art catalogue.—F. Digby, 9, The Oval, Hackney Rd., E.2. 'Phone: Bishopsgate 6458. [0128

COILS, TRANSFORMERS, ETC.

TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 244, Dalston Lane, London, E.8. [9706

600 and 1,000 ohms Decoupling Resistances, specified for the largest and most important "Wireless World" receivers; 1/6 each, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1088

KILO-MAG Four Formers, slotted, ready for winding, 12/6 set; 1930 Everyman Four, 8/6 set, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1089

FERRANTI P10 Transformer, 230-250v. 50 cycles, secondary 4v. 4 amps, 6v. 3.5 amps., 45v.; 23/-.—Gleaves, Curzon Rd., Stockport. [1180

TRANSFORMERS and Chokes, every description.—Enquiries "Stolys," 125, Eswyn Rd., Tooting, S.W.7. [1172

BAND-PASS Four, Coils, complete, 80/-; Ideal Home receiver coils, complete, 43/-; superhet. adaptor coils and base, 24/-; S.G. S.W. Three, 4 coils, 34/-; 4 additional, 46/-; Berclif coils from stock for all popular sets; trade supplied.—Simmonds Bros., Shireland Rd., Smethwick. [9941

DYNAMOS, ETC.

DYNAMOS and Motors, Rotary converters and motor generators, 2,000 in stock at bargain prices.—Electradix Radios, 218, Upper Thames St. [1125

GRAMOPHONES, PICK-UPS, ETC.

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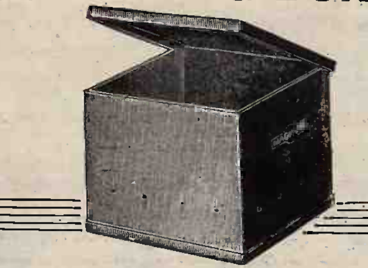

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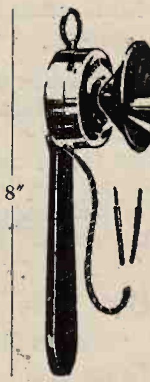

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INDEX TO ADVERTISEMENTS.

	PAGE
Adolph, Fredk.	11
Appleby, E. Hetherington	8
Baker's "Selhurst" Radio	12
Belling & Lee, Ltd.	8
Benjamin Electric, Ltd.	
Broderson, A.	4
Burne-Jones & Co., Ltd. (Magnum)	11
Celestion, Ltd.	Cover iii.
Clarke, H., & Co. (Manchester), Limited	7
Cole, E. K., Ltd.	Cover i.
Darwins, Ltd.	4
Day, Will, Ltd.	2
Dubilier Condenser Co. (1925), Ltd.	2
Eastick, J. J., & Sons	10
Edison Swan Electric Co., Ltd.	3 and 5
Electradix Radios	
Exact Manf. Co.	
Exide Batteries	
Ferranti, Ltd.	7
Garnett, Whiteley & Co., Ltd.	9
General Electric Co., Ltd.	1
German Radio Exhibition	
Heayberd, F. C., & Co.	
Holzman, Louis, Ltd.	2
Hughes, F. A., & Co., Ltd.	
Lectro Linx, Ltd.	12
London Electric Wire Co. & Smiths, Ltd.	4
Marconiphone Co., Ltd.	6
McMichael, L., Ltd.	
M-L Magneto Synd., Ltd.	Cover ii.
Mullard Wireless Service Co., Ltd.	Cover i.
Parker, W. H.	10
Perseus Manf. Co., Ltd.	10
Pertrix, Ltd.	Cover iv.
Philips Lamps, Ltd.	Cover ii.
Player's	7
Potter, H. B., & Co., Ltd.	4
Regent Radio Supply Co.	
Rich & Bundy, Ltd.	12
Rowley, Ltd., Thomas A.	
Six-Sixty Radio Co., Ltd.	
Standard Telephones & Electric Co., Ltd.	Cover iii.
Tannoy Products, Ltd.	8
Telegraph Condenser Co.	Cover i.
Thomas, Bertram	10
Transformer Repair Co.	10
Varley (Oliver Pell Control), Ltd.	5
Westinghouse Brake & Saxby Signal Co., Ltd.	Cover iii.
Wilkins & Wright, Ltd.	Cover i.
Wingrove & Rogers, Ltd.	10

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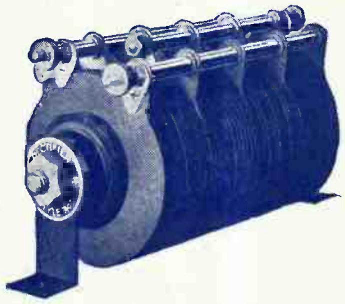

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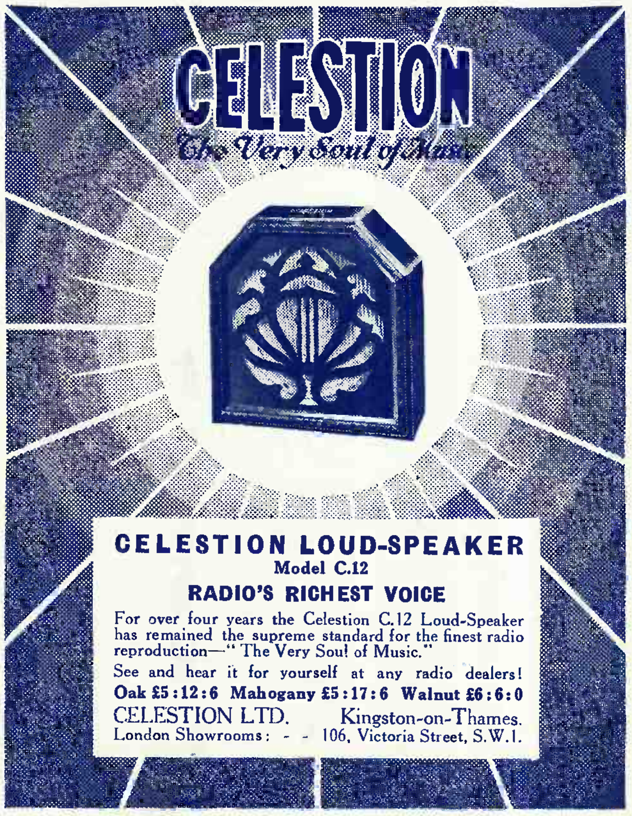

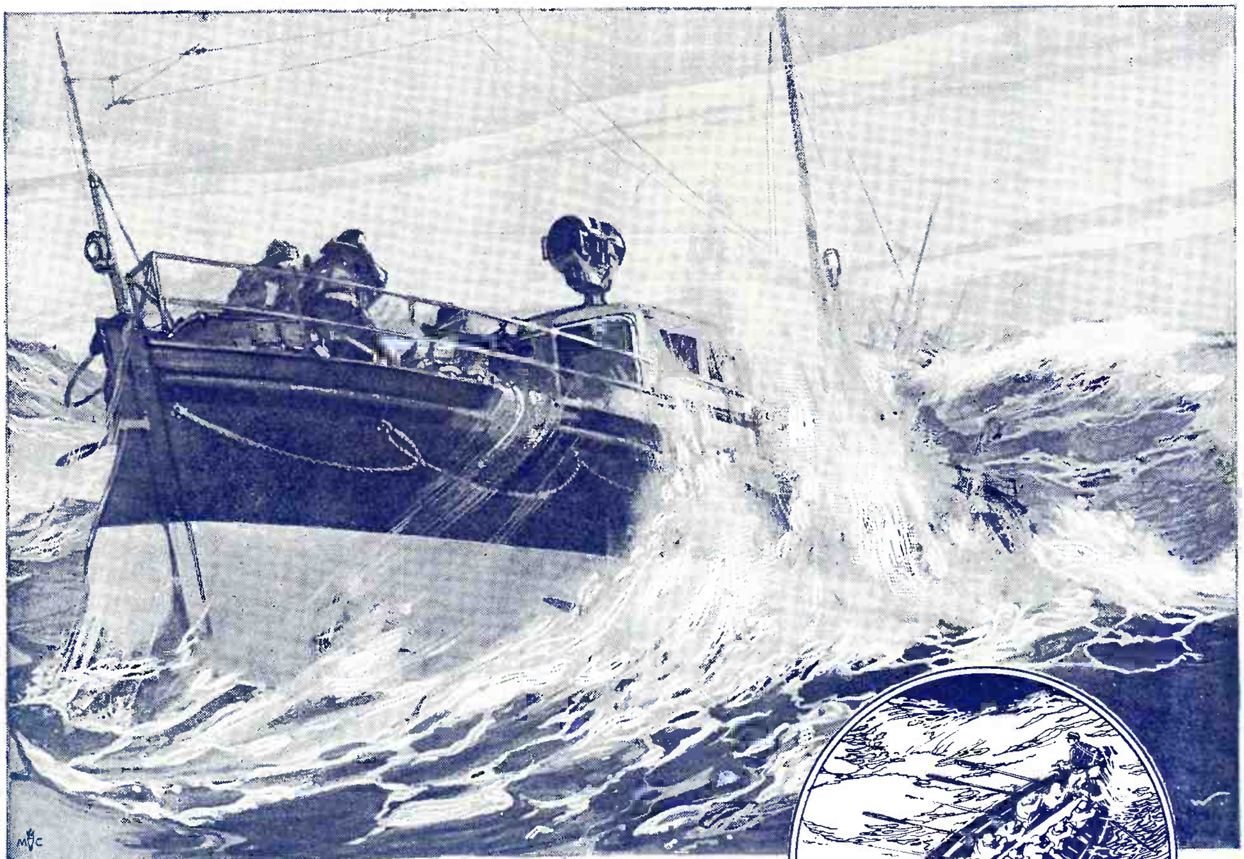

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THE ALL D.C. THREE

4D

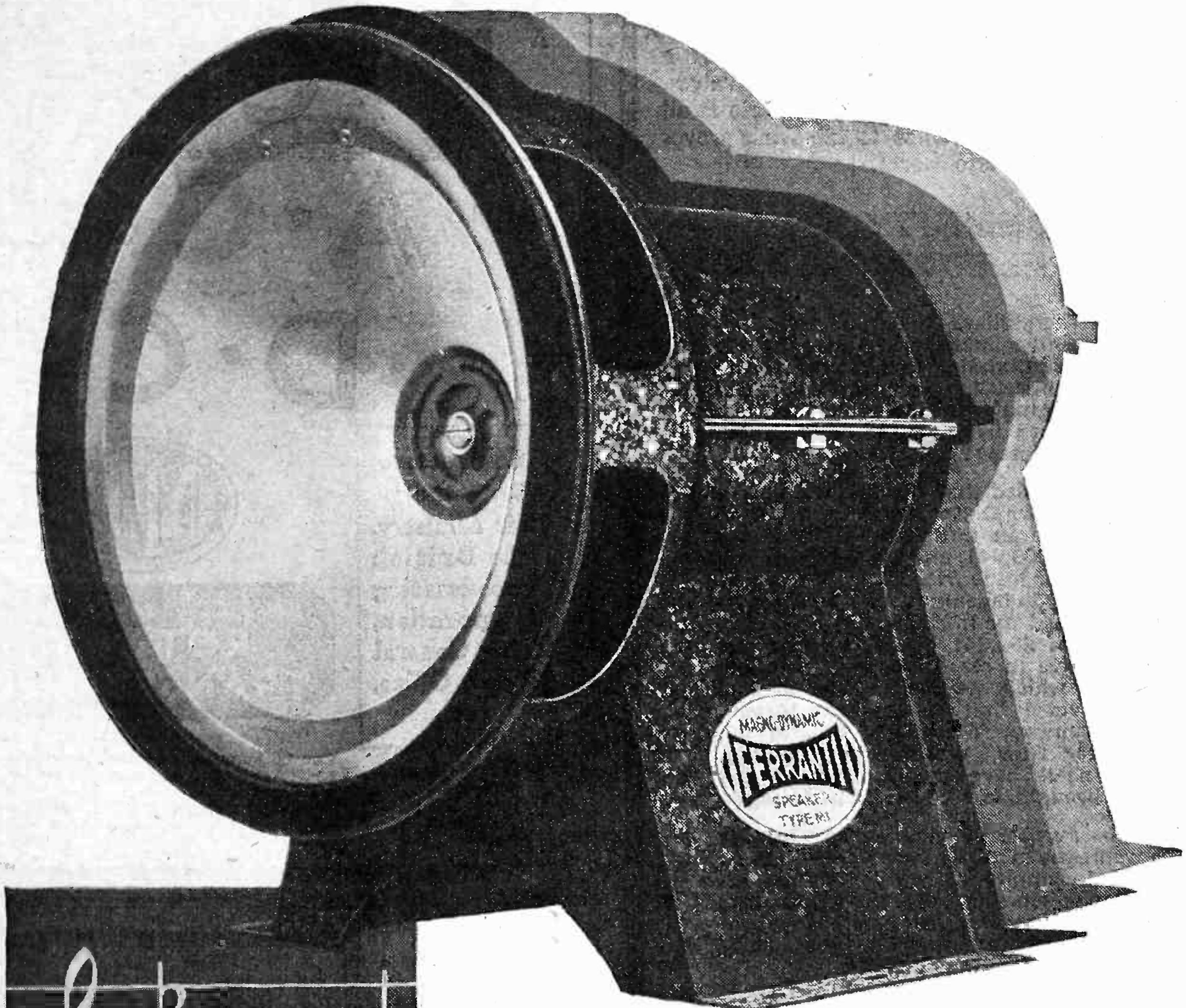
The Wireless World

AND RADIO REVIEW

The Paper for Every Wireless Amateur

Wednesday, August 20th, 1930.

No. 573. Vol. XXVII. No. 8



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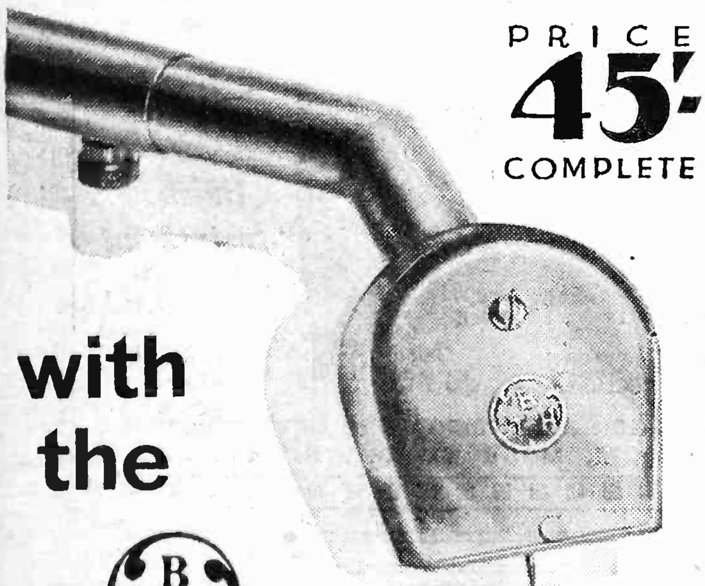

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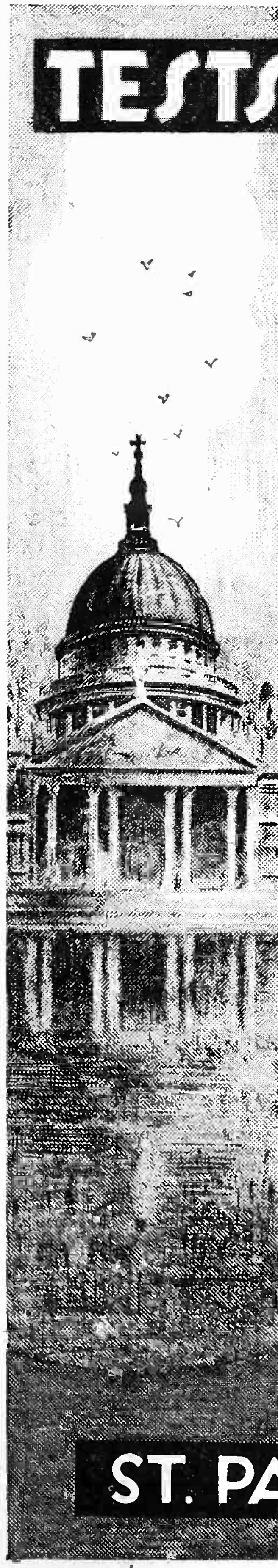

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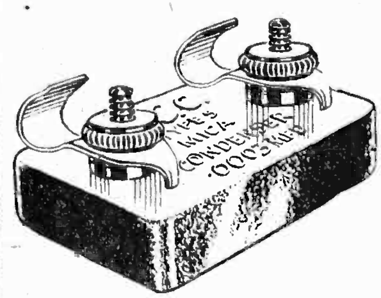

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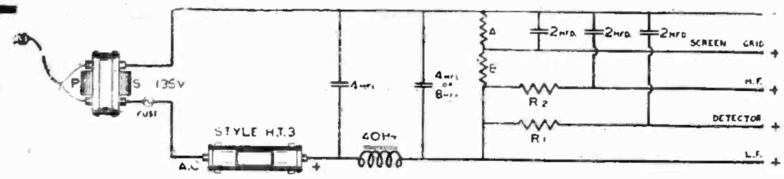

for a battery eliminator for A.C. Mains

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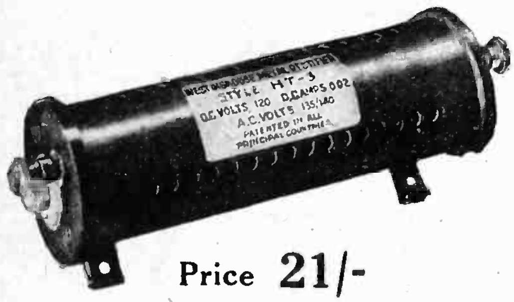

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TYPE H.T.3

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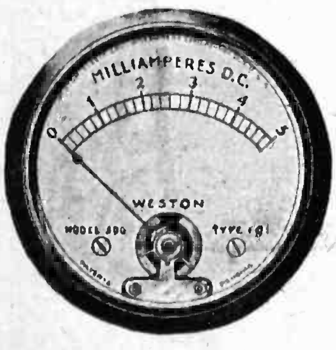

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Fil. amps.	...	1·0

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The Wireless World AND RADIO REVIEW

(18th Year of Publication)

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS OF THIS ISSUE.

	PAGE
Editorial Views	157
All D.C. Three. By H. B. Dent	158
Response Curves. By Prof. C. F. Jenkin	163
Insulators Tested. 4. Mycalex. By W. H. F. Griffiths	167
Current Topics	169
Valves we Have Tested. Two New Mullard Valves	171
Wireless Theory Simplified. By S. O. Pearson	173
Practical Hints and Tips	176
Broadcast Brevities	178
Broadcast Receivers Reviewed. Cossor Two-Valve Battery Receiver	180
Correspondence	181
Readers' Problems	183

THE B.B.C. MACHINE.

A VISITOR from the Continent, giving us his impressions of our broadcasting organisation recently, described it as an extraordinarily efficient machine which turned out high-class programmes as monotonously as tunes on a hurdy-gurdy, but was, in fact, as inhuman and soulless as the most ideal of red tape Government Departments.

We thought this rather a scathing comment to make on broadcasting, because the microphone is generally regarded as providing a much more human atmosphere than can be attained through the medium of books or mechanically reproduced music. But apparently it was not this aspect of the question which our friend had been considering. He had a high opinion of the programmes and of the material used in their composition, but he contended that there was no individuality in the B.B.C. constitution. This probably arises from the fact that the B.B.C. is not authorised to comment officially on current events; that is to say, there must be no equivalent to an editorial introduction to programme items which might be construed as an official expression of opinion by the Corporation. Is there not, however, some means of compromising with this stipulation? Cannot something be devised to give the B.B.C. a soul; that is to say, to bring it more into sympathy with the listener, and remove from the microphone the impersonal and almost mechanical atmosphere in which it is being slowly enveloped?

We believe that if Sir John Reith and members of the Governing Board would come to the microphone from time to time and talk to listeners on such questions as the aims and policy of the B.B.C., it would produce a very good effect. The talks could also provide the opportunity for sympathetically replying to well-meaning current criticisms levelled at the Corporation. These talks would have the effect, as it were, of taking the listener into confidence, and might do much to assist listeners to realise that, after all, the B.B.C. is a human organisation rather than a programme-producing machine.

oooo

ULTRA SHORT WAVES.

IT is generally conceded that it is to the amateurs that we are indebted for hastening the development of the use of short waves for practical communication, for it will be recalled that at a time when the short waves had been allotted for amateur use because they were considered to be of little use for commercial communication, amateurs in this country, in Australia and America, astonished the world by establishing inter-communication on low power on short wavelengths. That is some five or six years ago, and since that time considerable attention has been focused on wavelengths of a still lower order, particularly between 5 and 2.5 metres, and although much remains to be learned concerning this band, there is already sufficient evidence to indicate that it has great possibilities.

Previously *The Wireless World* has had the opportunity of acting as a medium for bringing into touch those amateurs who were undertaking short-wave experimental work, and we feel that we should like once more to act as the means of assisting amateurs working on the new wavelengths to co-operate. Naturally, a transmitting licence is necessary before transmitting on these wavelengths can be undertaken, but reception can be carried out by a large number of observers, and the results obtainable from such observations would be of the utmost interest in establishing data on range, screening, and other effects. We shall welcome correspondence from any amateurs interested in experimental work on this band.

All D.C. THREE

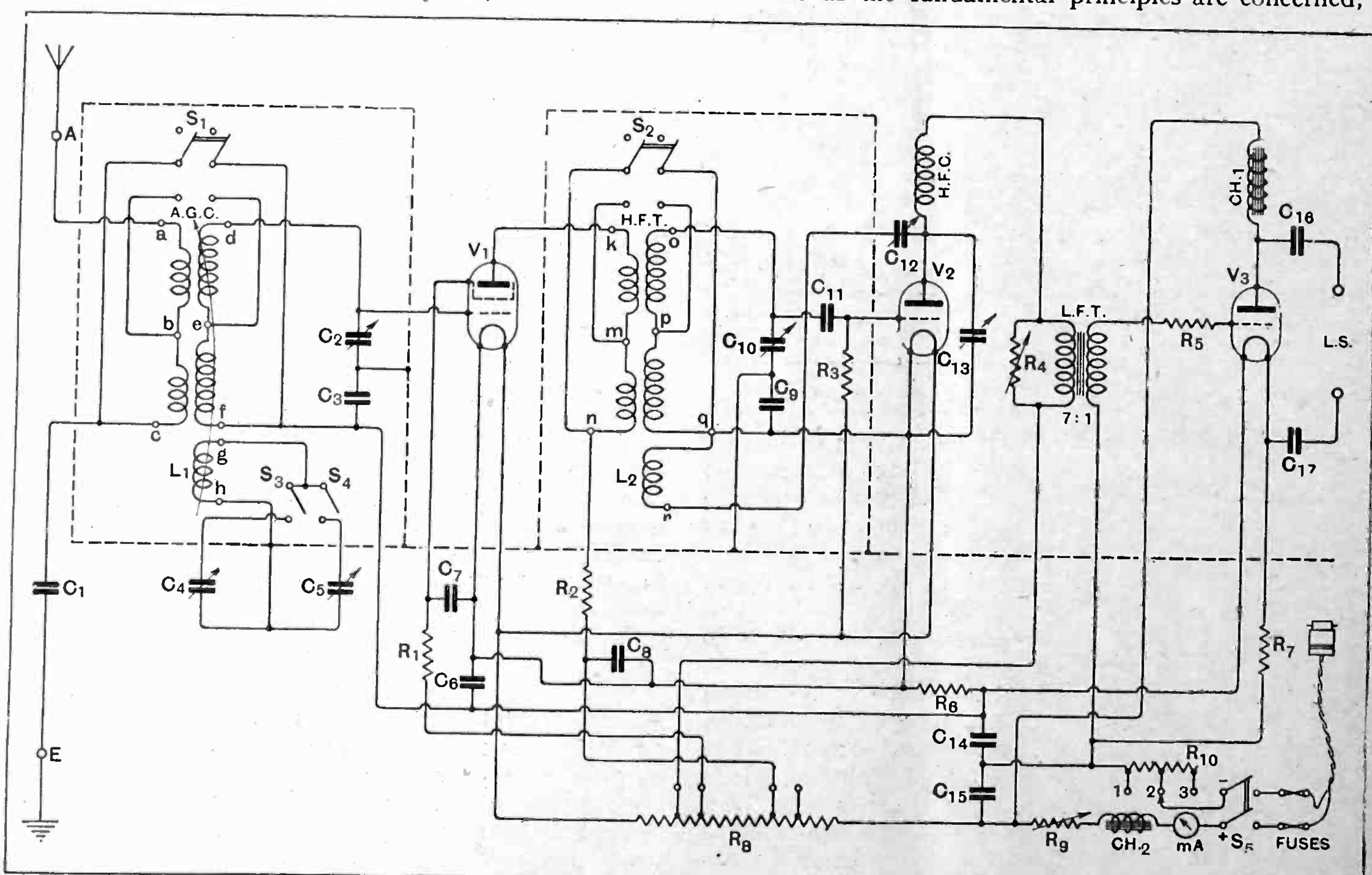
Batteryless Three-Valve Receiver with Rejectors.

By H. B. DENT.

ABOUT six months ago the writer discussed in these pages a few of the more economical methods of deriving the filament current for a receiver from the D.C. mains,[1] and concluded by giving a theoretical diagram of a set embodying the principal features mentioned. As a number of readers have expressed a desire for more detailed information, especially as regards values for the various components required, it was thought that these could best be supplied by submitting the design of a complete three-valve set embodying the main features discussed at that time, and also any new developments that may have come to light more recently.

So far as the fundamental principles are concerned,

[1] *The Wireless World*, February 19th, 1930.



Theoretical circuit. Values are as follows:—C_1, C_3, C_7, C_8, C_9 and C_{14} = 1 mfd.; C_6 = 0.1 mfd.; C_2, C_{10} and C_{12} = 0.0005 mfd. variable; C_4 and C_5 semi-variable with maximum of 0.001 mfd.; C_{16} and C_{17} = 2 mfds.; C_{11} = 0.0002 mfd.; C_{13} = 0.0003 mfd. semi-variable; C_{15} = 8 mfds.; R_1 and R_2 = 600 ohms; R_3 = 2 megohms; R_4 = 25,000 ohms variable; R_5 = 0.25 megohm; R_6 = 4 ohms; R_7 = 54 ohms; R_8 = 630 ohms total; R_9 = 50 ohms variable; R_{10} = 160 ohms total.

All D.C. Three.—

the article mentioned above may be regarded as a theoretical treatment of this particular set, so that it is unnecessary to repeat them here. The space available will be devoted entirely to practical matters, but in cases where there has been any material deviation from the theoretical conception, a few words of explanation will be given.

From the theoretical diagram of the receiver illustrated here, it will be seen that the H.F. and detector valves, V_1 and V_2, have their filaments connected in parallel, and that the power valve filament is in series with these. The grid bias resistances are suitably disposed in series with the valve filaments. This particular scheme has been illustrated and discussed fully in the earlier article. In the present version, however, it has been thought advisable to adopt the leaky-grid method of detection on the grounds of sensitivity, and to enable reaction to be employed. This is followed by a 7 : 1 ratio L.F. transformer feeding into a three-electrode power valve of the 6-volt 0.25 amp. filament class. The combination gives ample L.F. amplification, and dispenses with the slight additional complications involved by the use of a pentode.

SPECIFICATION.

A selective receiver in which both filaments and anodes derive their current from D.C. mains. A specially designed L.F. choke ensures freedom from hum.

Rejectors *are included. The effective selectivity can be enhanced when working close to a powerful station without adding to the complication of tuning.*

Single Screen Grid H.F. Stage *with transformer coupling.*

Leaky Grid Detector *coupled by 7 : 1 L.F. transformer to triode output valve.*

Reaction *applied to intervalve coupling.*

Grid Bias *obtained automatically from voltage dropping resistances.*

Waveband Switching *is incorporated.*

Metal Screening *isolated from mains, thus preventing shock when positive mains conductor is earthed.*

One other feature has been introduced, this being the inclusion of a rejector circuit in lieu of a separately tuned aerial circuit, as by its aid the effective selectivity, when relatively close to a powerful broadcast station, can be enhanced without adding to the complication of tuning.

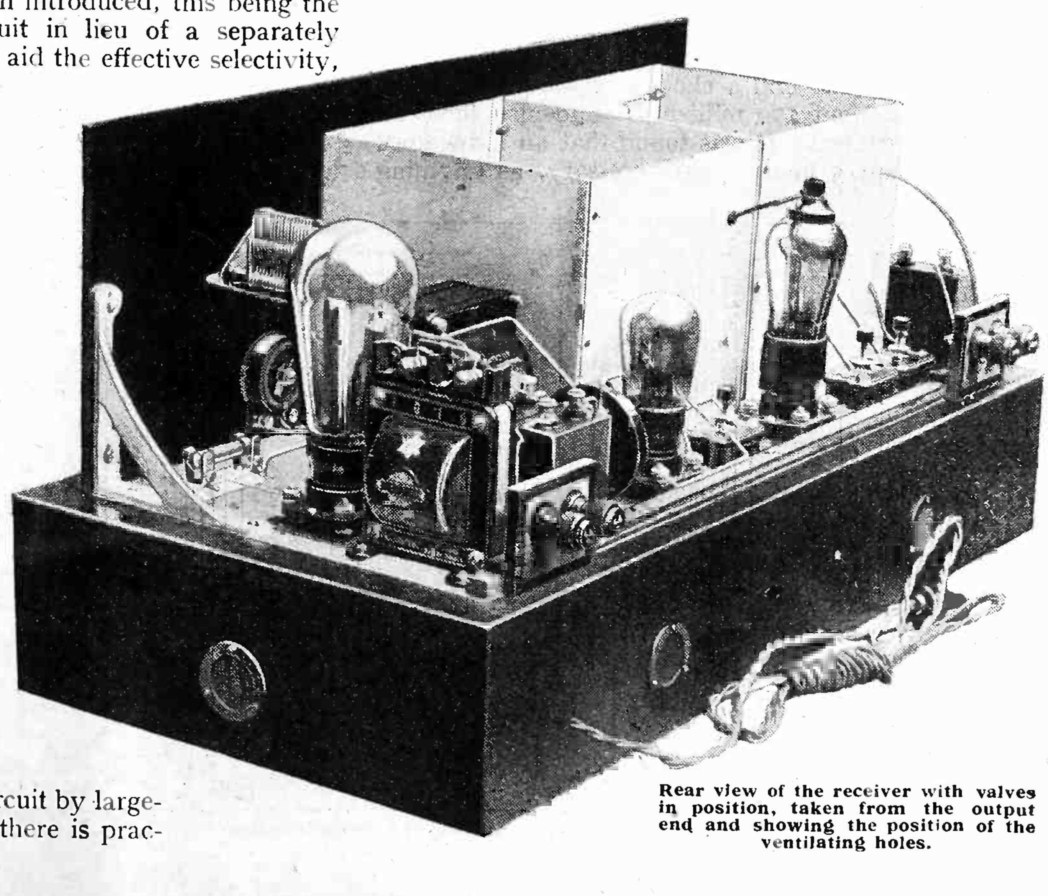
Provision is made for reception over the whole of the present broadcast waveband, switches being included to short-circuit the loading coils associated with each circuit. By suitably disposing the reaction coil, and carefully adjusting its turns, reaction can be obtained over the whole of the waveband covered without the need for two separate coils. This simplifies the switching on the intervalve H.F. transformer.

One other point of interest regarding the design is that all the metal work, and exposed conducting parts, are isolated from the D.C. circuit by large-capacity condensers. Thus there is practically no danger from electric shocks, even when the set is used on a supply main in which the positive conductor is earthed at the generating station.

A little thought will show that, to comply with these conditions, the tuning condensers C_2 and C_{10} should be insulated from the metal boxes, which would entail bushing the fixing holes with insulating material. Although this is not really troublesome to effect in practice, it was decided to fix them in the usual way and to insert 1-mfd. condensers, shown at C_3 and C_9, which would achieve the desired result in a more simple constructional manner. Condenser C_1 has been included in the earth lead to complete the scheme, and to isolate fully the wireless earth from the lighting system should the turns on the aerial-grid coil inadvertently short-circuit.

The output end of the set has been similarly treated and the additional feed condenser C_{17} included to isolate totally the loud speaker terminals from the mains. A 1 : 1 output transformer would serve the same purpose from this point of view, but it might encourage L.F. instability unless certain precautions were taken.

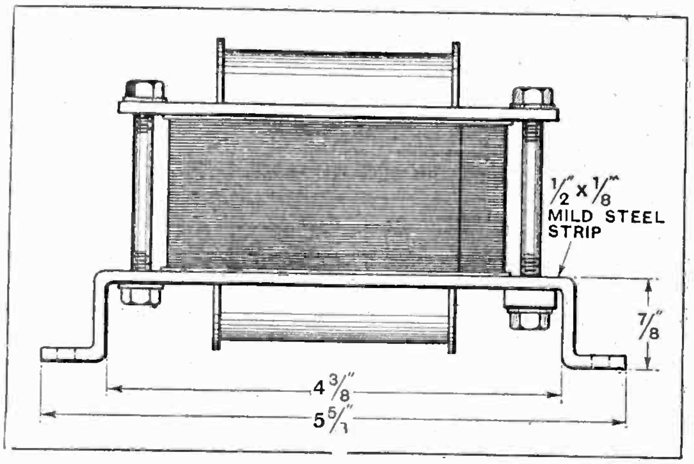
As there seems to be little more to be said about the general features of the set, attention can now be



Rear view of the receiver with valves in position, taken from the output end and showing the position of the ventilating holes.

All D.C. Three.—

directed to the construction of the few special parts that cannot, to the best of the writer's knowledge, be purchased at present. These include the special L.T. choke, CH_2; the resistances R_6, R_7, R_8, and R_{10}; the aerial-grid coil, and the high-frequency transformer.

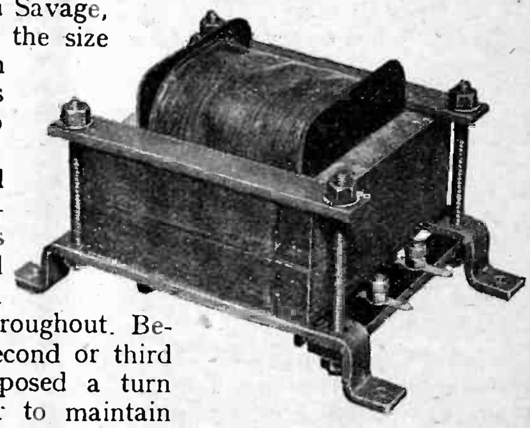


Dimensional data of the L.T. smoothing choke giving about 5 henrys when passing 275 milliamperes of D.C.

The smoothing choke is of particular interest, as its function is to smooth out the superimposed ripple, thus rendering the D.C. suitable for both filament heating and H.T. Experiments have shown that, unless the filament supply, which also provides grid bias, is entirely free from ripple, no amount of smoothing of the H.T. will give a silent background. Furthermore, having acquired a satisfactory L.T. supply, it is quite unnecessary to include further smoothing equipment in the anode supply. Having arrived at this conclusion, the next step was to find a choke that would carry the total current—about 270 milliamps—and also show an adequate inductance. It was found that an inductance of not less than 5 henrys was necessary, as anything below this would not put up a high enough impedance to the lowest ripple frequency likely to be encountered, which was adjudged to be of the order of 50 cycles.

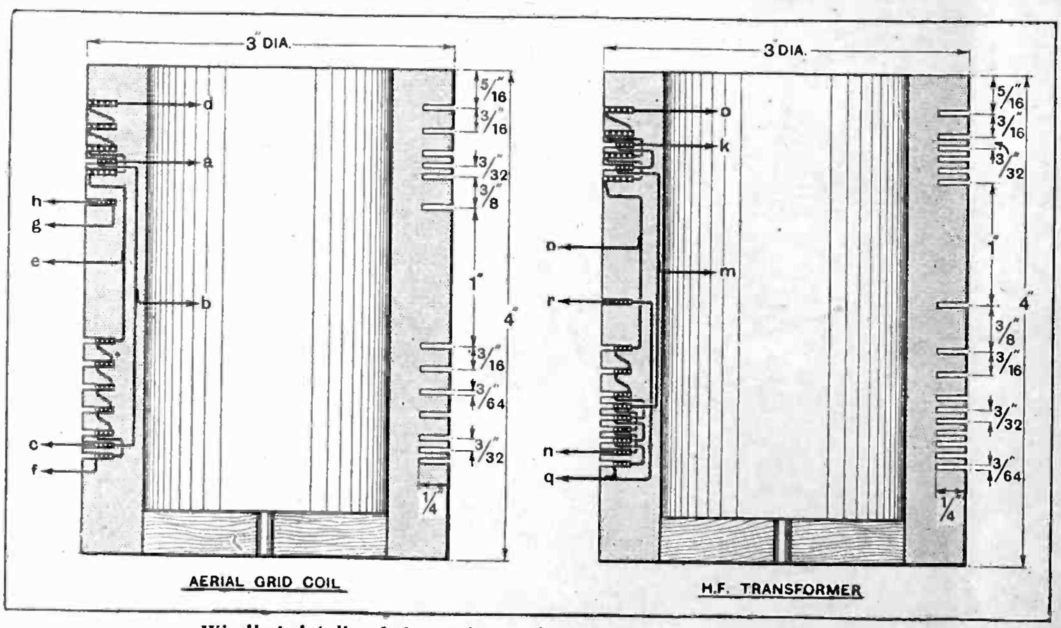
Unfortunately, the writer was unable to trace a commercially made article complying with these specifications, and as a consequence attention was given to the question of designing one for this particular set. It is a relatively simple piece of apparatus to construct, albeit a little tedious, perhaps, but, as it is virtually the key component in the set, the need for the exercise of care in its construction is essential and cannot be too well stressed.

The core is built up from the No. 4 size transformer stampings—familiar to most readers by now, as they have been used from time to time in the small power transformers described in this journal. The winding is carried on one of the special bakelised formers sold by W. Bryan Savage, and listed as the size No. 4F. On this bobbin is wound 3,000 turns of No. 28 enamelled wire with consecutive turns touching, and wound in layer form throughout. Between each second or third layer is interposed a turn of thin paper to maintain an even winding surface. The wire must be kept fairly taut throughout the winding process, as otherwise there may be some difficulty in accommodating the requisite number of turns. The casual method of winding in which the turns are run on in no particular sequence is definitely not advised, since this takes up too much space for the given number of turns.



The L.T. smoothing choke.

To obviate magnetic saturation of the iron, an air-gap must be left in the core, so that it is not practicable to assemble the laminations in the order described for the small power transformers mentioned above. It will be recalled that in these each pair of stampings—a pair comprising one "T"- and one "U"-shaped piece—were assembled, so that the joint in one pair did not coincide with the joint in the consecutive pairs. In the present case all "T" pieces are inserted into the bobbin from the same side, and this applies to the "U" pieces also, so that the joints come together. Actually, there



Winding details of the aerial-grid coil and H.F. transformer.

LIST OF PARTS.

3 Variable condensers with dial, 0.0005 mfd. (Utility "Mite").
2 Change-over switches, 2-pole, lever pattern (Wearite 1.12).
3 Valve holders (Benjamin "Vibroholder").
1 L.F. transformer, ratio 7 : 1 (Ferranti A.F.6).
1 L.F. choke (Igranic "F").
1 H.F. choke (Igranic).
1 Porcelain rheostat, 50 ohms. (Igranic P56-E).
1 Grid leak, 2 megohms.
1 Grid leak, 0.25 megohm.
1 Porcelain grid leak holder.
4 Ventilation windows (Bulgin).
2 Dial indicators (Bulgin).
2 Screening boxes, 6½ × 6½ × 6in. aluminium (Magnum).
2 Coil formers, 9-ribbed, 3in. dia. × 4in. length (Becol 9a).
1 Variable resistance, 25,000 ohms. (Rotor-ohm).
1 Push-button mains switch, 2-way, 5 amp. (G.E.C. S.2304).
1 Escutcheon plate for above (G.E.C.).
2 Cut-outs, 5 amps. (G.E.C. S.845).
2 Decoupling resistances, 600 ohms (Wearite).
100 Pairs No. 4 stampings (Savage).
1 No. 4 F. bobbin (Savage).
1 lb. No. 28 enamelled wire.
8 oz. No. 28 Eureka wire. (L.E.W.).
Quantity No. 28 D.C.C., No. 32 D.S.C., and No. 40 D.S.C.
2 Fixed condensers, 4 mfds., 400 volt D.C. test (Dubilier B.T.).
2 Fixed condensers, 2 mfds., 400 volt D.C. test (Dubilier).
6 Fixed condensers, 1 mfd., 400 volt D.C. test (Dubilier).
1 Fixed condenser, 0.1 mfd. mica (Dubilier B.775/1).
1 Fixed condenser with clips, 0.0002 mfd. (Dubilier No. 620).
2 Terminal mounts (Junit).
4 Terminals, L.S., A and E. (Belling-Lee). Ebonite shrouded.
1 Paxolin panel, 21in. × 7in. × $\frac{3}{16}$in.
1 Milliammeter, 0-500 mA. (Hunt 144F.).
2 On-off switches (Wearite).
2 Semi-fixed condensers, 0.00017-001 mfd. (R.I. "Varicap," No. 5).
1 Semi-fixed condenser, 0.00006-0003 mfd. (R.I. "Varicap," No. 3).
1 Sheet aluminium, 27in. × 9in.
Material for cabinet and resistance formers.
Systoflex, wire, screws, plug adaptor, etc.

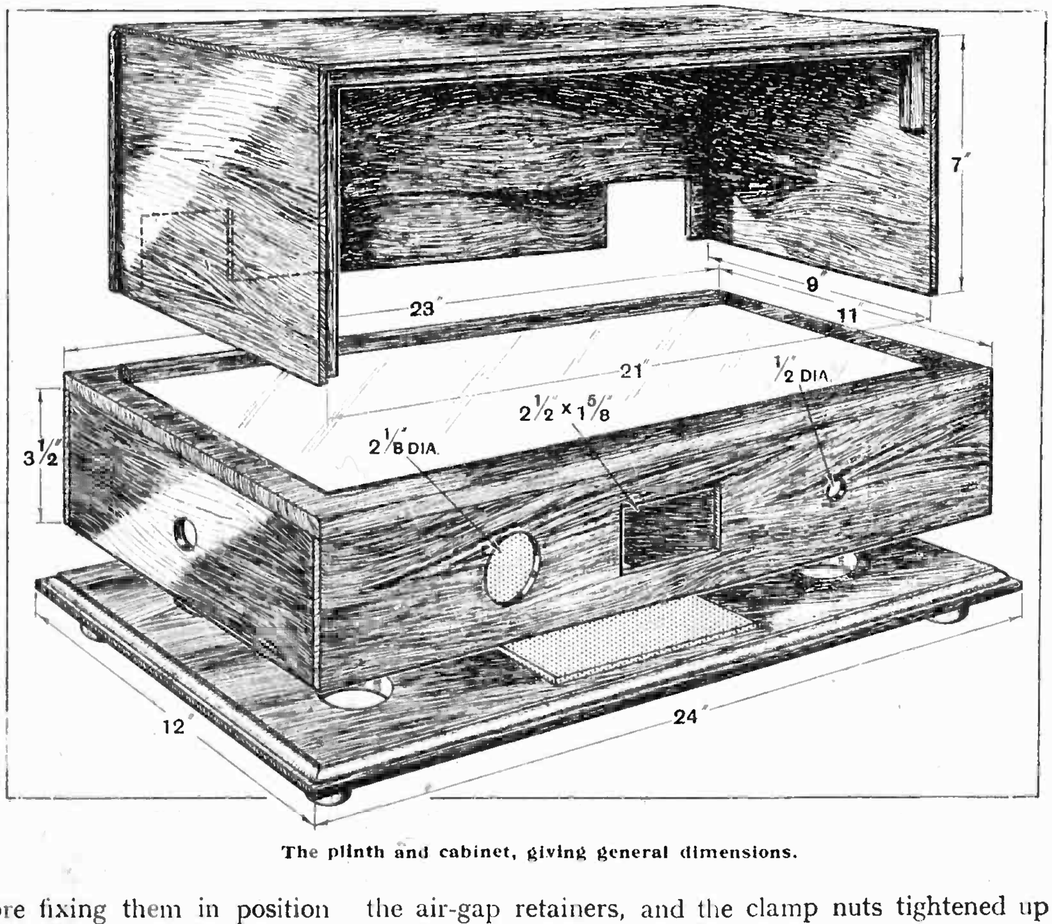
Approximate cost (excluding material for cabinet,) £12.

In the "List of Parts" included in the descriptions of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer and illustrated in the photographs of the instruments. Where the designer considers it necessary that particular components should be used in preference to others, these components are mentioned in the article itself. In all other cases the constructor can use his discretion as to the choice of components, provided they are of equal quality to those listed and that he takes into consideration in the dimensions and layout of the set any variations in the size of alternative components he may use.

are three joints in the core—one in the centre limb and one in each of the side members. There is one little matter that has to be seen to before finally clamping the stampings and filling in the gaps with the positioning pieces used for fixing their width.

When the stampings are assembled in this manner there is sometimes a tendency for the two halves of the core to twist so that the tails of the "T" pieces slightly overlap the "U" pieces, and, should this occur, it will introduce a much larger air gap than is desirable or necessary. As a means of obviating this, a "T" and a "U" of the same size as those forming the core should be cut out of thin Paxolin sheet—about $\frac{1}{64}$in. thick—and inserted in the centre of the iron, but put in from the opposite side from their respectively shaped stampings. This positions the stampings and overcomes the trouble mentioned above.

In all, about 100 pairs of stampings are required, and when they have been assembled in the core they can be secured together by the specially shaped iron clamps shown in the drawings and illustrations. Before fixing them in position place a strip of thin paxolin between the core and each clamp, as otherwise the iron will short-circuit the air gaps. The fixing bolts may then be inserted and the nuts run up finger-tight, after which the pieces of paxolin, mica, or other non-magnetic material should be inserted in the gaps in the iron core. These should be 0.02in. in thickness, which is approximately No. 24 S.W.G. The core can then be hammered up so that the iron beds down firmly at all points on to the air-gap retainers, and the clamp nuts tightened up with a spanner. The measured inductance of the choke built to this specification works out at 5.25 henrys at 50 cycles when carrying 275 milliamps of D.C., and with 5 mA. of A.C. superimposed.



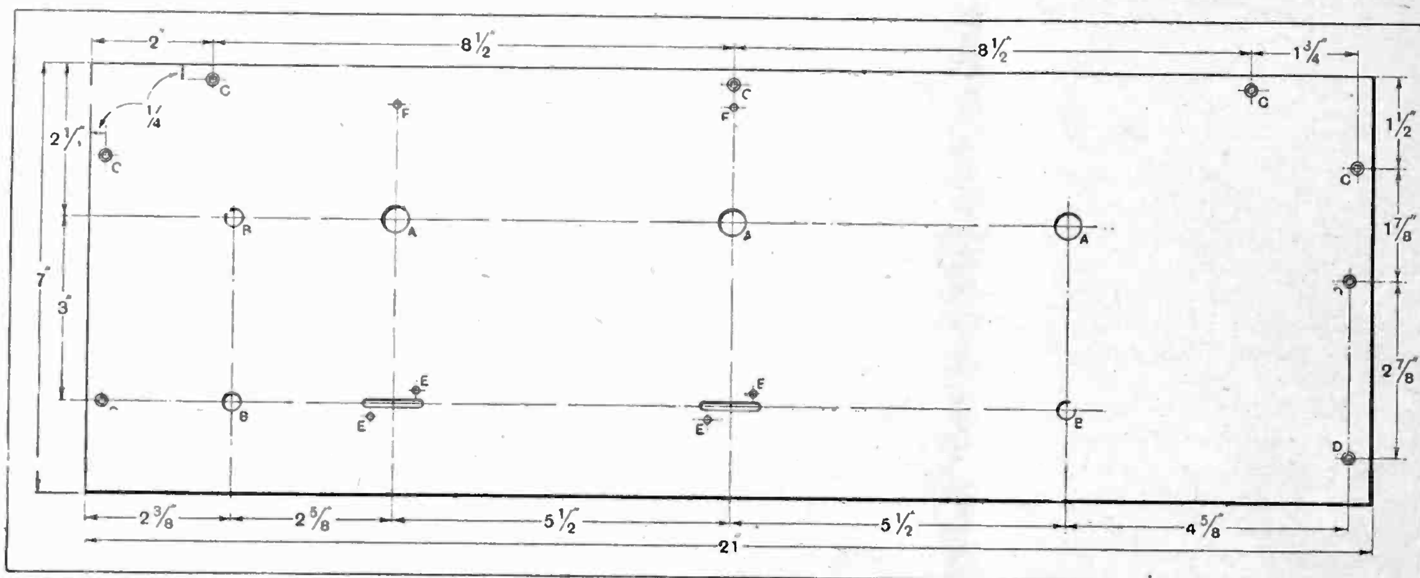
The plinth and cabinet, giving general dimensions.

All D.C. Three.—

The next job to tackle should be the coils, which follow closely the general lines of those used in the certain *Wireless World* sets. A Becol nine-ribbed former is used in each case, and the various windings are carried in slots, the positions and dimensions of which can be obtained from the dimensional drawings. On the aerial-grid coil, four sections, each wound with 15 turns of No. 28 D.C.C., form the medium-wave coil, while for the long-wave loading coil six slots are used, each carrying 30 turns of No. 32 D.S.C. wire. The aerial winding is split into two parts, one coupling with the medium-wave coil, and the other with the loading coil. A single slot cut in the space between the two end sections at the low potential end of each carries 8 turns of No. 40 D.S.C. in the case of the medium-wave portion, and 20 turns of the same gauge wire for the long-wave section. Both aerial and grid-loading coils are short-circuited when receiving on the 200- to 600-metre band. Spaced $\frac{1}{4}$in. from the low potential end of the medium-wave grid coil is a single slot carrying 20 turns of No. 32 D.S.C.; this is the wave-trap. The grid windings should be put on first, and where the wire passes from the top of one slot down to the bottom of the next, it should be laid well down on to the former, so as to leave a clear space for the aerial coil.

The H.F. transformer is likewise divided in sections, four wound with 15 turns each forming the medium-wave grid coil, and six sections each with 35 turns, in this case of No. 32 D.S.C., form the long-wave loading coil. The primary windings are carried in shallow slots sandwiched between the low potential end sections of each grid winding. For the medium-wave primary, two sections, each with 15 turns of No. 40 D.S.C., are required, while for the long waves there are three sections, each wound with 35 turns of No. 40 D.S.C.

Located between the two banks of windings is the reaction coil, which is wound in one slot spaced 1in. from the low potential end of the medium-wave portion. This slot carries 30 turns of No. 32 D.S.C. wire. As in the case of the aerial-grid coil, the secondary sections can be put on first, and care should be taken to see that where the wire passes from one slot to the next it is made to follow the contour of the former so as to leave room for the primaries. It might be well to place a strip of mica along the length of the former, so as to ensure that these inter-slot connections do not touch the primaries. Similar care should be given to the carrying-over turn linking together the primary sections. In this case the wire is taken over the top of the secondary sections, and a strip of mica might well be placed so as to afford good insulation. The fact that the primaries are at high D.C. potential with respect to the secondaries should be borne in mind when winding the coils.



Panel drilling. A = 7/16in.; B = 5/16in.; C = 1/8in. countersunk for No. 4 wood screws; D = 1/8in. countersunk for No. 6 B.A. screws; E = 1/8in.; F = 3/32in.

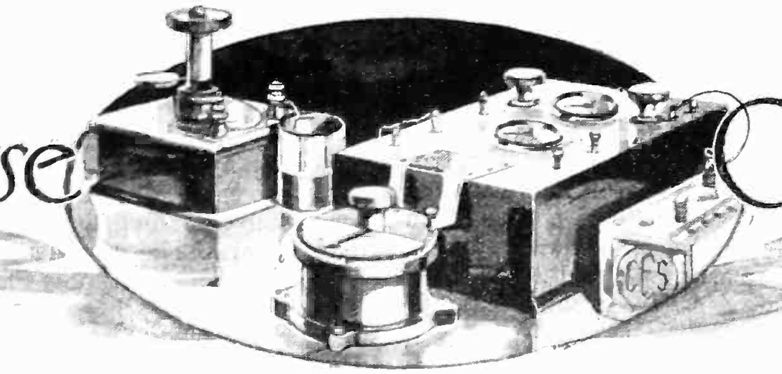
The plinth, which houses the mains equipment, and serves also as a baseboard for the wireless components, measures 23in. × 11in. × $3\frac{7}{8}$in. outside. Any kind of hard wood may be used for this, and the thickness can well be left to the constructor. The essential dimension is the depth inside, which should not be less than $3\frac{1}{2}$in. The model illustrated was built up from three-ply wood, $\frac{3}{16}$in. thick, and oak-faced, for the sides, while the top was a piece of hard wood $\frac{7}{16}$in. thick. Strengthening pieces are glued in the four corners, also at intervals along the sides to facilitate fixing the rather thin sides to the top. There is no objection to the use of thicker material for the sides if this is desired.

The top of the plinth is covered by an aluminium plate measuring 21in. × 9in., and this is held in position by the screws fixing the various components to the base. Its object is to afford a measure of screening between the unscreened portions of the detector and L.F. circuits and the mains equipment. Next drill the ventilation holes and holes to take the mains switch, the meter, and the variable resistance in the plinth.

When the paxolin panel has been drilled according to the details given in the drawings, it can be placed in position and the corresponding holes in the aluminium boxes marked off, using the panel as a template.

(To be concluded.)

Response Curves



Determination of Response Curves. An Experimental Method of Approximate Accuracy.

By PROFESSOR C. F. JENKIN.

A SIMPLE method is described for measuring experimentally the response curve of a particular receiving set. The response curves so obtained show the effect produced when certain constants of the circuit are varied or adjustments made.

ALL readers of *The Wireless World* must be grateful for the various articles published early this year on filter circuits and their response curves, and particularly for the advice as to the best ways of arranging the coupling so as to get the results desired; but most experimenters will wish to know what response curves they are actually obtaining when they have made up the circuits recommended. A simple method of experimentally measuring the response curve for any particular receiving set is therefore rather urgently needed. The method described below has been successfully used by the author; it is simple, but it is only applicable to sets which use the type of anode bend detection recommended in *The Wireless World* (e.g., in an article by W. I. G. Page, March 27th, 1929) and are fitted (or can be fitted) with a milliammeter in the detector plate circuit, as recommended in that article. It cannot lay claim to great accuracy, but appears to be amply accurate enough for most purposes, and to be devoid of complicated measurement.

To make the measurements it is necessary to rig up an oscillation generator to induce oscillations of the desired frequency in the aerial. The circuits are shown in Fig. 1. On the left is the generator with tuned grid circuit; on the right is the receiving set; the filter, H.F.S.G. valve and detector valve only are shown, the other parts of the set do not concern us. The filter is arranged in the way A. L. M. Sowerby recommended in *The Wireless World* of February 26th, 1930, and shown in his Fig. 4b, the two tuned circuits being coupled by a small coil M. Coils with 10, 11, 12, 13 and 14 turns, 1in. diameter, have been made and can be plugged in as desired. The generator is loosely coupled to the aerial and induces in it currents of any desired frequency. The response of the set is shown by the milliammeter. Thus we can read the response as the frequency changes, i.e., we

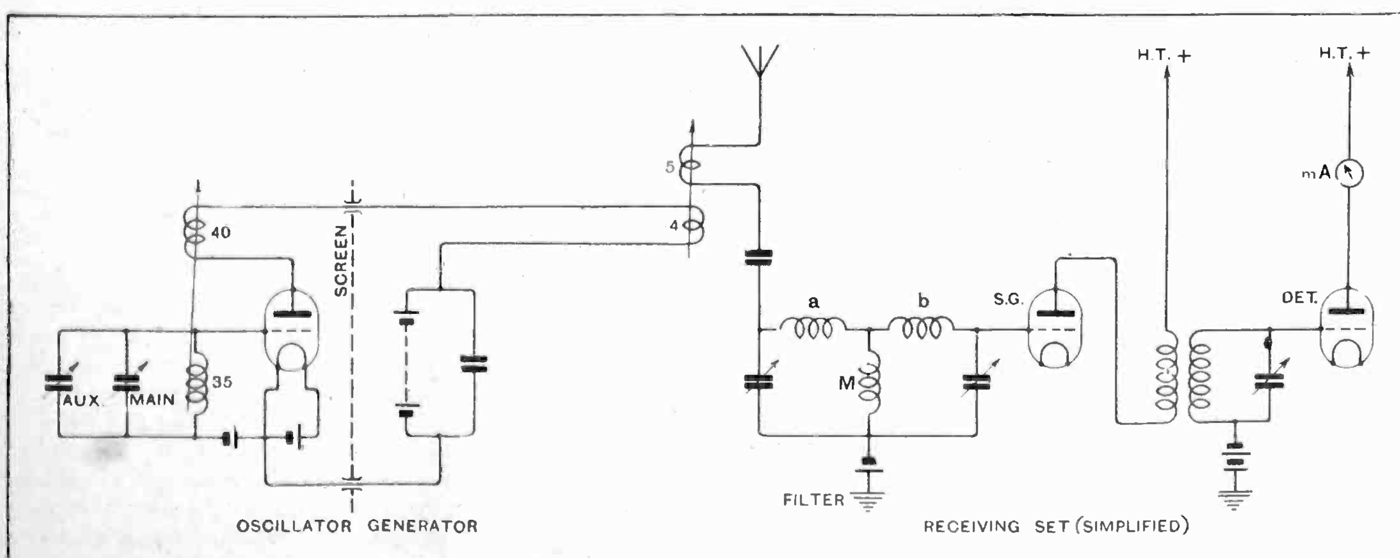


Fig. 1.—Circuit used for the measurements.

Response Curves.—

obtain the co-ordinates of the response curve. No special apparatus is required, but the main condenser used in the oscillation generator must be calibrated; a condenser with circular plates (straight line capacity) is the most convenient. The auxiliary condenser should also have circular plates; it can be calibrated from the main condenser during the test. It should have a capacity of about one-tenth that of the main condenser.

Tests can only be made when the B.B.C. is silent. The procedure is as follows. In the evening leave the

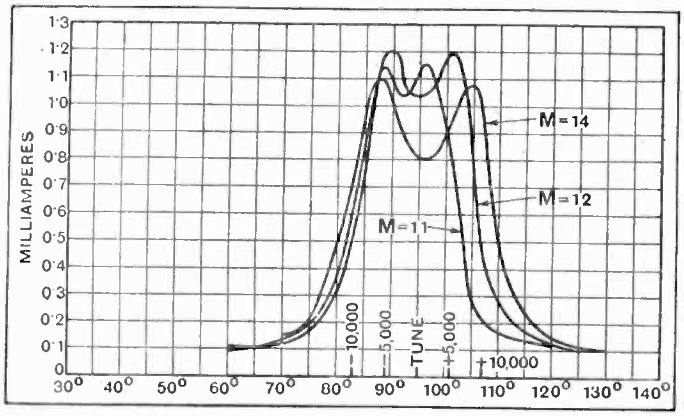


Fig. 2.—NATIONAL. Various filter couplings.

set tuned to, say, the National programme. Next morning (or after the B.B.C. shuts down) switch on the generator and tune it till it gives the maximum response as shown by the milliammeter (loosening the couplings till a convenient reading is obtained). The generator frequency is now known, viz., 1,148 kc. Next vary the frequency by small amounts up and down, by means of the auxiliary condenser, and note the corresponding milliammeter readings for each position of the auxiliary condenser. Plot the milliammeter readings as ordinates and the dial readings of the auxiliary condenser as abscissæ. The curve so obtained is the response curve of the set for the National programme frequency, but to use it we must add proper scales. The vertical scale is to read from 0 to 100 per cent. response. The zero is the milliammeter reading before we switch on the generator; it is convenient to adjust it to the constant value of 0.1 milliamps. The 100 per cent. corresponds to the maximum reading of the milliammeter during the test, or more strictly (when the response curve has a double peak) to the reading when the generator is in tune with the set—or to the reading mid-way between the peaks, when they are equal. It is hardly worth putting on this scale; the response at any frequency is merely the height of the curve above the 0.1 m.a. line divided by the maximum height.

Taking a Measurement.

The frequency scale is more difficult to calculate. If a wavemeter is available, the frequency corresponding to the settings of the auxiliary condenser can be measured at once and the scale of frequencies marked on the response curve. But a wavemeter is not a necessity. We already know the frequency of the mid-point of our curve (1,148 kc.), and we only want to add a scale of "Cycles off tune." These will be small percentages of the central known frequency; for example, 10 kc. off tune is $10/1{,}148 = .0087$ or 0.87 per cent. of the National programme frequency. To produce this change of frequency the capacity must be altered twice as much (Frequency varies as $\sqrt{\text{Capacity}}$) or 1.74 per cent. So we mark "10 kc. off tune" at the point corresponding to 1.74 per cent. change of capacity. Thus the horizontal scale is determined. The only difficulty in applying this method is that the generator capacity is a little bigger than the sum of the two condenser capacities owing to the effects of screens, and the self-capacity of the coil and connecting wires. A simple method of finding this extra capacity is given in the appendix.

Checking the Oscillation Generator.

It is assumed that during any test the oscillating current produced by the generator will remain constant. To ensure this the current must be fairly large and the coupling to the aerial as loose as possible. The coils used had four and five turns respectively, 3in. diameter, and a few inches apart. If the coupling is too close the set reacts on the generator. The generator should have separate batteries from the receiving set so as to avoid unwanted couplings. To ascertain whether the oscillating current did remain constant in his test the author coupled it to a crystal and high resistance in series with a sensitive mirror galvanometer. With small generator currents changes were observed when the generator came into tune with the set, but when large oscillating currents were used, with looser couplings, this defect disappeared. The author's generator is made up of a P.M.254 valve with 100 volts H.T. and – 10 volts grid bias; the grid coil is a Lewcos 35 coil and the reaction coil a Lewcos 40 coil. The coils are about 3in.

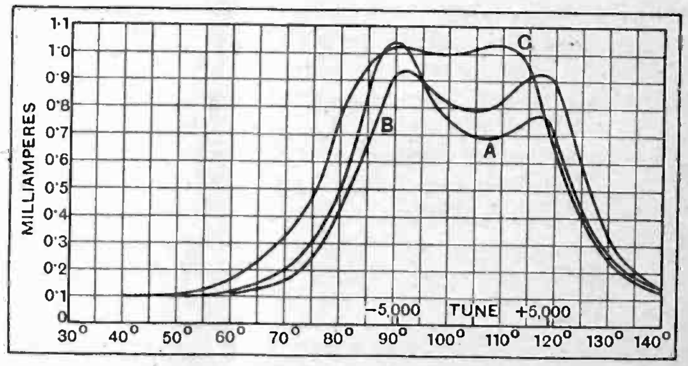


Fig. 3.—REGIONAL. M=12 turns; B, distuning 3rd circuit; C, distuning 3rd circuit and adding resistance.

apart in a screening box. The main condenser has a capacity of 0.001 mfd. and the auxiliary condenser 0.0001 mfd. It will tune to the National programme and to the Midland Regional. The coupling between reaction and grid coil should be as loose as possible.

The following results are selected from a number which the author has already obtained. Fig. 2 shows how the response curve changes with the filter coupling M. They are for the National frequency, and all show small double peaks. To obtain two equal peaks special tuning is necessary. This is illustrated in Fig. 3 (London

Response Curves.—

Regional frequency). Curve A with unequal peaks was obtained when all three circuits were adjusted to give the maximum response when in tune; curve B shows how these peaks were equalised by very slightly distuning the third circuit (tuned transformer). Finally, curve C shows how the peaks were flattened by adding $3\frac{1}{2}$ ohms resistance in each filter circuit. The reason for the inequality of the peaks[1] is twofold; the coil (*a*) in the first filter circuit has (as is usual) fewer turns than that (*b*) in the second circuit, and the first circuit is coupled to the

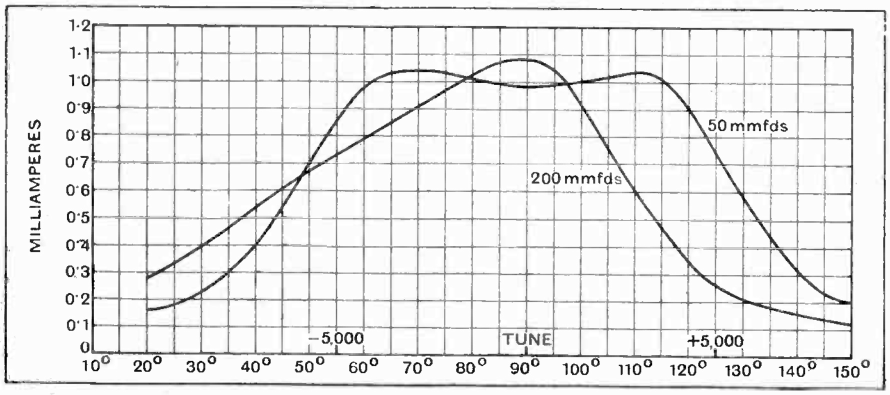


Fig. 4.—MIDLAND REGIONAL. M=13 turns. Showing effect of aerial coupling.

aerial, which affects its tuning. The effect of the aerial in disturbing the action of the filter is not referred to in either of A. L. M. Sowerby's articles. That it may be serious is shown in Fig 4. (Midland Regional frequency), where one curve was obtained when the aerial coupling condenser was small (50 $\mu\mu$F.), and the other when the coupling was increased to 200 $\mu\mu$F.

Some Unexpected Results.

Fig. 5 shows how a serious and quite unsuspected defect was found in the receiving set. To reduce the signal strength (the author's house is only six miles from Brookmans Park) a potentiometer feed to the grid of the first valve was used, as recommended by Dr. McLachlan for the "Megavox Three" and illustrated in W. I. G. Page's article already referred to. The potentiometer has ten steps and was mounted in the first screening box. When the contact arm was on the first step (full volts to grid) curve A was obtained. When the contact arm was

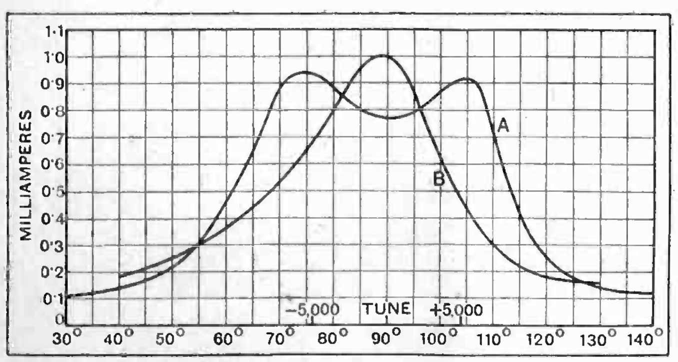


Fig. 5.—REGIONAL. M=14 turns. Effect of defective potentiometer control.

[1] See the end of this article for a more accurate discussion of this point.

on the second step curve B was obtained. The cause of the complete distortion of the tuning curve is believed to have been the capacity between the contact arm (with its spindle) and the screening box. In the first position this capacity is merely in parallel with the tuning condenser and does no harm, but in the second position this capacity is in series with the resistance of the first part of the potentiometer. The potentiometer was, of course, removed and others methods of control adopted.

Fig. 6 shows the effect of reaction; curve A (Regional frequency) was the response curve without reaction, curve B with reaction, the input having been reduced to about one-fifth. When more reaction was used the flat top of the curve disappeared and curve C was the result. The signal strength had been reduced about one-twentieth in this test. The author has not come across the theory of the effect of reaction on a filter circuit.

Finally, Fig. 7 shows the effect of removing coil M from the filter circuit. The two halves of the filter circuit are then in series and the set remains almost in tune, so that a small adjustment of either condenser brings it into perfect tune. (The two condensers are in series, their capacity is halved; the two coils are in series and their inductance is doubled.) The circuit is now the ordinary one without a filter. The response curve is much narrower and only shows 22 per cent.

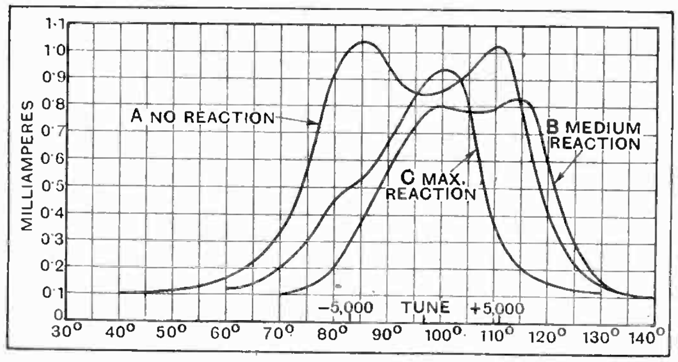


Fig. 6.—REGIONAL. M=12 turns. Showing effect of reaction.

response at 5,000 cycles off tune, which may be compared with the 95 per cent. shown in Fig. 3 for curve C.

Since the above account was written, the cause of the unequal peaks shown in curve A, Fig. 3, has been fully investigated. The inequality is not due to the causes suggested above, but is the necessary result of tuning the set to give the maximum response, when the response curve has a double peak. What we automatically do is to tune the set to a frequency just above or just below the correct one, so that it is working on the lower peak (if tuned too high) or on the upper peak (if tuned too low). When this is realised it is easy to tune so that either the right or left peak shall be the higher, but it is impossible to hit the mid-point, which is what is wanted, without using some special device. A suitable device is to put a temporary resistance in each arm of the filter during tuning; the tuning

Response Curves.—
must not be touched after the resistances are removed.

These examples are sufficient to show that interesting results can be obtained by this test. No great accuracy is claimed for the method, but when dealing with large effects accuracy is not of great importance. It will be noted that the upper parts of the curves are given much more accurately than the lower, so that the curves are more useful for estimating side-band transmission than for estimating selectivity. It is interesting to note that the only piece of calibrated apparatus required for the test (in addition to the detector milliammeter) is the main condenser in the oscillation generator.

APPENDIX.

METHOD OF FINDING THE STRAY CAPACITY OF THE OSCILLATING GENERATOR CIRCUIT.

Tune the generator to three waves of known frequencies, say the National, London Regional, and Midland Regional, noting the total capacity of Main condenser plus Auxiliary condenser for each.

Plot these capacities against the reciprocal of the square of the corresponding frequencies, i.e., plot K against $\frac{1}{f^2}$. The three points so found should lie in a straight line. Produce this line to cut the vertical axis, which it will do below the origin, at, say, $-A$ microfarads. Then A is the stray capacity required.

The total capacity in the generator circuit is the sum of the three parts, Main condenser capacity + Auxiliary condenser capacity + Stray capacity A.

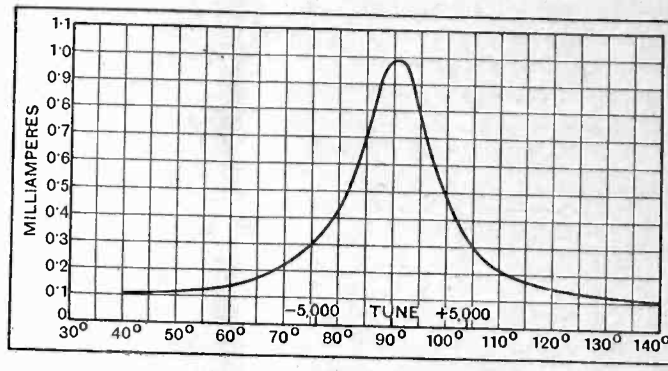


Fig. 7.—REGIONAL. With coil M removed.

Two points would be sufficient to determine the straight line, and thus A, but it is a wise precaution to observe a third, to make sure that they lie in a straight line.

THE NEW HOME OF R.I.

Well Planned Factory at Croydon.

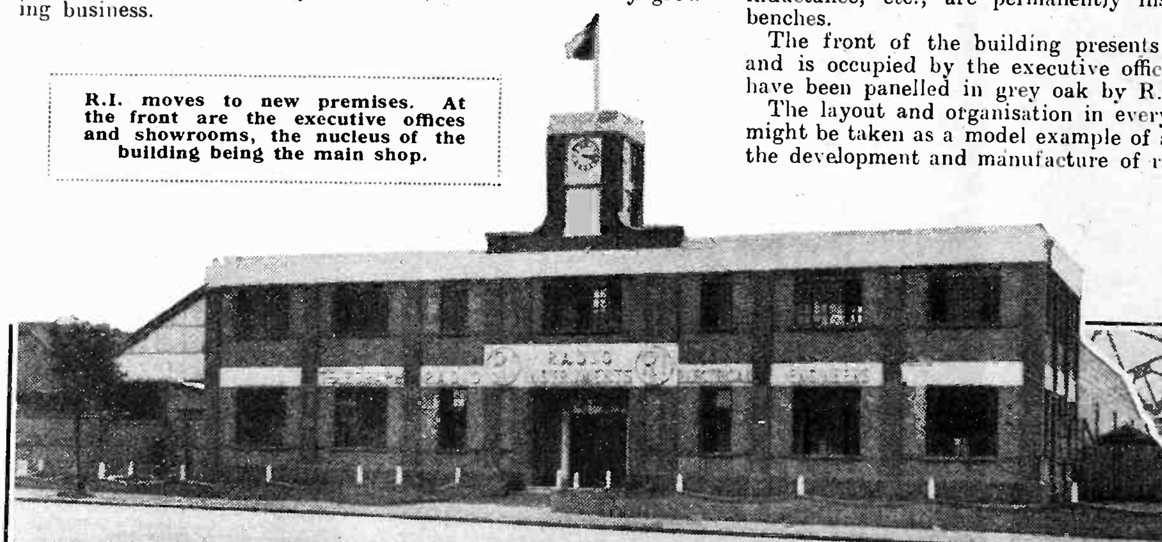
FOR some time past the limited accommodation at the old Hyde Street factory of Radio Instruments, Ltd., has imposed obstacles of increasing difficulty in the way of smooth organisation, and a move has at last been made to new premises at Purley Way, Croydon. This change reflects the stable position reached by the firm to-day and is evidence of a steadily growing business.

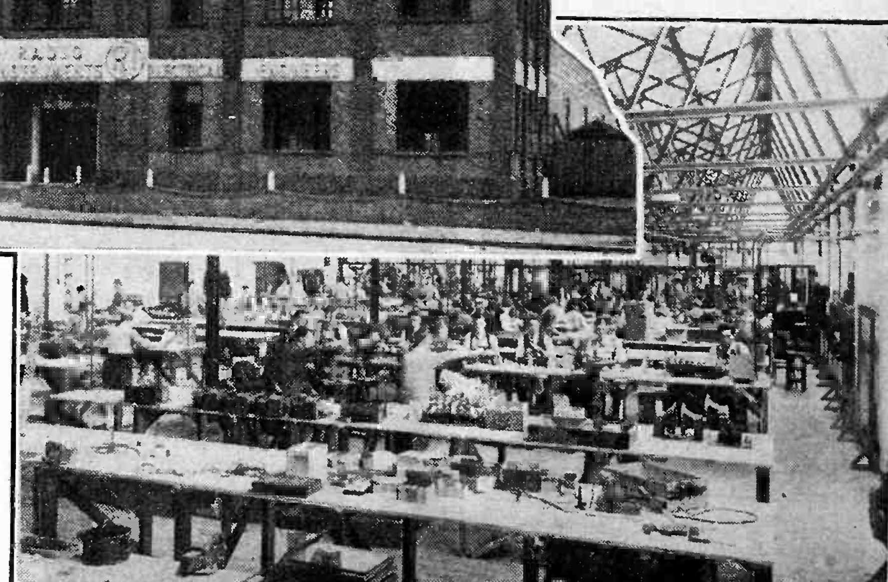
The test room leads off the main shop at the front near the final assembling benches, and has ample accommodation for both routine testing and research and development work. A central switchboard and branch leads duplicate mains and battery supplies on every bench, while standard tests for capacity, inductance, etc., are permanently installed each on separate benches.

The front of the building presents a very pleasing façade, and is occupied by the executive offices and showrooms which have been panelled in grey oak by R.I. cabinet makers.

The layout and organisation in every detail is excellent, and might be taken as a model example of a factory ideally suited to the development and manufacture of radio apparatus.

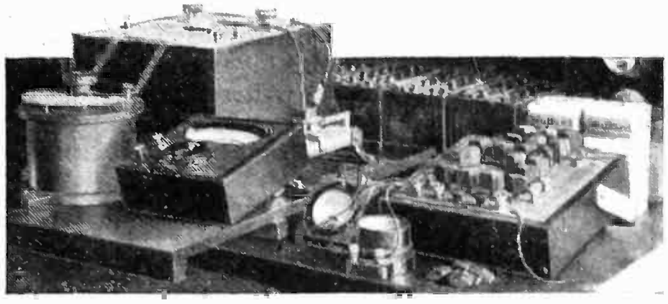
R.I. moves to new premises. At the front are the executive offices and showrooms, the nucleus of the building being the main shop.





The new factory has been built to the specifications of Radio Instruments, and the layout is specially adapted to the manufacture of radio sets and components. The nucleus of the building is a large central shop accommodating the whole of the manufacturing processes, including machinery, press-work and assembling. Running down the left-hand side are the stores for raw materials and finished products with doors opening on the outside to a concrete roadway for loading and unloading vans and lorries. The works manager's office is glass-framed and overlooks the whole shop.

INSULATORS TESTED



[4] MYCALEX

A New Insulating Material of Exceptional Interest.

By W. H. F. GRIFFITHS, F.Inst.P., A.M.I.E.E.

THE need has long been felt for an insulating material which could combine the wonderful strength and heat-resisting properties of Bakelite with the low power loss of pure ebonite. In Mycalex we have a material with this strength, with even greater heat-resisting properties, and yet having much lower dielectric loss than ebonite, especially at the higher radio frequencies.

Until recently the best that could be expected in efforts to combine these desirable mechanical and electrical properties was a compromise by scientifically loading ebonite to obtain a material such as Keramot, of moderately good dielectric properties, fairly hard and with a reduced plastic yield. This material, however, as well as being merely a compromise, has a high temperature coefficient of expansion—almost as high as that of true ebonite. The only other alternative, if a really low-loss, heat-resisting, low-expansion, and strong insulator was required, was one built up of a large number of clear mica laminations clamped together with great pressure between flanges—an expensive proposition and one to which one seldom resorted.

Fused silica and pyrex are other insulators sometimes employed in the construction of wireless apparatus in which low dielectric loss and great geometrical permanence are desirable features. These insulators are, however, both difficult to work and very apt to fracture either during the assembly of the apparatus or during its transportation.

Having therefore exhausted our list of likely insulating materials, and having rejected each for one reason or another, it is easy to see why the newly invented Mycalex should be welcomed in the field of radio generally, and more especially, perhaps, by those of us who are directly interested in the design of precision apparatus for the more specialised field of radio measurements.

Mycalex is a British Invention,[1] and, although hitherto it has only been obtainable from Germany and America, production is now commencing at a London factory. In its manufacture finely divided mica and certain silicates are fused together, resulting in a very hard vitreous material of low thermal expansion which can be ground, drilled, tapped, and sawn.

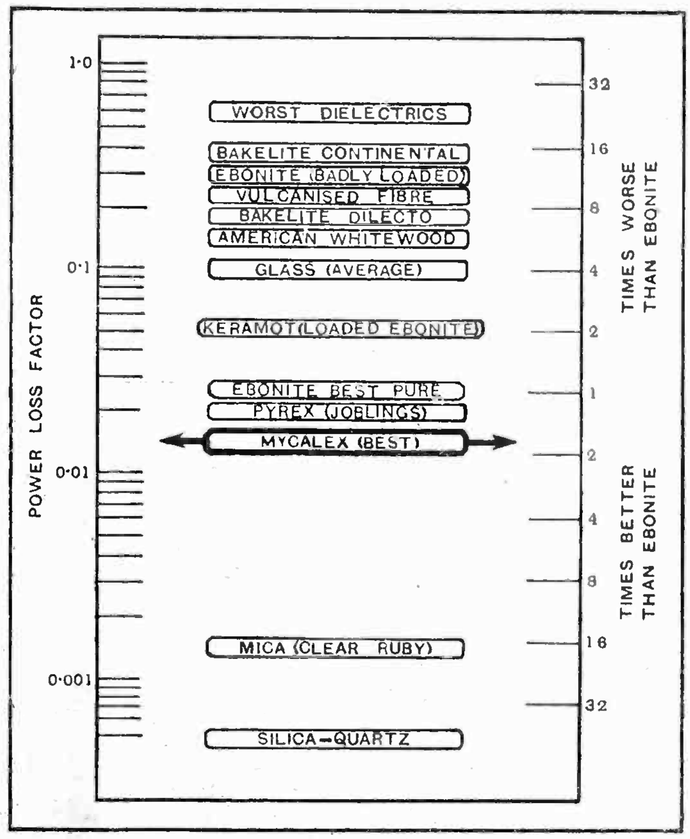


Fig. 1.—Chart of insulating materials showing relative power-loss factors.

When supplied by the manufacturers, Mycalex has a soft crust or skin which is very absorbent and has, at the lower frequencies at any rate, a much greater dielectric loss than that of the really hard homogeneous material which is exposed upon the removal of the skin. The skin thickness varies apparently with slight changes in the method of production, and it is somewhat difficult in some cases to judge the correct amount to grind off owing to the change in nature being ill-defined.

The material is, or will be, used for many purposes in the construction of industrial electrical apparatus[2] where the property with which we, in low-loss radio design, are most concerned—the power-loss factor—is of very little or no importance. This may be the reason for the great varia-

[1] The inventor is P. B. Crossley, F.I.C., M.I.Chem.E.

[2] Mycalex can be moulded with metal inserts and so is ideal for a large number of commercial electrical fittings and domestic appliances.

Insulators Tested—(4) Mycalex.—

tion of power-loss factor which the author has experienced in the various specimens of Mycalex which he has investigated. These original samples, which were supplied some time ago by Messrs. Allgemeine Elektricitats Gesellschaft, in some cases were found to have power-loss factors of from 0.3 to 0.6 at a frequency of 800 cycles per second, although at the medium-high radio frequencies they always improved to a great extent, sometimes to as low a figure as 0.06. Thus at speech frequencies the material appeared to be as bad as the worst dielectrics on the chart of Fig. 1, and at radio frequencies round about 300 metres it exhibited the same loss as Keramot or a little greater.

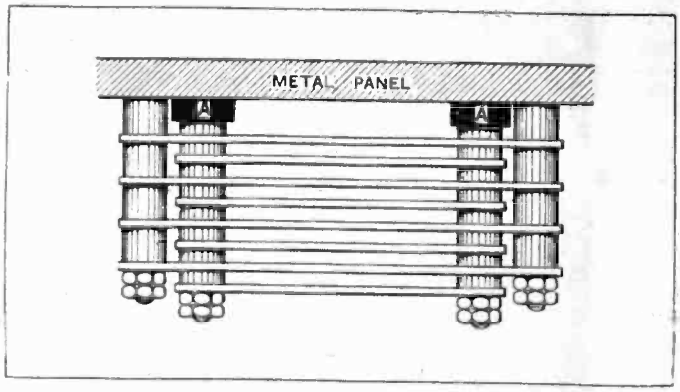


Fig. 2.—Method of supporting the plates of an air dielectric condenser and used to compare the material with ebonite.

It was, however, discovered that the extraordinarily high power loss at speech frequencies was due largely to the soft skin, for the specimens had been tested just as they were received from the makers, and in some cases the skin was a considerable proportion of the total thickness. Even upon the removal of the skin the power-loss factor was, however, still much too high.

Later specimens from the same source are much better and more consistent in dielectric quality, but the behaviour of the material before the removal of its soft crust is most interesting. In almost every case the power-loss factor increased rapidly with a *decrease* of frequency, until at mean speech frequencies it was as high as 0.1—as bad as ordinary glass.

After removing the crust, however, these later specimens of Mycalex were found to be very hard and non-absorbent and to have a very low dielectric loss, especially at the higher radio frequencies with which the wireless amateur is most concerned. At these frequencies (round about 300 metres) the material is twice as good as ebonite, as will be seen in the chart of Fig. 1, which means that the equivalent series resistance of the 250 $\mu\mu$ F air condenser of Fig. 2 would be decreased from 0.2 ohm[1] to 0.1 ohm on this wavelength if the ebonite insulators "AA" were replaced by similar pieces of Mycalex.

Thus it will be seen that Mycalex, as well as being hard, unyielding even at very high temperatures, non-absorbent, and of low thermal expansion, has lower dielectric loss than any of the insulating materials except mica and fused silica. Moreover, the fact that it can be worked cheaply and without ***extreme*** difficulty makes it a much more desirable material for use in all but the most low-loss designs.

[1] Assuming that 10 $\mu\mu$F of the capacity is due to the field actually passing through the *ebonite* insulators.

NEWS FROM THE CLUBS.

Compiling the Winter Programmes.

A number of the more active clubs are already engaged in the preparation of programmes for the coming session, a task which grows less difficult from year to year owing to the ever-expanding scope of radio research. In the early days repetition of subject was less easily avoided, and although many will argue that oft-repeated lessons are the most valuable, the dangers of monotony have been the undoing of more than one wireless club in the past.

Entertaining and instructive demonstrations are now given by the majority of the better-known wireless firms, and club secretaries labouring to fill gaps in their syllabuses can hardly do better than apply to the trade for the facilities which are so readily supplied.

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Transmitter Hunt in Herts.

A number of members of the North Middlesex Radio Society, equipped with portable direction-finding apparatus, met recently at Croxley Green and spent the afternoon amidst beautiful country in locating a hidden transmitter, which sent out signals every half-hour.

This proved to be at a farm near the village of Newgate Street, some fifteen miles from the start, and the first party to locate it arrived in a little over two hours—a creditable achievement.

The Golders Green and Hendon Radio Society was represented by two well-equipped parties.

Hon. Secretary, Mr. E. H. Laister, "Windflowers," Church Hill, Winchmore Hill, N.21.

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Making Screening Boxes.

"Screening Boxes" was the subject of a lecture given by Mr. R. W. Lawrence at a recent meeting of Slade Radio (Birmingham). Commencing with a brief history of the tinplate industry, the lecturer outlined the reasons which have led up to the present practice of entirely screening the most efficient receivers and proceeded to give details of the methods which are open to the amateur who wishes to make his own screening boxes.

Hints on marking, cutting, bending and soldering were offered, and useful advice was given on how to overcome difficulties. A short practical demonstration was given at the conclusion of the lecture.

Particulars regarding membership of the Society, which holds meetings every Thursday at 8 o'clock at the Parochial Hall, Broomfield Road, Slade Road, Erdington, may be obtained from the Hon. Secretary, 110, Hillaries Road, Gravelly Hill, Birmingham.

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D.F. in the Forest.

The discovery near London of an ideal venue for direction-finding operations was revealed in the course of a field day held recently by the Golders Green and Hendon Radio Society in conjunction with the Muswell Hill, North Middlesex, Western Postal, and Belsize Radio Societies. The locality chosen, *viz.*, the neighbourhood of Epping, provided competitors with opportunities of testing the shielding effect of forests without interference from telegraph wires and other sources.

No reduction in signal strength was reported by the D.F. groups, who were situated nearly four miles from the transmitter and separated from it at most times by a belt of woodland at a greater altitude than the apparatus.

The scheme was divided into two parts. In Part A each group was required to take bearings from three different positions, marks being awarded for accuracy. In Part B groups had actually to discover the transmitter.

Mr. Maurice Child, one of the prize-winners, used a screened grid set installed at the rear of a two-seater car.

The fact that amateurs from all parts of North London were engaged in the afternoon's experiments proves that wireless field days are as popular as ever.

In October members of the Golders Green and Hendon Radio Society will pay a special visit to the B.B.C. transmitters at Brookmans Park.

Full particulars of membership can be obtained on application to the Hon. Secretary, Lt.-Col. Ashley Scarlett, 60, Pattison Road, N.W.2.

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All About Filter Design.

"The A.B.C. of Filter Design" was the title of an unusually interesting lecture given recently by Mr. G. Stewart Halliday before the Radio Experimental Society of Manchester. Touching on most phases of the subject but dealing mainly with L.F. filter circuits, he showed how to design the smoothing circuits of eliminators and how to work out all the necessary figures for band-pass filters in connection with the compensation of uneven frequency output curves for gramophone pick-ups and other apparatus.

The Society still has several vacancies for members and welcomes enquiries from interested amateurs, who are cordially invited to inspect the laboratory at No. 8, Water Street, Manchester.

Particulars from R. M. Kay, B.Sc., Tech., Joint Hon. Sec., at 58, Daisy Bank Road, Victoria Park, Manchester.

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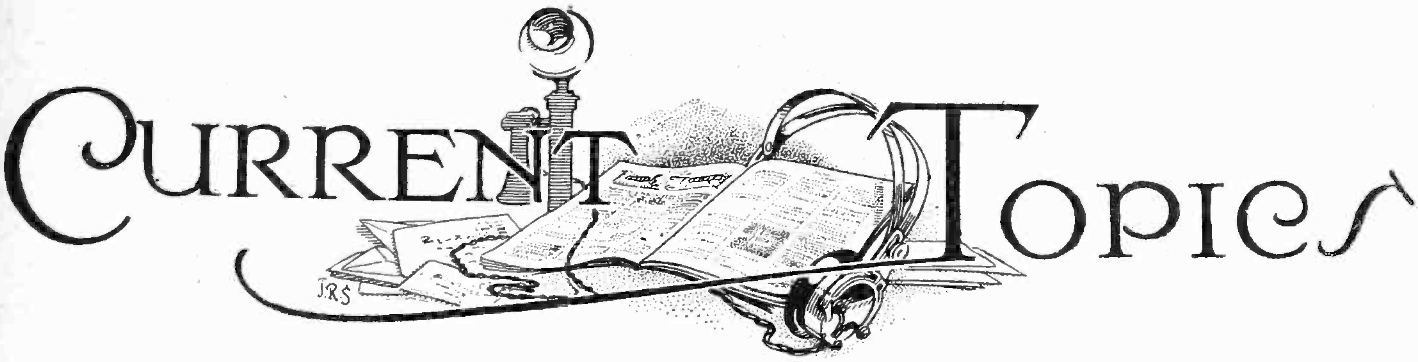
Change of Address.

Mr. Fred J. Waller (5QK), hon. secretary of the Southend and District Radio Society, has now changed his address to 40, Fermoy Road, Thorpe Bay.



Events of the Week in Brief Review.

ANOTHER 50-KILOWATTER.

The world's latest 50-kilowatt broadcasting station is KMOX, St. Louis, which is the ninth American station of its class to be granted a licence by the Federal Radio Commission.

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60 KILOWATTS FOR RADIO TOULOUSE.

Radio Toulouse, probably the most popular station in France, is about to be moved to a new site outside the town. The transmitter is to be enlarged with a power increase to 60 kilowatts.

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THE WIRELESS SWIM.

Crowds of holiday-makers lined the banks of the river Severn on August 5th to witness the annual distance swimming race which is held in aid of the Mayoress of Worcester's fund to provide wireless for the blind of the city.

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PARIS RADIO EXHIBITION.

Definite dates have now been fixed for the Paris Autumn Wireless Exhibition, which will open on September 26th at the "International Salon," which is close to the Montparnasse railway station in the Latin Quarter. The Exhibition will remain open until October 9th.

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A SIX MONTHS' SHOW.

A French "Wireless Week" will replace the usual Paris radio show next year. This decision has been arrived at by the French radio manufacturers in view of the fact that a wireless section will be one of the permanent attractions of the Paris International Colonial Exhibition which will open in the Bois de Vincennes in May, 1931, and run for six months.

"Wireless Week" will probably occur in the autumn.

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PROGRAMME POTTING IN U.S.

"Home-recording" is to be the new fashion among American listeners, according to our Washington correspondent, who reports that one of the leading manufacturers is about to announce the production of a radio-gramophone set capable of recording the broadcast programmes as they are received, in addition to performances in the home.

The new set, which will sell in the medium price class, will make its first appearance at the Radio World's Fair, New York, opening on September 22nd.

SCHOOL WIRELESS IN FRANCE.

It is estimated that broadcast receivers are now installed in 2,000 French chools.

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A NEW NAME.

"Contemptible radi-owe" is a Newcastle journal's description of wireless piracy.

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INTERNATIONAL SHOW IN COLOGNE.

A wireless exhibition will be held in Cologne from September 14th to 19th. Foreign firms are allowed to participate if represented in Germany.

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HOUSE OF COMMONS WIRELESS.

We understand that a large number of signatures have been obtained to a petition for the installation of broadcast receiving apparatus in various rooms in the House of Commons. The organiser of the petition is Mr. E. Edwards, M.P. for Morpeth.

SWISS WIRELESS SHOW.

Lausanne will hold a wireless exhibition from September 13th to 28th.

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AMERICA'S RADIO STATE.

Alabama is reported to be leading all other American States in its enthusiasm for radio. A receiver is now installed in every court house in the State, and the authorities are paying one-third of the cost of all receiving sets installed in the schools.

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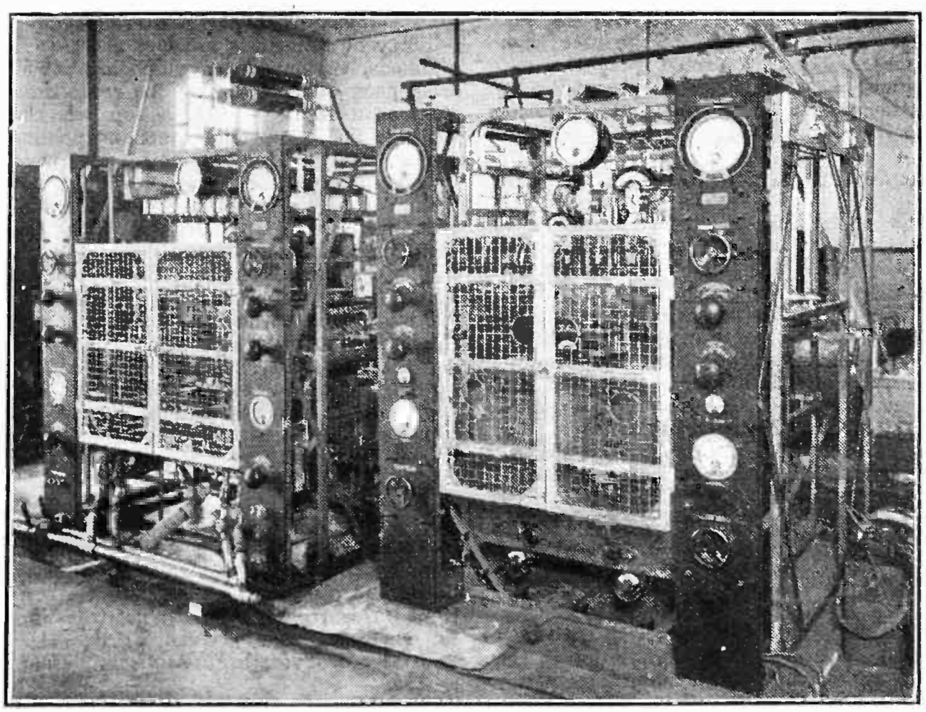
YUGOSLAVIA AND MAN-MADE STATIC.

Clause No. 213 in the country's new Penal Code indicates that the Yugo-Slavian Government is on the side of the angels in cases of electrical interference with wireless installations. The clause runs :—

"Whoever, voluntarily or by negligence, prevents, or interferes with, the functioning of a radio installation by means of



A PIONEER TRANSMITTER. 5SW, the Marconi short-wave transmitter at Chelmsford, whose daily tests extending over three years, have demonstrated the practicability of an Empire broadcasting service. As first exclusively reported in *The Wireless World*, the erection of a new permanent short-wave station has been sanctioned by the Colonial Conference.

electrical installations, or who interferes with or misappropriates the current necessary to the working of a radio installation, will be punished—in the event of a disturbance or stoppage taking place—by one year's imprisonment or a fine of 10,000 dinars (approximately £394)."

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COMPULSORY RELAYS IN URUGUAY.

Theatres and concert halls in Uruguay are now legally compelled to allow the broadcasting of their performances, according to the new radio statute. Apparently theatre managers who refuse facilities will be fined 100 pesos (£20) for each offence!

The radio administration will be supported by listeners' licence fees, the annual contribution being about £2. Revenue will also be drawn from radio import duties.

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FL TO ABANDON BROADCASTING.

The Eiffel Tower station is generally regarded as France's national transmitter. In the near future, however, it is likely to be superseded by the new Paris P.T.T. station which will shortly install apparatus with a power of 12 kilowatts. It is an open secret, writes our Paris correspondent, that the Eiffel Tower will ultimately abandon concert-giving, being reserved for official communications and experiments under the direction of General Ferrié, the Chief of the Army Radio Services.

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NORWEGIAN BROADCASTING UPHEAVAL.

A complete change is about to take place in the administration of Norwegian broadcasting, the Government having decided to take over all existing broadcasting stations in order to form a State service. The programmes will be supplied under contract by private companies. It is expected that the new regime, incorporating 43 main and relay stations, will be in complete operation not later than 1934.

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CANADIAN LISTENERS HEAR AIRSHIP CHAT.

By cable from Montreal details have been received of the broadcast of a two-way wireless telephonic conversation between a land station at Ottawa and the R100 during the passage of the airship over the capital of Canada. The details were arranged through the co-operation of the Royal Canadian Signal Corps in conjunction with the Radio Department of the Canadian National Railways.

The Hon. R. B. Bennett, the Prime Minister, took his place in the studio of CNRO, situated in the Chateau Laurier, and from there spoke to Wing-Commander Colmore, Sir Dennistoun Burney and Major G. H. Scott, and others aboard the R100. In turn those on the R100 addressed the land station CNRO.

Transmission both ways was clear and distinctly audible though reception in the ship was better, due to the greater power available at CNRO. Communication was maintained from 10.34 p.m. to 11.7 p.m., and it is believed that this is the first occasion on which a broadcast of such character has been conducted.

WATCH YOUR MAST!

The latest story from America concerns a family of woodpeckers who, it is stated, recently succeeded in stopping the transmissions of Station WNBO, Philadelphia, for forty-eight hours. This they accomplished by drilling a hole through a 100-foot cedar wireless mast three feet thick. Eventually the mast collapsed.

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A NEW APPOINTMENT.

Mr. W. B. Bartley, who was educated at Winchester and at New College, Oxford, where he obtained his B.A. in the Honours' School of Physics, has joined the technical staff of Murphy Radio, Ltd.

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FRENCH COLONIAL BROADCASTING STATION.

An experimental Colonial broadcasting station for France will be inaugurated at the Paris Colonial Exhibition of 1931, according to a decision of the committee recently nominated to discuss the question. The test station will be erected by the Post Office, writes our Paris correspondent, and the experience gained in its operation will be utilised in the construction of a permanent station at Saint-Germain, to be controlled by a "National Federation of Colonial Broadcasting."

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OLDFIELD IN ANOTHER "TEST."

Mr. Oldfield, the Australian wicket-keeper in the Test matches, recently tested a number of British portable sets to decide the best type for use in Australia, where distances from transmitters are measured in hundreds of miles. We learn from Messrs. Dunhams, Limited, that one of their new S.G. four-valve portable sets was the ultimate choice.

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AMERICAN RADIO COLLAPSE?

Forty of America's precious short-wave channels, the supply of which has otherwise been exhausted, may be recaptured soon as a result of the action of the Chicago federal district court in appointing a receiver for Universal Wireless Communications Co., Inc., which was formed to develop a coast-to-coast radiotelegraph system to compete with the Western Union and Postal Telegraph.

The company was given three years in which to complete and have in operation 110 stations in as many cities (writes our Washington Correspondent). The quota for the first year, 1929, was met with a dozen stations, and construction was begun in other cities to meet the second year's quota. It is understood that most, if not all, of these stations have shut down.

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CONTROL OF INDIAN BROADCASTING.

A decision to place the Calcutta and Bombay broadcasting stations directly under the control of the Indian Government Department of Industries and Labour has been arrived at by the Central Broadcasting Advisory Committee.

The Government is determined that the system shall in time become self-supporting through the contributions of all listeners. In the words of the *Indian Radio Times*, "the service caters for Europeans and Indians equally; it recognises no distinction of cast or creed or colour; it aspires to bring all together into one grand harmony of Union and Happiness."

We hope that the Indian Government will succeed in conquering the two principal foes of broadcasting in India, viz., public apathy and unlicensed listening.

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CROWDING THE FRENCH ETHER.

Several new broadcasting stations are planned for French listeners, including Radio-Touraine, Radio-Fécamp, Rouen, and Clermont-Ferrand. The journal *Intransigeant*, referring to these projected stations, reminds the public that the Plan de Prague, which is still valid, allots only sixteen wavelengths to France. As France already possesses twelve stations beyond her legitimate number, it is predicted that the opening of more stations will cause Germany and England to "howl."

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HOW AUSTRALIA LISTENS.

Victoria still retains the leadership among the Australian States in the number of wireless licences with 141,081. The total number in the Commonwealth on May 30th was 311,322. New South Wales had 110,682 licences in force, Queensland 22,797, South Australia 25,448, Western Australia 5,552, and Tasmania 5,762.

BOOKS RECEIVED.

Development of the Visual Type Airway Radiobeacon System. By J. H. Dellinger, H. Diamond, and F. W. Dunmore. (Bureau of Standards, Research Paper No. 159.) Pp. 25, with 28 illustrations and diagrams, including 9 half-tone plates, price 20 cents.

A Critical Review of Literature on Amplifiers for Radio Reception, issued by the Radio Research Board, of the Department of Scientific and Industrial Research. Special Report No. 9. A review and general bibliography of the more recent literature on the design of radio receivers divided into four main sections: 1, Radio Frequency Amplifiers; 2, Rectification; 3, Audio Frequency Amplifiers; 4, Measurements. Each main section is subdivided and a critical essay based on the study of the literature of each subsection is followed by an abstract of the principal articles reviewed. Sections 1, 3, and 4 compiled by Mr. H. A. Thomas, M.Sc., and Section 2 by Mr. F. M. Colebrook, B.Sc. Pp. 239-VIII. Published by H.M. Stationery Office, price 5s. net.

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A Tuned-Reed Course Indicator for the 4- and 12-Course Aircraft Radio Range. By F. W. Dunmore. (Bureau of Standards, Research Paper No. 160.) Pp. 14, with 14 illustrations and diagrams, including 2 half-tone plates, price 15 cents.

All the above obtainable from the Superintendent of Documents, Washington, D.C., U.S.A.

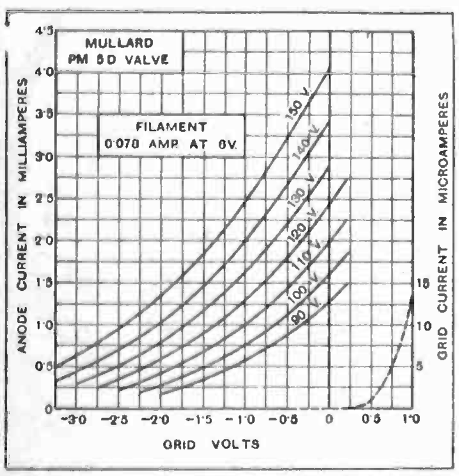
VALVES WE HAVE TESTED

Two New Mullard Valves. The P.M.5D. and P.M.256A.

THE P.M.5D. is a medium impedance valve which occupies an intermediate position between the P.M.5X. and the high-impedance P.M.5B. the rated characteristics being:—

A.C. resistance, 20,000 ohms;
Amplification factor, 26;
Mutual conductance, 1.3 mA./volt;

measured at 100 volts H.T. and zero grid bias, the maximum anode voltage being 150. A specimen valve



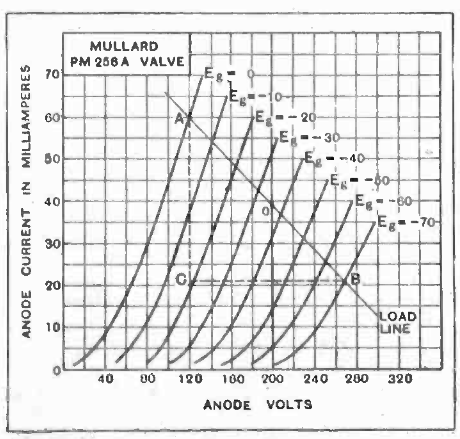
Characteristics under working conditions, average values, A.C. resistance 24,000 ohms, amplification factor 28, mutual conductance 1.12 mA./volt.

measured under the same conditions exhibited slightly less good characteristics than the makers' figures, the A.C. resistance being 27,000 ohms, the amplification factor 29.6, and the mutual conductance 1.1. mA./volt.

This particular sample would appear to be somewhat below standard, as the emission is low at all points on the curves prepared, as compared with the anode current-grid volts curves supplied by the makers. There was no trace of reversed grid current, showing that the vacuum is dead hard. Although the valve is heavily "gettered," it is just possible to discern the nature of the internal construction. The electrodes are of the familiar "flattened" type, and are mounted horizontally in the bulb.

The P.M.256A and P.M.5D valves.

According to the makers' recommendation, this valve requires a grid bias of −3 volts with 150 volts H.T., but it will be seen from the curves taken with the specimen tested that in this particular case a bias of −1.5 volts is adequate for amplifying conditions.



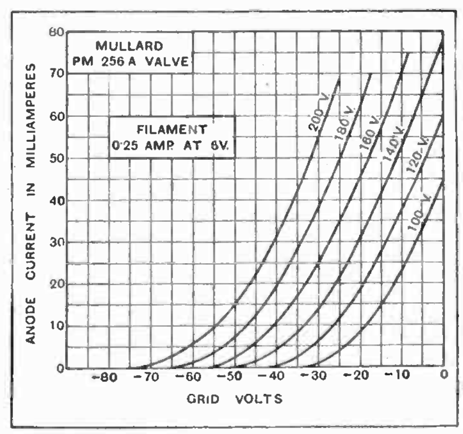
Anode volts/anode current curves of the P.M.256A. From these the maximum undistorted power output, the optimum grid bias and the best loud speaker impedance (load line) can be found.

P.M.256A.

This is a super-power valve capable of handling considerable power without an unduly high anode voltage, and should accordingly meet the requirements of a large number of readers. The rated characteristics are:—

A.C. resistance, 1,400 ohms;
Amplification factor, 3.6;
Mutual conductance, 2.6 mA./volt;

taken as 100 volts H.T. and zero



Characteristics under working conditions: A.C. resistance 1,410 ohms, amplification factor 3.1, mutual conductance 2.2 mA./volt.

grid bias. The maximum anode voltage is 200.

The sample tested appeared to be a good specimen, as the anode current was slightly higher at all points of the anode current-grid volts curves taken as compared with those supplied by the makers. Incidentally, these familiar curves convey very little useful information in the case of a power valve, so it was decided to prepare a second set connecting anode current and anode voltage for equal increments of grid bias from 0 to 70 volts, and with a 50 per cent. increase in anode voltage. From these curves we can ob-

Valves We Have Tested.—tain such essential information as the maximum undistorted power output, the most suitable loud speaker impedance and the optimum grid bias voltage for any value of H.T.

The sample tested was found to give 726 milliwatts output, after allowing for 5 per cent. second harmonic, and with the maximum of 200 volts H.T. and a grid bias of −36 volts. The distortion introduced by this value of second harmonic is generally agreed as being the maximum that can be tolerated in the majority of cases. The most suitable loud speaker impedance was found to be 3,800 ohms. By reducing the anode voltage to 150, and making the required adjustment to the grid bias, the power output, for the same conditions, falls to 390 milliwatts. The measured characteristics of this valve at 100 volts H.T. and zero grid volts are:

A.C. resistance, 1,300 ohms;
Amplification factor, 3.6;
Mutual conductance, 2.6 mA./volt.

Since precise figures regarding the maximum permissible anode dissipation in watts are not available, it would be advisable to assume that it is of the order of that determined by the operating conditions imposed by the makers. Consequently, care should be exercised at all times where a change in the operating voltages is contemplated, and under no conditions should the valve be run with insufficient grid bias. Should it be required to make any alterations in the bias value, the H.T. should be disconnected.

LABORATORY TESTS.

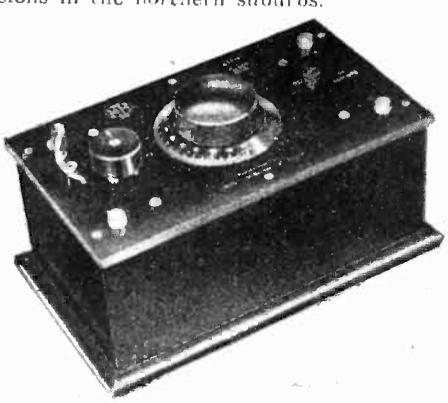
New Apparatus Reviewed.

McMICHAEL RADIO FILTER.

At the time Brookmans Park commenced operations many listeners were still unprepared to cope with the new conditions, and as a consequence numerous units were quickly evolved to improve the apparent selectivity of the simpler type of sets. Many of these were obviously palliatives, albeit commendable prices of apparatus.

Time has now enabled the problem to be approached from a more scientific angle as exemplified by the new Radio Filter produced by Messrs. L. McMichael, Ltd., 179, Strand, London, W.C.2. This is not a wave-trap, but a cleverly devised aerial tuner, which, by varying the coupling between it and the aerial, and also between the tuner and the set, affords a wide range of selectivity. It can be adjusted to admit the London Regional and the National programmes so that either can be received with a minute trace of background from the other, or the response so sharpened that a clear band of approximately 60 metres exists between the two.

These results were achieved with a simple o-v-2 set, which, normally, would not separate the two London transmissions in the northern suburbs.



McMichael Radio Filter.

The tuning inductance is cylindrical and the turns spaced; tappings are provided to give three alternative aerial positions, and the coil is tuned by 0.0005 mfd. variable condenser. A few turns of the coil are used as the coupling to the set, the degree of coupling being variable and capacity controlled. A four-pin plug is used in place of a switch to bring the unit into action when required. The whole is enclosed in polished mahogany case measuring 8½in. × 4¾in. × 4in. deep with a polished ebonite top carrying the controls and terminals. It covers the 200-600 metre waveband, and the price is 37s. 6d.

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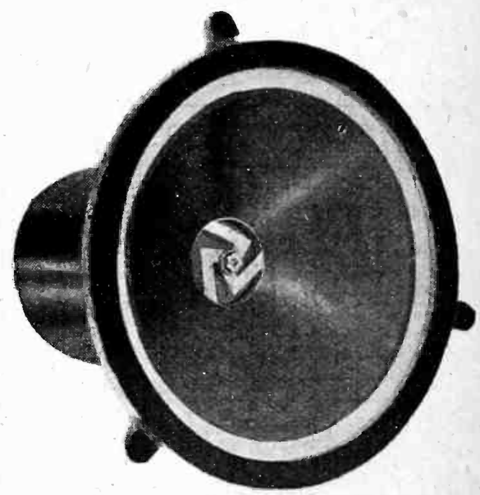
VOX VERITAS MOVING-COIL LOUD SPEAKER.

This loud speaker is made by The Morogoro Trading Corporation, Ltd., 12, Union Court, Old Broad Street, London, E.C.2, who make a speciality of supplying moving-coil windings to suit output valves of any given impedance. The specimen tested had a 3,000-turn winding designed to match pentode valves, and its impedance at various frequencies was as follows:—

Frequency.	Impedance (ohms).
50	14,100
100	5,340
200	5,030
400	5,870
800	7,820
1,600	11,550
3,200	21,350
6,400	—

It will be observed that the impedance between 100 and 400 cycles is lower than at any other point in the frequency range, and this would account for the absence of "boom" in the bass and lower middle register, which the makers claim as a feature of this instrument. On the other hand the 50-cycle reproduction is much better than the average moving coil, due to the rise in impedance at this frequency.

The only points of criticism are that the sensitivity is somewhat below the average, and that a slight dip occurs in the frequency characteristic at 2,000 cycles. When listening either to speech or music the effect of this depression is difficult to detect and the general result is entirely satisfactory.



Vox Veritas moving-coil loud speaker.

The field magnet is massive, and consumes 33 watts at 220 volts.

The price of the unit tested is 52s. 6d.; for windings other than the special pentode winding the price is 50s.

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R.K PERMANENT MAGNET LOUD SPEAKER.

In connection with the report on this unit, which appeared in the July 16th issue, it should be noted that the diameter of the diaphragm is 8in., and not 10in. as stated.

This instrument is fitted with dust windows in the fabric spider which centres the cone, and dust particles are effectively prevented from entering the air gap.

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BLUE SPOTS UNIT.

In respect to our review of the new 66R and 66P units on Page 132 of the August 6th issue, F. A. Hughes and Co., Ltd., point out that the 66K model has not been superseded by the new units, but will continue to be marketed concurrently with them.

WIRELESS THEORY SIMPLIFIED

By
S. O. PEARSON,
B.Sc., A.M.I.E.E.

(Continued from page 152 of previous issue.)

The Valve as an Amplifier.

HAVING obtained an exact formula for calculating the actual voltage amplification n given by a valve with a non-inductive resistance connected in the anode circuit, the next step is to examine this equation with a view to finding out the manner in which the value of the added resistance in the anode circuit affects the voltage amplification obtained.

The voltage amplification is

$$n = \mu \times \frac{R}{R + R_a} \quad \ldots\ldots\ldots\ldots \quad (1)$$

where R is the series resistance in ohms in the anode circuit and R_a is the A.C. resistance or differential resistance of the valve, μ being the amplification factor. From the curves given in the previous section showing the relationship between grid voltage and anode voltage it was found that with 13,400 ohms in the anode circuit the voltage amplification obtained was somewhere between 18 and 20, as close as it was possible to read from the small-scale curves. The A.C. resistance of the valve itself was 13,400 ohms and its amplification factor 36, and therefore, substituting these values in equation (1) above, we get

$$n = 36 \times \frac{13{,}400}{13{,}400 + 13{,}400} = 18,$$

which is in agreement with the value determined graphically.

From this result it is clear that when the series anode resistance is made equal to the A.C. resistance of the valve the voltage amplification obtained is just half the amplification factor. Of the total alternating E.M.F. introduced into the anode circuit by the action of the grid when an alternating voltage is imposed on it half is absorbed in driving the alternating component of current through the A.C. resistance of the valve and the other half in driving this current through the external anode resistance. It is this latter half only which becomes available for practical use.

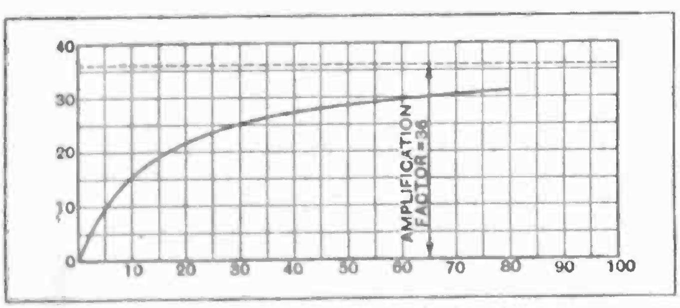

Fig. 1.—Calculated voltage amplification obtained for a valve with μ = 36 and R_a = 13,400 ohms for various values of resistance in the anode circuit.

If V_g is the alternating voltage imposed on the grid the effective electromotive force in the anode circuit is μV_g volts. This is then divided in the direct ratio of the A.C. resistance of the valve to the external resistance in the anode circuit for all values of R. Thus if R is made three times as great as the internal A.C. resistance of the valve the external resistance R is three-quarters of the *total* resistance, and therefore the voltage amplification will be three-quarters of the amplification factor of the valve. The larger R is made, the greater is its ratio to the total resistance, and therefore the greater will be the voltage amplification.

Obtaining Maximum Voltage Amplification.

Continuing along this line of argument, and making the series resistance larger and larger, we reach the limiting condition that when the anode resistance is made infinitely great the voltage amplification becomes actually equal to the amplification factor of the valve. But this is only theoretical, because an infinitely great resistance constitutes an open circuit, and under such conditions there would be no D.C. component of voltage at the anode and the valve would not function. To be strictly correct, then, we should state that the voltage amplification approaches more closely to the theoretical maximum value, namely, the value of the amplification factor, as the value of the anode resistance is raised, until such a point is reached that the mean anode potential becomes too low to allow the valve to function properly.

The voltage amplification obtained with various values of resistance in the anode circuit has been calculated from equation (1) for the same valve as treated throughout. These figures are plotted as a graph in Fig. 1 and enable one to see at a glance how the voltage amplification is determined by the value of the series resistance. When the anode resistance is made equal to 67,000 ohms, or five times the A.C. resistance of the valve, the voltage amplification is 5/6 of the amplification factor, being 30.

The curve of Fig. 1 applies only to the particular valve cited as an example, and so Fig. 2 has been drawn giving the voltage amplification as a percentage of the amplification factor, and the scale on the horizontal axis gives the ratio of the added resistance in the anode circuit to the A.C. resistance of the valve. This curve is applicable to any valve; from it we see that to obtain amplification equal to 90 per cent. of the amplification

Wireless Theory Simplified.—

factor of the valve it would be necessary to connect in the anode circuit a resistance nine times as great as the A.C. resistance of the valve. An amplification of 100 per cent. could never be reached.

By applying in a suitable manner the amplified voltage variation developed across the resistance R in the anode circuit of the valve to the grid circuit of another valve operating under similar conditions the voltage variation would be further amplified, and therefore, in theory, we should be able to multiply the minutest voltage variation up to any desired value by the use of a sufficiently large number of valves connected in succession or *in cascade*. But in practice there are conditions which limit the number of valves that can be operated satisfactorily in cascade to quite a few. Details of this nature relating to the operation of cascade amplifiers will be dealt with in due course. At the moment we are concerned with the action of a single valve.

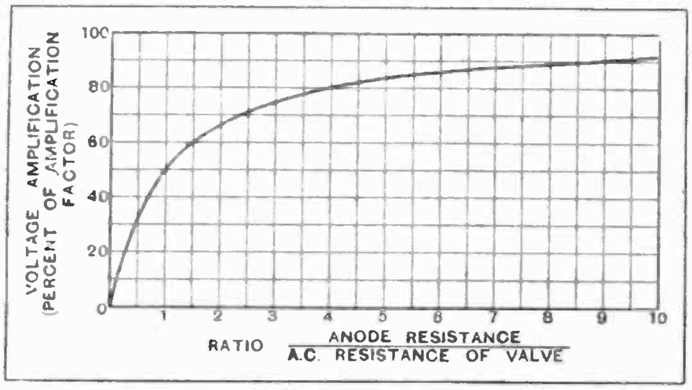

Fig. 2.—Curve showing how the voltage amplification, expressed as a percentage of the amplification factor of the valve, depends on the ratio of anode resistance to A.C. valve resistance. This curve applies to any three-electrode valve.

A Satisfactory Compromise.

One of the factors with which we have to contend when a non-inductive resistance is employed in the anode circuit of a valve for the purpose of obtaining voltage amplification is the reduction of the mean anode potential due to the voltage drop in the resistance. In some respects this is an advantage and in others a disadvantage. The chief advantage is that the lowered anode voltage and reduced current result in a very much longer useful life of the valve itself. The principal disadvantages are (*a*) that if the anode potential is reduced below a certain minimum value the amplification factor of the valve is lowered. There is thus an optimum value of anode resistance for which the amplification obtained will be a maximum for a given value of H.T. supply voltage; and (*b*) that with a lowered anode potential there is an increased tendency for grid current to flow when the fluctuating negative grid voltage approaches the zero mark.

These disadvantages can be nullified by increasing the H.T. supply voltage, but this in itself may constitute a further disadvantage in another direction, namely, by way of increased cost and complication. So in practice a compromise is struck; the H.T. voltage is usually made somewhat greater for resistance amplification than for other methods, and the anode resistance is kept sufficiently low not to impair the operation of the valve. An anode resistance from three to five times the A.C. resistance of the valve, together with H.T. supply voltage at least equal to the maximum permissible value given in the maker's rating, constitutes a satisfactory arrangement.

Effects of Frequency on Resistance Amplification.

The relationship between voltage and current is independent of frequency for a pure resistance, and therefore in the case of resistance amplification with a three-electrode valve the voltage amplification obtained would be the same for all frequencies if there were really no capacity or inductance anywhere in the anode circuit. But although the series resistance R in Fig. 3 (*a*) may be made sufficiently free from inductance and capacity to ensure practically constant impedance over the range of frequencies likely to be encountered in practice, a comparatively large amount of capacity exists between the anode and cathode of the valve itself; the anode and cathode constitute the two plates of a "small" condenser. If we denote this *inter-electrode* capacity by C_a in farads we can represent the circuit as in Fig. 3 (*a*), where the valve is assumed to have no capacity whatever, but has a condenser whose capacity is C_a farads connected externally between the anode and the cathode. R_a is the A.C. resistance of the valve and R the added resistance in the anode circuit.

Now, although no direct current can flow through a circuit with a condenser in series, alternating current can, and therefore a fraction of the alternating component of the anode current will flow directly back to the cathode *via* the capacity C_a instead of all passing through the resistance R. Since the amplified voltage

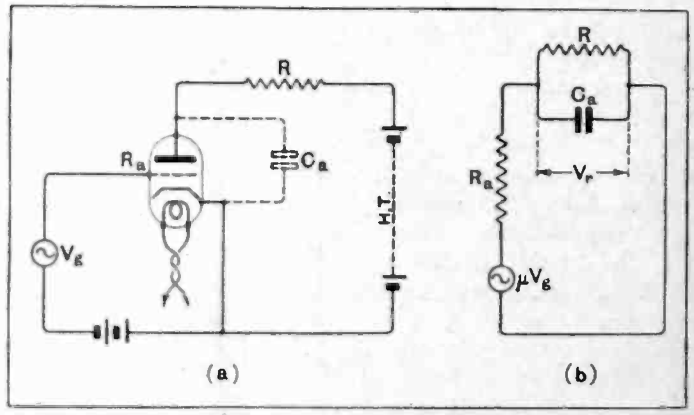

Fig. 3.—Diagrams for illustrating the effect of capacity between the anode and cathode of a valve on the degree of amplification obtained at various frequencies.

developed across R is proportional to the current there, it follows that the by-passing of some of the current through the capacity C_a will result in the alternating voltage across R being less than if no capacity were present, and the efficiency of the arrangement as an amplifier is impaired.

Fig. 3 (*b*) gives the equivalent anode circuit as far as the alternating components are concerned, and from this it will be seen that the anode resistance is virtually

Wireless Theory Simplified.—

shunted by the capacity C_a. The alternating current coming from the anode divides between the resistance branch and the capacity branch of the equivalent circuit.

For a given value of alternating electromotive force the current taken by a condenser is proportional to the frequency and to the capacity. In this particular case, if V_r is the alternating component of the voltage set up between the anode and cathode of the valve, and therefore across both R and C_a in the equivalent circuit, the current in the condenser branch will be $2\pi f C_a V_r$ amps., and that in the resistance will will be V_r/R amps. But it must be remembered that for a resistance the current and voltage are in phase, whereas for a condenser they are 90° out of phase, and therefore, since the same voltage V_r is common to both branches, it follows that the respective currents in them are 90° out of phase. Hence these two currents cannot be added together by simple arithmetic to give the total current. They must be treated as two quantities at right-angles and added as vectors, namely, square each, add the squares together, and then extract the square root.

But at this juncture we shall not make an actual calculation as this subject will be dealt with at greater length under another heading. It is only necessary to state here that the loss of amplification due to the inter-electrode capacity of the valve does not become serious until radio frequencies are reached. Resistance amplification for this reason lends itself admirably to audio-frequency amplification because the degree of amplification obtained is practically uniform over the whole of the audible range, an essential condition for high-quality reproduction from a receiver. On the other hand, at high or radio-frequencies the loss of amplification due to the valve capacity is unduly great when a non-inductive resistance constitutes the "load" impedance in the anode circuit, especially at medium and low wavelengths. Thus it will be found that in an amplifier designed for high-frequency amplification before the detector stage each amplifying valve has connected in the anode circuit either a tuned circuit of some sort or a high-frequency choke across which the amplified radio-frequency variations are developed.

(*To be continued.*)

TRANSMITTERS' NOTES AND QUERIES.

Short-Wave Working.

Mr. Robert Holmes (G6RH) is now testing on the 5-and 10-metre wavebands, using a self-excited T-P, T-G set, in his station at Allerton, Liverpool. He has experienced some difficulty in getting frequency-doublers to work satisfactorily at the high frequencies, and will be testing on 10 metres every Sunday until about 15.00 B.S.T.

G6RH has lately been working on the 160-metre band with G2QW and G2HP in London, and also finds that conditions are improving on the 40-metre band, though work on the 20-metre band is still difficult. Incidentally, he asks us to correct a slight error in the paragraph on page 68 of our issue of July 16th. The time should read either "11.30 p.m." or "23.30 B.S.T."

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British Arctic Air Route Expedition.

Through the courtesy of the Secretary, Wireless Sub-Committee, B.A.A.R.E., we are able to supplement the information given on page 99 of our issue of July 30th.

The wireless engineer to the expedition is Capt. P. H. Lemon, Royal Corps of Signals, who has been loaned by the War Office. He is to maintain an internal and an external scheme of communications. Three parties will leave the base of the Expedition for the coast survey and the meteorological station in the interior, and they will each be equipped with Army portable apparatus, and will work with the base on medium wavelengths. A short-wave station of a power of 100 watts will provide communication with England. The call-sign will be GKN, and the wavelength to be used will normally be 29.27 metres. This base station will work on alternate nights with a special station GKM at Aldershot, operated by Army personnel and with GFA, the R.A.F. station at Croydon. GKN will also carry out tests with the amateur stations G2CW and G6CR on a regular schedule. The co-operation of other amateur stations would be welcomed by the Committee. Any traffic from GKN that does not appear to be getting through to the British stations should be sent to the Secretary, Wireless Sub-Committee, B.A.A.R.E., Royal Signals Mess, Aldershot.

New Call-Signs and Changes of Address.

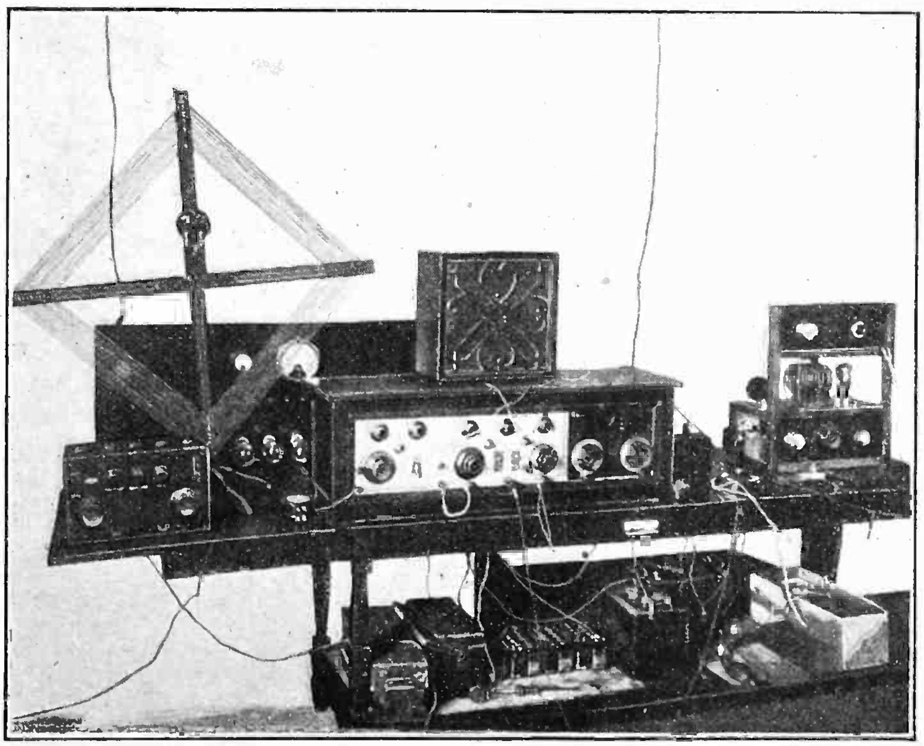
G2QX (ex 2BJG) A. E. Groom, 13, William St., Luton, Beds., working on 41.6 and 21.4 metres, and welcomes reports.

G2SJ J. Jones, 42, Fford Estyn, Garden Village, Wrexham.

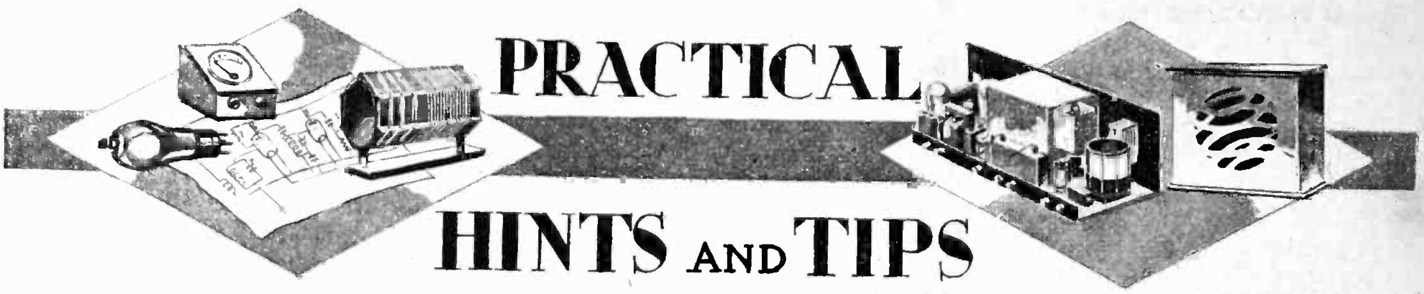
G6HO H. L. Holt, 73, Barricroft Rd., Didsbury, Manchester. (Change of address.)

GI6NY W. Locke, Daisy Hill Villa, Newry, Co. Down, N. Ireland.

2ACO (ex 2AXA) J. A. G. Cole, 33, Grosvenor Rd., Wallington, Surrey. (Change of address.)



CT 2AG owned and operated by Fernando Hinte at Gorreana, San Miguel, Azores. The transmitter, on the right, is a Mesney using about 20 watts to a Philips JB004/10 valve and coupled to a full-wave 42-metre Hertz aerial. The receiver in the foreground is an 8-valve superheterodyne.



PRACTICAL HINTS AND TIPS

Aids to Better Reception.

EARTHING SWITCH CONNECTIONS.

It might seem that the fitting of such a simple device as an aerial earthing switch should be so straightforward that incorrect methods of procedure would be impossible. Actually, unanimity has not yet been reached on this subject, and authorities are apt to disagree even as to whether a safety switch is necessary at all for domestic broadcast receivers, let alone as to the best method of securing immunity from lightning risks.

Without suggesting for a moment that the possibility of damage from this source is anything but remote, it may be pointed out that the user of an external aerial who takes reasonable precautions is in a stronger position with regard to possible liabilities than he who ignores the question of protection altogether. It should be remembered that there is a tendency to blame the wireless installation for eventualities for which it is most unlikely that it can be responsible.

Probably the most popular kind of safety device is in the form of a single-pole, double-throw switch, connected as in Fig. 1A. This arrangement allows the aerial to be connected either to the receiver, or, for safety during electrical storms, directly to earth. To obtain full benefit from this device it is desirable that the switch should be mounted outside the building, and that its earth connection should also be external. The first-mentioned proviso suggests that the switch itself should be capable of withstanding the weather, and so some such material as well-glazed porcelain should be used for insulation. Its contacts, apart from being self-cleaning, should be more robust than would be necessary for ordinary service.

This form of switch connection, though satisfactory enough, is susceptible to criticism on one point: in the event of a discharge actually taking place at the moment when the switch is being changed over, the user may receive a shock, particularly if the insulating knob on the blade is moist, or if the fingers come into contact with the metal blade.

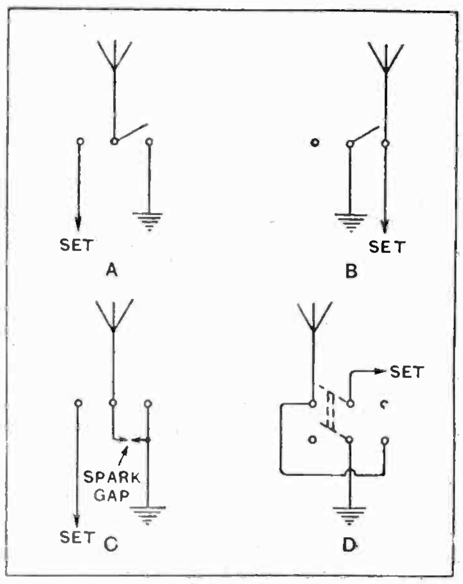


Fig. 1.—Methods of connecting aerial safety switches.

The chance of an accident of this kind is avoided by connecting the switch as in Fig. 1B, so that it acts as a short-circuit across the aerial-earth system. This arrangement has the disadvantage that discharges may be passed into the building, particularly if the external "earth" is of fairly high resistance.

Probably the best form of connection is that given in Fig. 1C, which is similar to that of diagram A, but with the addition of a safety spark gap. This device provides a measure of immunity even if the switch happens to be in the "receive" position, and risk of shock during manipulation is practically non-existent, provided the operating knob is of reasonable dimensions.

Still another way of joining a switch is shown in diagram D. This is free of the objection put forward with regard to arrangements A and B, but has one or two practical weaknesses. Double-pole switches, of the type generally sold for this purpose, have sometimes an insulating bar (between their two blades) of vulcanised fibre or similar material which is distinctly unsuitable for use under open-air conditions, as it absorbs moisture. Any leakage or serious dielectric loss at this point will adversely affect the performance of the receiver.

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IMPROVING SENSITIVITY AND SELECTIVITY.

It is very much easier to deal with a definite fault in a receiver than to overcome the cumulative effects of a number of minor deviations from good practice in its design. We have all encountered the type of set that functions after a fashion, but is lacking, to a greater or less extent, in all the essentials that go to make up a piece of apparatus that is a pleasure to handle; sensitivity just insufficient for proper reception of that rather elusive station, and selectivity just inadequate to prevent an annoying background of signals from the local station. There is a temptation to say outright that the best way to deal with such a set is ruthlessly to dismember it and to use as many of its component parts as possible for constructing an up-to-date outfit free of the original defects.

But such a course is not always practicable; it is the purpose of this note to indicate one of the most promising lines of attack to those whose "H.F." receivers are suffering from the shortcomings under consideration, which are always due to tuned circuits of poor design or careless construction, or to excessive loads thrown on these circuits.

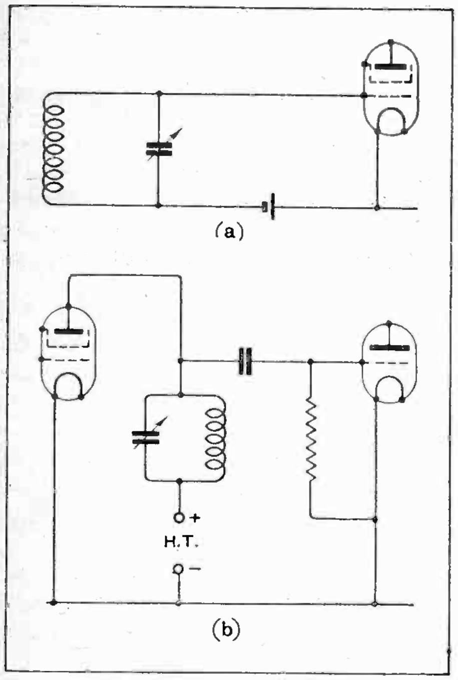

Fig. 2.—Where to look for losses in tuned circuits.

As a beginning we may take the grid circuit of an H.F. amplifying valve (Fig. 2(a)) and see where matters may be improved. First and foremost comes the coil; ignoring all questions of high-note loss and stability, a reduction of the losses due to this component is most likely to be helpful. The physical size of an inductance should be a measure of its "goodness," but this is not always so, and the possibilities of making a better coil to occupy the same space should be investigated if it is found impossible to accommodate a larger winding. If coils of greater size—and consequently with a more extended external field—can be used, one is faced with the probability that more extensive inter-circuit screening will be called for.

Apart from the question of the windings themselves, the dielectric properties of the material supporting them must be considered, and losses are particularly likely to be serious if terminals or contact pins are mounted close together. Useful guidance to the choice of the best substances to use has been published in this journal.

As the tuning condenser is directly in shunt with its associated coil, it is not hard to see that any wastage of energy in this component must be additive to that inherent in the winding. Fortunately, losses in condensers produced by reputable manufacturers have been reduced to a very low figure, but occasionally a noticeable improvement can be effected by making a change.

Another glance at Fig. 2 (a) shows that the remaining component connected across the tuned circuit—and therefore capable of absorbing energy from it—is the valve; to do anything to it, short of drastically replacing an indifferent specimen or removing the cap, is beyond our powers. The latter expedient is hardly likely to appeal except to the most enthusiastic searcher after efficiency. The valve-holder must not be forgotten, and that a shilling or so may be well spent in buying a replacement that is designed to avoid any unnecessary losses.

When a transformer is used for coupling the first H.F. valve to its successor—whether it be another H.F. amplifier or a detector—any shortcomings in the primary or anode circuit are likely to be overshadowed by losses in the tuned secondary. This, of course, is part of the next grid circuit, and so the possibilities of improving matters here should be investigated on the lines indicated in the preceding paragraphs. If grid detection is used, it almost follows that reaction will be provided, so no very determined effort need be made to remove every possible source of inefficiency. For the moment, at any rate, we can "skip" the detector grid circuit, and before attempting to improve it, pass on to the detector anode circuit. It is often possible to improve rectification efficiency, or, more correctly, to minimise the losses thrown back on the detector grid circuit, by reverse reaction through the valve capacity, by maintaining a larger capacity than usual between anode and filament. One must be cautious in making this addition, as there is a risk of impairing high-note reproduction.

If anode-bend detection is used, similar recommendations will still apply, but, due to the absence of direct reaction, it becomes more profitable to reduce losses in the grid circuit by fitting better coils, etc.

A tuned anode intervalve coupling circuit is susceptible to the same treatment as a grid circuit. Indeed, it stands in that relationship with regard to the succeeding valve. This point, not always fully realised, is made clear in Fig. 2 (b), where the conventional circuit is drawn in a rather unconventional way.

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GRID LEAK CONNECTIONS.

In an ordinary grid detector circuit it makes no real difference whether the leak is connected between grid and filament (Fig. 3 (a)) or directly in parallel with its associated condenser (Fig. 3 (b)). This is because its resistance is many times greater than the effective dynamic resistance of the tuned circuit across which it is shunted when the first-mentioned method is adopted.

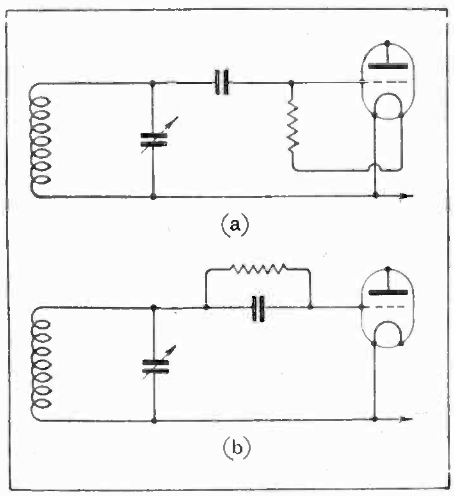
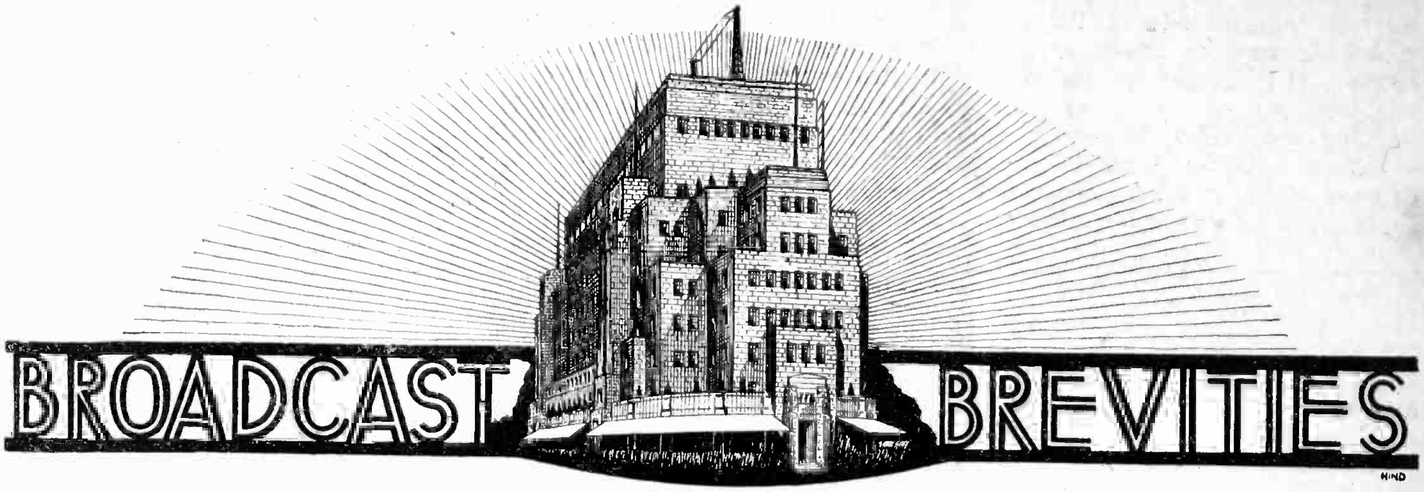


Fig. 3.—Alternative grid leak connections.

The position is rather altered by the introduction of power-grid detection, for which a leak of 0.25 megohm, or even less, is required for proper operation. Now a resistance of this order is almost comparable with the theoretical dynamic resistance of a reasonably good tuned circuit, which, even under working conditions, is unlikely to have a working value many times less than that of the leak. For this reason, the method shown in diagram (b) is generally to be preferred when the new system of rectification is used.



By Our Special Correspondent.

News from Portland Place.—Northern Regional Tests.—Captain Eckersley at the Microphone.—Where are the Radio Plays?—At the "Proms."

'Broadcasting House."

Rumour is now getting busy in connection with "Broadcasting House," which, it is suggested, may not be ready for the opening ceremony until March, 1932.

But the B.B.C.'s civil engineer himself states that the work is "well up to schedule." According to the contract the building is to be ready before the end of next year, and anybody who glances at the tower of steelwork in Portland Place would hesitate before declaring this to be impossible.

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Designing the Studios.

Although the main plans for the interior of the building are complete much of the detail work has still to be decided upon, particularly in regard to the studios. Noel Ashbridge, the Chief Engineer, has some very definite ideas concerning studio design, and many experiments will have to be conducted before the plans are finally passed.

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Transmission Tests from Moorside Edge.

At the time of writing the Chief Engineer and his staff are paying a visit to Moorside Edge, near Slaithwaite, where the Northern Regional station is rapidly nearing completion.

I hear that the first transmission tests may be expected in October.

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Wavelength Changes.

The wavelengths used by Northern Regional will be 479.2 and 301.5 respectively, the former being the present wavelength of Midland Regional (erstwhile 5GB) and the latter that of Aberdeen, which will have to resort to the national common wavelength of 288.5 metres. The Midland station will take Manchester's present wavelength, viz., 377 metres.

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The "Wipe-Out" Area.

Listeners in the West Riding area are beginning to realise that the Northern Regional station may have an uncomfortable "wipe-out" area. The same fears were entertained in regard to the Brookmans Park transmitters, not without reason, but I am afraid that the Northern station will be a greater offender. The station is situated on higher ground than Brookmans Park, and will have higher masts; moreover, it will admittedly have a larger service area than the London transmitters.

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A Question of Selectivity.

Faced with these facts, listeners with unpretentious sets are being told that the new conditions will involve them in extra expense if they desire to receive foreign stations. It seems to be forgotten that listeners with cheap sets never have indulged in foreign reception, while those blessed with better receivers can usually afford the small additional outlay necessary to increase their selectivity.

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FUTURE FEATURES.

National (261 and 1,554 metres).
AUGUST 24TH.—Religious Service from Buckfast Abbey.
AUGUST 25TH.—American music.
AUGUST 26TH.—Canadian music.
AUGUST 27TH.—Promenade concert.
AUGUST 28TH.—Vaudeville programme.
AUGUST 30TH.—Mozart concert relayed from Salzburg.

London Regional
AUGUST 24TH.—Military Band concert.
AUGUST 25TH.—Promenade concert.
AUGUST 26TH.—"Beggar on Horseback," a play by George Kaufman and Marc Connelly.
AUGUST 27TH.—Vaudeville programme.
AUGUST 29TH.—"Prunes and Prisms," written and produced by John Watt.

Midland Regional.
AUGUST 28TH.—Anglo-American Songs and Duets, Old and New.

West Regional (Cardiff).
AUGUST 25TH.—Orchestral concert from Weston-super-Mare.
AUGUST 26TH.—A Welsh Interlude.

North Regional (Manchester).
AUGUST 25TH.—"Request" Orchestral concert.
AUGUST 30TH.—Northumbrian Folk Songs and Dances (from Newcastle).

Glasgow.
AUGUST 25TH.—Musical Comedy.
AUGUST 29TH.—Scottish Music, from Edinburgh.
AUGUST 30TH.—"Mary of Delight," a play by Naomi Jacob.

Belfast.
AUGUST 25TH.—An Irish programme.
AUGUST 29TH.—Instrumental concert from Portrush.

A Chief Returns.

Captain Eckersley has not entirely forsaken the B.B.C. On September 23rd he will revisit Savoy Hill to deliver the first of a series of talks by leading authorities. He will deal with electrical engineering.

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Crystal User's Feat.

Recently a restaurant orchestra broadcasting from Birmingham had to pause in the middle of a selection owing to the din created by a passing street band. Next day Savoy Hill received an enthusiastic letter from a crystal user stating that during the break in transmission he had heard loud music from the Continent.

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A Non-existent "Technique."

Where are the new radio plays? What has become of the much-discussed radio dramatic technique which was ushered in with Tyrone Guthrie's play "Squirrel's Cage"? We now know that the success of that play was due largely to the novelty of its underlying dramatic device, viz., the repetition in chorus of a theme phrase which tended to dominate the mind of the listener and produce the appropriate "atmosphere." Subsequent attempts along the same lines have shown that the device has lost its force.

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One New Radio Play.

Only one new play specially written for broadcasting appears in the B.B.C.'s dramatic programme for the coming winter. This is "The Path of Glory," by L. du Garde Peach, to be given early in the New Year. The other dramatic features consist entirely of "repeats" of tried favourites or of stage successes, such as Galsworthy's "Strife," which can hardly fail to be effective at the microphone.

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"Brigade Exchange."

Two war plays will be given. The first, "Red Tabs," is an adaptation of the Canadian war story "Romance." The other is "Brigade Exchange," the German war sketch which was so successful at the microphone in the spring. "Brigade Exchange" will probably be broadcast on Armistice Day.

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"International Conversations."

Several new series of talks have been planned for the autumn. "International Conversations" will consist of exchanges between an Englishman and a foreigner, in which the latter will describe his country's view of England. These will include Russia, Turkey, Germany, France, Italy and America.

A second series will deal with "Science and Religion," and is bound to be provocative.

A third series consisting of twelve talks will give a comprehensive picture of Africa from all angles. Major Walter Elliot, M.P., will open this series.

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A Musical "First Night."

The people who complain that broadcasting empties the concert halls should have been dragged in a body to the Queen's Hall on Saturday evening, August 9th, and shown the fervent multitude who stood listening to the first Promenade Concert. It would have been impossible to find anywhere else in London so many people in such a comparatively small space.

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Why "Promenade"?

What struck me most about the standing audience was its youth. Upstairs in the circle and gallery were many elderly folk, but the floor of the house was mostly occupied by "promenaders" who must have been born in the present century.

By the way, why "Promenade" concerts? I saw no room to promenade either in the hall or at the buffet.

Amid the glittering spectacle of players, soloists, the conductor, the instruments and the palms, one object seemed to escape notice. It was the microphone.

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The Audition Ordeal.

Even the attainment of a place in the B.B.C.'s National Chorus apparently brings with it no permanent peace of mind. Already, I hear, half the members are to undergo a fresh audition during the next few weeks and the remainder will be re-heard at the end of the season.

Thereafter every member will have to submit to a fresh audition at the end of every second season.

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Probationers in Waiting.

What will probably increase the natural frightfulness of these auditions will be the thought that the Probationary National Chorus, to which I referred last week, will be lying in wait, ready to fill gaps as they occur.

The fact that failure to pass the tests involves no financial loss, all the singers being amateurs, will hardly lessen the pain of failure.

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Probationers in Other Departments?

There is something menacingly effective about the probation system which prompts one to ask whether it could be applied to other departments of the B.B.C., from the top downwards. If the Governors were told that the Probationary Governors had arrived, would they proceed to govern more wisely? Would an announcer grow happier and calmer if a probationer appeared in the background? Would the sight of a lurking understudy diminish a soprano's tendency to wobble?

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Instilling Confidence.

Possibly in each case the probationers would instil confidence; probably they would not. I think that the best friends of the National Chorus will hope that its members will forget all about those probationers.

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More Bach Cantatas.

The Bach Cantatas will be resumed on the last Sunday afternoon in August, after the summer holidays.

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Another Austrian Relay.

Herr Bruno Walter, one of the most distinguished of German musicians, will conduct the Mozart concert which is to be relayed to London from the Salzburg Festival on August 30th. The Vienna Philharmonic Orchestra will be heard in the "Haffner" Symphony and a Concerto for two pianos and orchestra in E flat.

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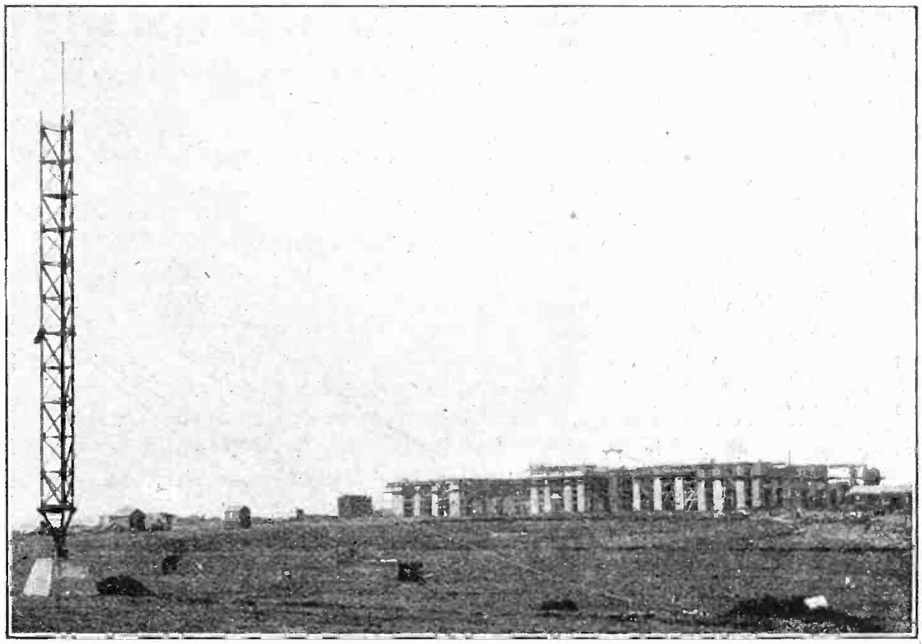
A Scottish Event.

There are comparatively few programmes which the B.B.C. can afford to repeat with any regularity, but, so far as Scottish listeners are concerned, there is always one at least which will receive a welcome as often as it is put on. This is a recital of "Songs of the Hebrides," given by their famous collectors and exponents, Mrs. Kennedy-Fraser, her daughter Patuffa, and her sister Margaret Kennedy. The three are to give one of these recitals in the Edinburgh studio on September 3rd, which will be broadcast from all Scottish stations.



NORTHERN REGIONAL. This photograph, taken at Pole Moor, Slaithwaite, a few days ago, shows the progress achieved in the construction of the Northern Regional broadcasting station. Our Special Correspondent indicates that preliminary transmission tests may start in October.

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Where B.B.C. Programmes are Popular.

During the present month no fewer than seven B.B.C. transmissions appear in the American programmes. The relays have included dance music, an orchestral concert from Manchester, and the Tidworth Tattoo. America usually "taps" the British programmes *via* 5SW at about 10 or 11 p.m. (G.M.T.).

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Canadian Night.

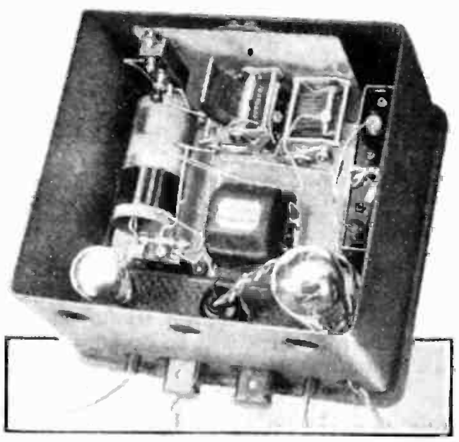
The folk music of Canada will provide a National programme on August 26th, in which the artistes are Frances Adaskin and Harry Adaskin, the latter a member of the Hart House String Quartet.

The National Museum of Canada has collected four thousand French and three thousand Indian melodies to form the backbone of the Dominion's folk music.

BROADCAST RECEIVERS REVIEWED

COSSOR *Two-Valve Battery Receiver*

WHEN the Regional scheme was first proposed, and, indeed, up to the time of its first practical application, many of us were inclined to be altogether too pessimistic regarding its effect on the performance of popular existing types of receivers. For instance, the opinion was freely expressed that simple detector-L.F. sets would automatically fall into disuse, being insufficiently selective for the new conditions. But we ignored the axiom that any receiver capable of separating a pair of twin transmitters at the extreme limit of its range (and few are unable to do so) could, by suitable control of H.F. input, be made to separate them at the shortest possible range—even at the gates of a Regional station. Consequently, simple apparatus can still be perfectly adequate, provided—and the proviso is important—that consistent reception of other stations is not required, or at any rate is not considered as vital. It will hardly be necessary to add that interference from high-power stations falls off rapidly with increase of distance, and that the choice of programmes afforded by a given set becomes more and more extended as the listener moves farther away from the wipe-out area.



Interior view ; note H.T. connecting plug.

One is bound to admit that it is all to the good that these simple detector-L.F. sets have still a very considerable field of usefulness; they are bound to be cheaper, and are likely to be easier to operate and maintain than more ambitious outfits having one or more stages of H.F. amplification.

The Cossor two-valve battery model is typical, both with regard to its design and construction, of the simpler, but nevertheless effective, type of modern receiver. Its circuit arrangement comprises a grid detector with capacity-controlled reaction. The detector is shunted across the grid coil. As is shown in the accompanying diagram, the aerial system is semi-aperiodic for medium-wave reception, while on the long waves it becomes practically fully tuned. Alternative aerial sockets are provided, one of them being joined to the centre point of the medium-wave coil through a semi-variable condenser, which is brought into use when interference is experienced, or when the receiver is used with an aerial of unduly high capacity.

A pentode valve, which provides considerably more amplification than the usual triode, is used as an L.F. amplifier, and is coupled to the detector by a transformer. The loud speaker is directly connected.

Construction is on the chassis principle, and all apparatus is assembled on a plywood baseboard, which, after it is wired, is mounted in a neat metal container measuring some 10in. wide, 9in. deep, and 7in. high. The case is finished in "crackle" cellulose.

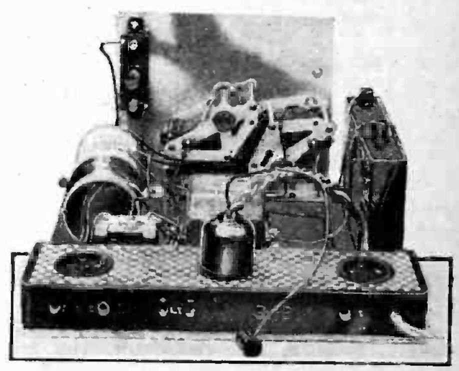
An Easily Installed Detector = Pentode Set Without Complications.

At the rear of the baseboard is mounted an insulated moulding carrying the valve sockets, and also plug sockets for external connections to aerial, earth, loud speaker, and L.T. battery; H.T. supply is fed through a multiple cable which is permanently attached mechanically, but of which the electrical continuity can be broken entirely by removing an internal plug on the terminal moulding. The grid bias battery is mounted inside the cabinet.

An ornamental escutcheon plate is fitted to the front of the receiver, and through it are passed the spindles for the control knobs.

The dual-range tuning and reaction coil assembly is wound in single-layer solenoid form on a paxolin former fitted with eyelet holes and tags for external connections. The reaction condenser, which is of commendably large capacity, is directly driven, but there is a suitable reduction gear for the tuning condenser.

Reverting to the circuit arrangement, it is noticed that the feed voltage for the pentode screening grid is the same as that applied to the detector anode (the pressure recommended is 90 volts). By operating the pentode in this way, its H.T. current consumption is considerably less than if its screen and plate were both supplied with the maximum available pressure, which in this case it is suggested should be 120 volts.

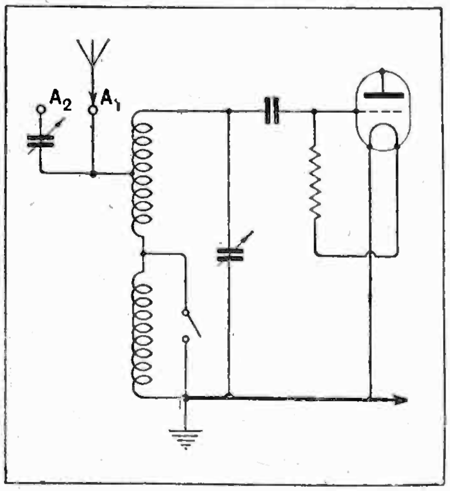


The chassis removed from its container.

There are three controls—tuning, reaction, and a combined filament-waveband switch. The reaction adjustment works particularly well on

Broadcast Receivers Reviewed.—
the long waves, but there is a slight overlap on the other band; tuning is but very slightly affected by variation of the feed-back capacity. As is to be expected, any change in the setting of the aerial series condenser has an appreciable effect on the main tuning control, but this is not objectionable in practice, as frequent alteration of this capacity is not likely to be made.

In the instructional pamphlet supplied, it is suggested that a bias of 9 volts should be applied to the pentode grid; this seems to be rather on the high side for the specimen actually tested, and a reduction to 7½ volts had the effect of improving quality. With this setting the total anode and screen current for both valves amounted only to 10 milliamperes. Reproduction was distinctly pleasing, and volume was adequate.



Input and wave-range switching connections of the receiver.

The general performance of the receiver was found to be fully up to the standard that can reasonably be set for a single-control detector-pentode set, and all the circuit constants seem to be well chosen, with the result that selectivity and sensitivity are good enough to ensure a reasonable choice of programmes in all but the most difficult situations.

There is very little to go wrong, and, as the moving parts—variable condensers and switch—are well made, there is little reason why the set should give trouble as long as it is provided with adequate L.T., H.T., and grid bias voltages. Should a fault develop, the chassis is easily removable from the container for test and repair by slacking off the control knob grub screws and by removing the four screws which secure the baseboard to the case.

The receiver is made by A. C. Cossor, Ltd., Cossor House, Highbury Grove, London, N.5, and is sold at £5 10s., complete with a 210 H.F. detector and a 230 P.T. pentode output valve.

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, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

MAN-MADE STATIC.

Sir,—We were very interested in the recent correspondence in your columns regarding electrical interference with wireless reception.

On behalf of a large number of listeners in this town, we have been endeavouring for some time to obtain some satisfaction from the authorities concerned regarding the intense interference caused in Darlington by the electric trolley 'bus service. After considerable correspondence with the B.B.C., etc., we have received a letter from the Engineer-in-Chief of the General Post Office stating that the Postmaster-General has no statutory powers to compel tramway or similar undertakings to adopt remedial measures.

As far as we can ascertain, no steps have been taken successfully to reduce the trouble, which is so bad that a very large proportion of wireless listeners here are incapable of receiving any programme satisfactorily.

It seems to us a lamentable state of affairs that the public are deprived of a service such as broadcasting, in order to enjoy the doubtful service of the tramway system. Surely it could be possible to arrange for one to cause little or no interference with the other. Whilst the law remains as at present the wireless listener is likely to be the victim, and we suggest that strong representation should be made by every person affected to his member of parliament.

E. AND H. GLOVER.

Darlington.

PORTABLE OR FIXED SETS?

Sir,—In view of the fact that the majority of potential buyers of wireless apparatus for the coming season, or for that matter at any time, are more or less ignorant of what will suit them best and give lasting satisfaction, it surely behoves all manufacturers in their own interest to make once and for all a clear distinction between the portable and the fixed set (or frame aerial set with external speaker).

Most manufacturers and retailers, for some unknown and short-sighted reason, push portables in preference to fixed sets, even when they know they will not be used as portables. Surely this procedure will eventually injure the prestige of manufacturer, dealer, and radio in general. Which type of set is likely to create a fresh sale, when heard by friends of the owner, after say two months' use, a portable or a fixed set? The modern portable is certainly a marvel of science and ingenuity and, used as such with a car, is a very desirable thing to possess, but it still remains, from the point of view of results and upkeep cost, the worst value in the world. In the vast majority of cases people have only one set.

All manufacturers should emphasise the fact that for general use a fixed set will give infinitely more satisfaction, both in upkeep costs and what is, perhaps, more important in its ability to do more justice to the excellent quality transmissions now sent out by the B.B.C., especially since the recent adoption by them of the condenser microphone for regular use. The important gramophone companies have long ago relegated the portable gramophone to its proper place, to their great financial benefit and the satisfaction of their numerous clients.

Surely nothing but benefit for all concerned can result from enlightening the general public about portable wireless. It seems so futile to propagate inferior radio, when it can so easily be otherwise, at a time when the programmes and quality of transmissions are daily becoming better and better.

Wolverhampton. W. D. PEARSON.

LONG-WAVE STATIONS IN BRITAIN AND IRELAND.

Sir,—I strongly support your view that Britain should forthwith insist on being allocated a second long wavelength for broadcasting. I hope the Saorstat may get for their proposed central station a long wave also; I was seldom able to agree with them on any subject, but it is certain this country is missing sadly what the Irish temperament and outlook can bring to public life, and if they had a station easily audible over the whole of Ireland and in this country and would condescend to speak the language we both understand and of which they are able to make such excellent use, they would add immeasurably to the influence of their culture in a world that needs it.

If Britain obtained an additional long-wave, probably the more remote districts of this island would be covered better by allowing the Midland National Station (5XX) to work on a medium wave, locating one of the long-wave transmitters farther north, *e.g* at Pole Moor, or better still, in Scotland, and the other one farther south than Daventry.

If Britain could not secure a second long wave—why she should not is difficult to understand, seeing that Paris and Holland have two apiece—experiments might be made to ascertain:

(1) Whether the present single long-wave transmitter could not be made to cover the whole country by increasing the power or altering the site, or both, or, if this proved impracticable,

(2) Whether two stations located as suggested in the preceding paragraph might not each use the same long wave (crystal controlled) as now used by 5XX, and each transmit the National programme.

In connection with the suggested increase of power, *Wireless World* readers will have observed in the issue of July 16th that Radio Paris and Tour Eiffel are increasing their power to 85 kW. and 24 kW. respectively; both are long-wave stations.

I do not understand Mr. J. A. Hall's alarm, consternation and anger at your excellent suggestion, nor his contempt for Savoy Hill. The B.B.C. manifests no self-satisfaction, and I believe feels none, though its achievements are far from being contemptible; on the contrary, the programmes bear evidence of careful compilation and their presentment thorough preparation, finish, dignity and, at times, even splendour. If they are listened to with attention the talks are of much interest, and, not least by the sick and convalescent, appreciated as welcome interludes between concerts. I speak from experience and with gratitude after three long and trying illnesses which B.B.C. programmes not only assisted me to endure, but materially accelerated recovery, besides adding to my store of general knowledge. It is not to the purpose to complain that B.B.C. programmes do not resemble those of other countries (save in the matter of the universal and often wearisome jazz of our American would-be masters); each country has its own culture, and its programmes should illustrate this, so that tuning in a foreign station should convey the atmosphere of its nationality, as, in fact, is usually the case. My only grumble at Savoy Hill is that the authorities occasionally seem to be afflicted with a Nordic-English-puritan-pacifist outlook instead of being robustly pro-British Commonwealth; that, however, is but a matter of personal taste.

I am somewhat surprised that at Bedford, with the outfit Mr. Hall describes, only long-wave foreign stations are receivable. I fear that recently he cannot have had time to peruse his *Wireless World* with attention and profit. He might, with great advantage and pleasure to himself, construct, say, one of the models of the "Foreign Listener's Four," after which his gloomy forebodings would assuredly depart.

Lest what I have written above should lead Mr. Hall and others to suppose that I am only a B.B.C. listener, I might observe that my own receiver (near London) has practically world-wide range on loud speaker. It is entirely of my own design and make, employs a *changeur de fréquence* (I.F. = 477 kh., *i.e.* $\lambda = 2\pi \times 100$m.); there are three S.G. I.F. stages, diode detector, with a stereophonic coupler preceding the 2nd L.F. (output) stage. Its total H.T. consumption is of the order of 24 mA. maximum, and on many European stations the volume control has to be set nearly at minimum to keep reproduction—which is of the highest quality—at less than overwhelming volume on three speakers, of which one is a M.C.

"SHENE ANGLORUM."

BROADCAST PROPAGANDA.

Sir,—While being in agreement with Mr. Munn that the B.B.C. programmes leave much to be desired, I do not think that the remedy lies in sponsored programmes.

If a manufacturer is willing to spend large sums of money on advertising *via* the ether, he would not be willing to confine the desirability of his product to a few casual remarks during the course of three hours' entertainment, as suggested by your correspondent, but would probably desire to make an announcement between each item. If Mr. Munn has ever spent an hour or two listening to the American S.W. stations he will realise what this means, and also that it is, in my experience, impossible to select any programme of a sponsored variety (apart from the advertising matter) which provides an entertainment equal to anything we have at present available from the B.B.C.

I think that a lot could be done towards improving the B.B.C. programmes by cutting down the talks by half, brightening up the Saturday evening programmes between 7 and 9, possibly by "variety," and making sure that there is at least always an alternative programme of different character.

The racing results might be left out of the "news," as they take up a lot of time, and are not of interest to more than a small percentage of the listeners; anyone who is really interested in these takes care to get an evening paper as soon as possible. If this was done I do not think the average owner of a receiving set would have much to complain about. G6RK.

Birmingham.

Sir,—Mr. Munn, in his interesting letter on broadcast propaganda, seems to imagine the broadcast programmes consist entirely of dance music, dowagers (what does a dowager sound like?) and drawing-room "entertainers," of which he evidently does not approve.

Ignoring for the moment (as Mr. Munn does) the symphony concerts, light classical concerts, military and brass band concerts, chamber music concerts, instrumental concerts, choral concerts, ballad concerts, organ recitals, plays, talks, prose readings, poetry readings, after-dinner speeches, running commentaries, which are broadcast from time to time, none of which seem to appeal at all to Mr. Munn, one cannot help wondering what sort of programmes *would* Mr. Munn like?

I, personally, have little fault to find with the programmes, except when they broadcast speeches, etc., without any alternative, which, in my opinion, they ought never, never, *never* to do. My grouse is that there is now no station from which I can be reasonably certain of receiving the National programme decently. During the summer it is rather the rule than otherwise for 5XX to be completely marred by atmospherics, especially after sunset (and especially during the "Prom" season!), while the Brookmans Park National is hopeless (even here, less than fifty miles from it) by reason of fading and distortion. Incidentally, the B.P. Regional also fades considerably, but does not distort. Alas, for good old 2LO, which always came in as steady as a rock and very nearly as strongly as B.P. Regional now does, and much more strongly than B.P. National! A. K. GORDON.

Crowborough.

Sir,—I have read with interest the views expressed with regard to broadcast propaganda in Mr. Munn's letter and your editorial. It is, I think, wholly undesirable, for the reasons you state, that the programmes of the B.B.C. stations should be interfered with in any way in the interests of advertising. If advertisers once obtain a hold on the programme matter of the B.B.C. there is no knowing to what evils their influence may lead. The dissatisfaction shown towards the B.B.C. results chiefly not from poor quality of the programmes but from the fact that individual taste can be satisfied to a small degree only, since there are so many different tastes for which the programme directors must cater. Whether a programme is poor in quality or not depends almost entirely upon the standard required by the individual critic.

If, however, advertisers must make use of broadcasting, why should they not erect a transmitting station of their own? The Press should be influential enough to solve the difficulty of wresting the monopoly from the B.B.C., and room could surely be found for it despite the crowded ether. This scheme would have several advantages. The public need not listen to the advertisers' programme unless they wished (or at least we hope the power would be restricted!), the programmes sent out would have to be good to command public attention, and the station would satisfy those who consider a mere alternative programme insufficient. G. A. BUSBY.

Newport, Essex.

READERS' PROBLEMS

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below, in some cases at greater length than would be possible in a letter.

Casual Couplings.

My "1930 Everyman Four" fails to work at all until the screening cover is completely removed, and even in this condition gives quite weak signals from the local station. Tuning of all three circuits is quite sharp. The L.F. amplifier (and probably the detector, as the set works well with a pick-up) seems to be quite satisfactory, so I suppose the fault must lie in the "H.F." end of the receiver. Will you please suggest the most likely place to look for it? The usual tests have been made, and everything seems to be in order. L. F. B.

It would appear likely that there is no proper linkage between the various tuned circuits, and that you obtain weak signals from the local station only by virtue of stray direct magnetic couplings between the coils. An effect of this sort might well be caused by a faulty H.F. valve; you should accordingly test your valve carefully, together with its feed circuits. The substitution of another valve known to be in order would be helpful.

It would be wise to check the coupling connections between aerial and secondary circuits, and also the primary circuit of the H.F. transformer assembly; the secondary circuit of this component is almost certainly in order.

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Frame and Filter.

Some time ago you published (in the "Readers' Problems" pages) a diagram showing how a filter circuit could be interposed between a frame aerial and an H.F. amplifying valve. The arrangement as shown necessitated the use of a centre-tapped frame; if this is not an essential part of the scheme, will you please give me a circuit diagram showing the connections of an untapped frame to a capacity-coupled filter? H. M. S.

We should point out that the centre-tapped frame aerial circuit to which you refer was intended to be a help in eliminating locally generated interference and "vertical" pick-up, and that a tapped frame is by no means essential when an input filter is used.

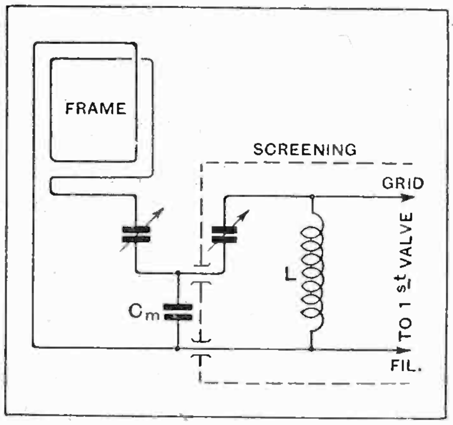

Fig. 1.—A frame aerial as part of a capacity-coupled filter.

We give in Fig. 1 the circuit diagram which you require; C_m is the coupling condenser, and L is the secondary inductance.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) **Every communication to the Information Department must bear the reader's registration number.**

(2.) *Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."*

(3.) *Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.*

(4.) *Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.*

(5.) *Practical wiring plans cannot be supplied or considered.*

(6.) *Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.*

(7.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.*

Good Coils.

I have reason to believe that the coils used in my receiver (which has a single H.F. stage using a S.G. valve) are not as efficient as they might be. As I am thinking of modifying the set, will you please refer me to one of your back numbers in which the best possible coils suitable for use with a screen-grid valve were described? C. R. R.

This is rather a difficult question to answer helpfully, as with a modern receiver there is a distinct limit to the "goodness" of coils that can successfully be used.

Probably the best coils, from the point of view of high dynamic circuit resistance were those described for the "Record III" in our issues of September 4th and 11th, 1929, but, apart from their large size, they were intended for a highly specialised type of circuit, and it is most unlikely that they would yield satisfactory results in any other kind of set.

If you care to send us a brief description of your receiver, we will endeavour to suggest the most suitable types of windings.

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Long-wave Instability.

The H.F. stage of my receiver is coupled by a transformer, and works extremely well on the medium wave band, but is lacking in stability over the majority of the long-wave tuning scale. I have tried the experiment of removing primary turns, without any real success, and am inclined to abandon the transformer in favour of the tuned-grid type of intervalve coupling. Do you consider that this change would have the desired results? D. P.

It would be a mistake to make this change, as there is no inherent reason why a tuned grid intervalve coupling should afford greater freedom from self-oscillation on the long waveband. On the contrary, it is quite likely that the trouble will be accentuated because, all other things being equal, this form of coupling is rather more efficient on the long waves than on the medium band.

Potential Dividers.

Is there any real difference between a potentiometer and a "potential divider"? I have been reading a text book in which these two expressions are apparently used indifferently to designate the same piece of apparatus. J. W. T.

These expressions, as generally employed, are synonymous, but the word "potentiometer" should, strictly speaking, be applied to an appliance for measuring potentials by the "balance" method. It is really incorrect to use it as an alternative name for a "potential divider"—although we all seem to prefer it to the more lengthy but more graphic and descriptive title.

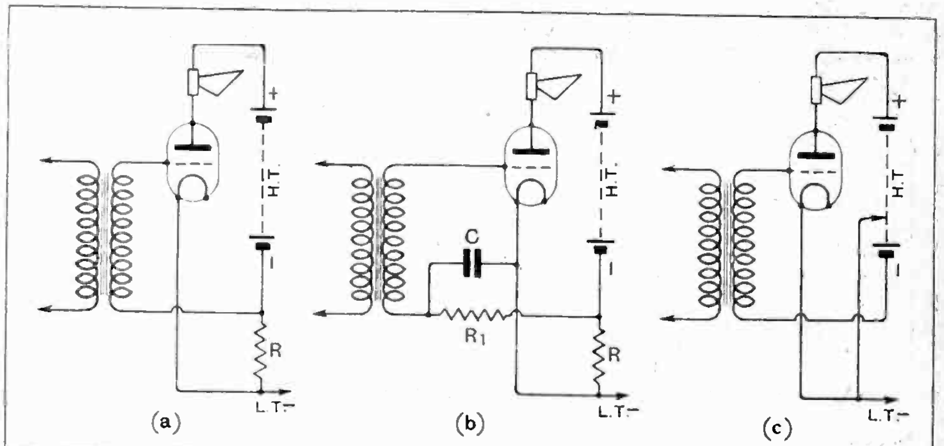

Fig. 2.—Illustrating methods of using a high-tension battery as a source of grid bias voltage.

Permanent Magnets.

Is the magnetic field of a reed-driven speaker unit likely to be retained for a greater length of time if the windings are directly connected (in the right sense, of course) in the anode circuit of the output valve than when a choke-condenser filter is provided. With the latter arrangement there is no steady D.C. current, and it seems to me that the magnets might quickly lose their strength. T. G. W.

We do not consider that this is a matter of any great importance. The comparatively small current flowing under normal operating conditions is most unlikely to have any great effect in assisting the retention of magnetism.

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Automatic Bias.

The voltage of my accumulator H.T. battery is rather greater than is necessary for reproduction of adequate volume for my needs; I believe that by sacrificing some of the excess voltage it is possible to use the battery for supplying grid bias for the output valve. Will you please show me how this may be done? R. L. L.

By inserting a resistance of suitable value between the negative terminal of the high-tension battery and the L.T. negative bus-bar of the valves in the receiver, grid bias for the output valve can readily be obtained, provided that its grid return lead is joined to H.T. negative. This method, in its simplest form, is illustrated in Fig. 2 (a), where the bias resistance is marked R.

Due to the fact that this resistance is common to the anode circuits of all valves in the receiver, it is probable that it will cause harmful interstage couplings, and so this simple circuit is hardly practicable. As a rule it will be necessary to add a decoupling resistance (R_1) of about 100,000 ohms, and a by-pass condenser (C) of about 2 mfds., as shown in Fig. 2 (b).

The need for using a bias resistance and decoupling devices is entirely obviated by the still simpler arrangement shown in Fig. 2 (c). The required number of cells at the negative end of the battery can be used for bias purposes if connection to the H.T. negative terminal of the receiver is made from a point on the battery that is positive (with respect to the negative end) by the required amount. Where an accumulator battery is used, this, again, is not altogether practical, as the end cells would not be discharged equally with the others.

A suitable value for the bias resistance shown in Fig. 2 (a and b) can easily be determined in the manner often explained in these pages.

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"Live" Loud Speaker Leads.

When the loud speaker leads of my set are brought in proximity to the aerial terminal a whistle is produced; otherwise it works satisfactorily enough, although I sometimes think that quality might be improved. Do you consider that the production of self-oscillation in this way is an indication that anything is wrong? D. R.

Effects of this kind show clearly that high-frequency currents are present in the output valve anode circuit, and consequently that H.F. and L.F. components have not been properly separated after the process of detection. Accordingly, you should fit some kind of "H.F. stopper." In its simplest form this may consist of a resistance of from 0.1 to 0.25 megohm connected directly in series with the grid of the first L.F. amplifying valve.

Interaction between input and output ends of a portable receiver is often caused in this way, and, to prevent it, a fairly large condenser is often shunted between detector and filament of the output valve; you might adopt this plan.

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L.F. Chokes in Parallel.

I am about to increase the power output of my eliminator by fitting a new rectifier, and am afraid that the current-carrying capacity of my present smoothing choke will be inadequate; also, its D.C. resistance will probably be unduly high. Do you recommend me to connect in parallel with this choke another of similar type, and with the same inductance value (30 henrys)? F. C. R.

By connecting two similar chokes in parallel, the resulting inductance may become less than that of either used separately, and therefore insufficient for adequate smoothing in your case.

In practice, matters will not be quite as bad as we have suggested, as the reduction of actual—as opposed to rated—inductance will be less than the figure given; this is because the current flowing will divide itself between the two chokes. But, in spite of this, we consider it unlikely that your proposed plan will yield satisfactory results.

FOREIGN BROADCAST GUIDE.

BERLIN-WITZLEBEN

(Germany).

Geographical Position: 52° 32′ N. 13° 25′ E.
Approximate air line from London: 580 miles.

Wavelength: 418 m. Frequency: 716 kc. Power: 1.5 kW.

Time: *Central European Time.
* *Coincides with B.S.T.*

Standard Daily Transmissions.

06.30 B.S.T. Physical exercises; 07.00 (Sun.) relay of concert from Hamburg; 08.15 breakfast concert; 08.50 (Sun.) sacred concert followed by carillon from Berlin Cathedral; 10.10, onwards, commercial reports and news broadcasts throughout day; 20.00 or 20.30 main evening programme; 22.20 news followed by dance music until 00.30 (except Tues. and Fri.).

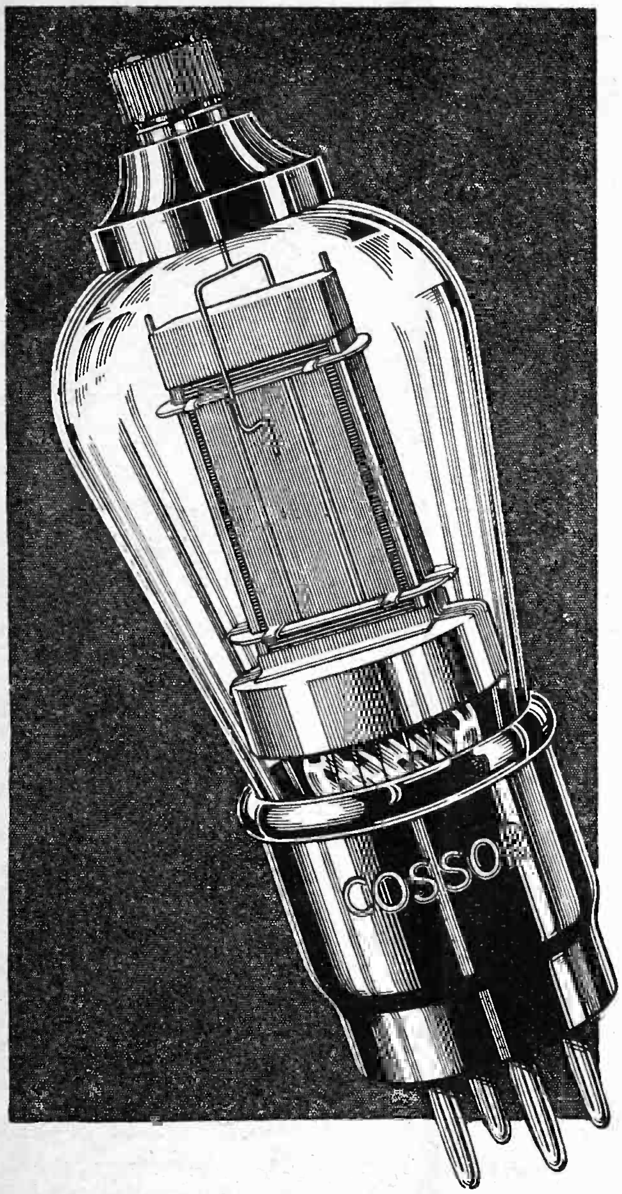
Closes down with the playing of the *Deutschlandslied* (Haydn's Hymn *Austria*).

Male announcers. Call: *Achtung! Achtung! Hier Berlin, Stettin und Magdeburg.*

Interval Signal: Metronome (4 beats per second) followed by abbreviated call: *Achtung! Berlin.* All announcements are made in the German language only.

When Koenigswusterhausen (1.635 m.) and the Zeesen short-wave transmitter (31.38 m.) take the programme the call includes their names as well as any other provincial stations to which the relay is being made.

Common wave relays: Berlin (E), Stettin, Magdeburg on 283 m. (1,058 kc.).



LOWEST inter-electrode CAPACITY ever attained

The actual amplification obtained from any Screened Grid Valve is largely governed by its inter-electrode capacity. Cossor research—during the past twelve months—has been focussed on this great problem. To-day we are able to announce that the new Cossor 215 S.G. has a lower inter-electrode capacity than any other Screened Grid Valve on the market. This capacity is of the order of ·001 micro-microfarads. Due to this—and also to many other features, including the new box-type screening grid and a method of shielding which is 100% efficient—the new Cossor 215 S.G. gives a degree of amplification with perfect stability and freedom from distortion which—a year ago—would have been considered utterly impossible. Use this new Valve in your Receiver and the all-round improvement in its performance will astonish you.

Cossor 215 S.G. 2 volts, ·15 amp. Impedance 300,000. Amplification Factor 330. Mutual Conductance 1·1 m.a./v. Normal working Anode Volts 120. Positive Voltage on Screen (approx.) 60. Price 20/-

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

THE NEW COSSOR 215 S.G.

HIGHEST *ACTUAL* AMPLIFICATION

5682

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THE CHARGE FOR ADVERTISEMENTS in these columns is :

12 words or less, 2/- and 2d. for every additional word.

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ADVERTISEMENTS for these columns are accepted up to **FIRST POST** on **THURSDAY MORNING** (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on **WEDNESDAY MORNING** at the Branch Offices, 19, Hertford Street, Coventry ; Guildhall Buildings, Navigation Street, Birmingham ; 260, Deansgate, Manchester ; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

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For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. 000, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes ; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged ; on transactions over £10 and under £50, the fee is 2/6 ; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

GEOPHONE 2-valve Mains Receiver, 200-260v. 50-100 cycles mains, used for demonstrations only, as new; £10.

EPOCH 22E M.C. Speaker, 6v. 0.3 amp., field, impedance, 1,000 ohms; £1/15.

ECKO V3 Mains Eliminator, 200-240v., output 120v. at 30 m.a., 3 taps, less valve; £2.

CALLERS, any day except Wednesdays.—McFarlane, 15, Rotherfield Rd., Enfield Wash, N. [1211

SCOTT SESSIONS and Co., Great Britain's Radio Doctors.—Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

Receivers for Sale.—Contd.

APPLEBY'S

1919-1931?

SEASON 1930-31.—A comprehensive catalogue of new season's radio apparatus of convenient size for the pocket will shortly be issued; price 9d., post free; as this catalogue will be a pocket guide to modern radio material, it will be in wide demand; those desiring to secure a copy, would greatly assist us by kindly making application now, enclosing 9d. in stamps; a copy will then be forwarded as soon as issued, about the time of the exhibition; the 9d. may be deducted from any following order before the end of 1930, in excess of £1.

PLEASE Apply Early! Please send in your radio material for part exchange credit early—and avoid the rush; it will be a great season, good sets, good components, and fine workmanship.

APPLEBY'S, where radio part exchange began.—Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines). [0340

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

BERCLIF D.C.2 All Mains Receiver, 200 to 250 volts D.C.; price £14/10; with valves and royalties, suitable for M.C. speaker; particulars free; trade inquiries specially invited.—Simmonds Bros., 38, Rabone Lane, Smethwick. [8734

YOUR Old Receiver or Components Taken in Part Exchange for New; write to us before purchasing elsewhere, and obtain expert advice from wireless engineer of 25 years' professional wireless experience; send a list of components or the components themselves, and we will quote you by return post; thousands of satisfied clients.—Scientific Development Co., 57, Guildhall St., Preston. [0226

DEMONSTRATION Model 1930 Portable 4-valve S.G., listed 23 guineas, upright type, Celestion speaker, new valves and batteries, tip-top order; 16 guineas.—Richardson, Aughton, Ormskirk. [1226

F. W. SMURTHWAITE, A.M.I.R.E., specialist in high grade individually designed and manufactured radio apparatus; contractor to the B.B.C. and L.C.C. for hospital and institution installations; whatever your requirements, be they a simple 2-valve receiver or the most intricate design, may I suggest you get into touch with me?

MY Unbiased Advice is at your Disposal with Pleasure; I am always pleased to submit specifications and quotations, without obligation; a long list of instruments does not convey much, as it is impossible to give full details within the limits of small advertisements; the following are intended as examples, and are more or less standard lines which experience has shown to be particularly popular.

A.C. Three, the outstanding all mains 3-valve receiver, made up to scientific instrument standard with the finest components available; circuit consists of 1 S.G. H.F. valve, fully screened, with highly efficient dual wave coils, anode bend or power detector (to choice), transformer coupled to an A.C.-P1 output valve which works at maximum anode voltage with automatic grid bias, thus ensuring ample power output for a moving coil speaker; price £25, complete with valves and royalty; hear this set before deciding on any mains receiver.

SCREENED Grid Five, a unique receiver for battery valves; the H.T. can be supplied from either a mains unit or batteries as desired; 2 S.G. H.F. valves coupled by efficient dual wave tuned transformers, all assembled in beautifully made aluminium screening box, anode or power rectifier and a specially designed L.F. amplifier arranged to give the best possible quality, choke condenser output filter; this set has ample power to bring in any station whose signal is above the noise level; prices from £25, according to specification.

RADIO Gramophones.—I have a number, of extremely efficient designs, and am always willing to make up cabinet work to exactly match existing furniture; genuine period reproduction cabinets if desired.

HIGH Power Amplifiers, for dancing, public address, etc.; full details on application.

SHORT Wave Receivers for Britons Abroad.—Any good design made up; I recommend the R.S.G.B. Four (with S.G. stage) at £20, complete with valves, packed and delivered f.o.b.; this set is giving satisfaction in many parts of the world.

F. W. SMURTHWAITE, A.M.I.R.E., 15a, Onslow Gardens, Wallington, Surrey. Works: Belmont Rd. 'Phone: Wallington 1982. [1221

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DON'T Buy Dry Batteries, join our service; we keep you continuously supplied with fully charged C.A.V. high tension accumulators by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more, we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms, from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5 'Phone: North 0623 (3 lines). [8751

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PHILIPSON'S Safety High Tension Supply Units for A.C. and D.C. Mains, 200-250 volts 40-60 cycles, also 230 volts 25 cycles.

10/- Down and Small Monthly Payment Secures the Finest H.T. Supply Available.

PHILIPSON'S Safety H.T. Units are Guaranteed for 12 Months Against All Defects.

ALL Models Sold on 7 Days' Approval to Ensure Complete Satisfaction.

PHILIPSON'S Safety H.T. Units are the Cheapest to Install and the Cheapest to Run; £1/17/6 to £6.

WRITE for Our Booklet, "Radio Power," which gives illustrations and full particulars.

PHILIPSON'S Safety Loud Speaker Output Filters for All Receivers, power valve, or Pentode; a remarkable output filter at a very low price; 16/6.

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038 Bolton. [0318

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.

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SAVAGE'S.—Reliable smoothing condensers, 1.500 volt D.C. test, 1 mfd., 2/-; 2 mfd., 3/-; 4 mfd., 5/3; 500 volt D.C. test 1 mfd., 1/6; 2 mfd., 2/3; 4 mfd., 3/9.

SAVAGE'S.—Super smoothing and output chokes, many types available; write for list.

SAVAGE'S.—Mains transformer for Westinghouse H.T.4 unit, with additional winding, 4 volts centre tapped 3 amps, 23/-; transformers for other Westinghouse units available.

SAVAGE'S.—Mains equipment for new Foreign Listeners Four, transformer, N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke C32O, 20/-.

SAVAGE'S.—Mains equipment for Power Pentode Two transformer, P.P.2, 33/-; output choke, L.C. 38P.G., 19/6; smoothing choke, L.C.36G, 18/-.

SAVAGE'S.—Mains transformer B.T.4, 500-0-500 volts, 120 m. amps, 7½ volts 3 amps., 6 volts 3 amps, 4 volts 2 amps., 4 volts 1 amp, 4 volts 1 amp., all centre tapped, specially developed for automatic bias; 57/6.

SAVAGE'S.—Mains transformers and power chokes are carefully and individually constructed from first class materials, with an exceptionally generous margin of safety.

SAVAGE'S, 146, Bishopsgate, London, E.C.2. 'Phone: Bishopsgate 6998. [9165

CHESTER BROS.—All types of mains transformers and chokes to any specification.—Chester Bros., 244, Dalston Lane, London, E.8. [9798

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

D.C. Eliminator, 220/240, Ecko, H.T., L.T., G.B., 60, 120, power; 60/-.—Kirkup, Bungalow, Fairholme Rd., Burnley. [1229

CABINETS.

CABINETS for All Requirements.—F. W. Ramsey, 63, Shaftesbury St., London, N.1. Clerkenwell 7139. [9736

DIGBY'S Cabinets.—Table models in solid oak and mahogany; from 11/6 to 71/-.

DIGBY'S Cabinets, fitted with Radion or Resiston ebonite if required.

DIGBY'S Cabinets.—Pedestal model, with separate battery components; from 56/- to £12.

DIGBY'S Cabinets Made to Customers' Own Designs.

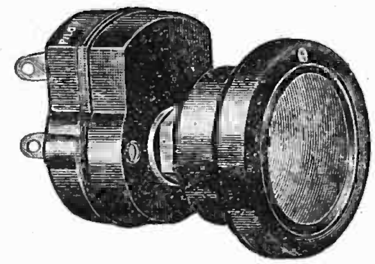
DIGBY'S Cabinets.—Write for new 16-page art catalogue.—F. Digby, 9, The Oval, Hackney Rd., E.2. 'Phone: Bishopsgate 6458. [0128

CABINETS to Your Own Requirements; quotations by return.—Hammonds, 1, Stratford St., Nuneaton. [1234

COILS, TRANSFORMERS, ETC.

600 and 1,000 ohms Decoupling Resistances, specified for the largest and most important "Wireless World" receivers; 1/6 each, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1088

THE PILOT SWITCH



A Power Switch for all uses, Mains Sets, Eliminators, etc. Handles 3 amperes at 220 volts. Supplied with black or brown Bakelite knob, or with lever and "on and off" plate.

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Sole Agents for Great Britain and Ireland for all lines manufactured by The Pilot Radio & Tube Corporation of New York.

West of England Distributors:—F. BURRIS & SONS, 7 to 16, Redcliffe Street, Bristol.

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D.C. Models now made in All - BAKELITE cases—a very pleasing finish.

B15 MODEL

PRICE 21/-

D.C. The B15 Model, giving 60 and 120 volts, 15 M/A. Price **21/-**, as illustrated.

A.C. The E10 Model, giving 60 and 120 volts, 10 M/A. Price 65/-, complete with valve.

D.C. The C25 Model, with tappings of 60, 120 and 150, 25 M/A. Price 32/6.

A.C. The E15, with tappings of 60, S.G. and 120, 15 M/A. Price 70/- complete.

All models guaranteed 12 months. 24 models in stock.

Write for lists.

Valve or Westinghouse Rectification optional.

SUPREMUS SPECIALITIES LTD., 118, HIGH STREET, ERDINGTON, B'HAM.

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London Agent: P. H. SMEDLEY, 50, Richmond Road, Leytonstone, E.11.

Coils, Transformers, Etc.—Contd.

TRANSFORMERS and Chokes for Battery Eliminators.—Chester Bros., 244, Dalston Lane, London, E.8. [9706

KILO-MAG Four Formers, slotted, ready for winding, 12/6 set; 1930 Everyman Four, 8/6 set, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [1089

BAND-PASS Four Coils, complete, 70/-; Ideal Home receiver coils, 43/-; superhet. adaptor coils and base, 24/-; S.G.S.W. Three, 4 coils, 34/-; additional coils, 46/-.—Below.

REGIONAL One.—Coils of guaranteed accuracy; write for prices; Berclif coils for all popular sets; trade supplied.—Note new address: 33, Rabone Lane, Smethwick, Simmonds Bros., the Original Coil People. [1243

BAND-PASS Coils, mounted, 55/-; boxes, 19/6 set; all special parts for Record III, Kilo-Mag, Everyman, Foreign Listeners Four.—Townhead Radio, Duke St., Rochdale. [1231

E.C. WIRELESS.—Regional One coils, 9/- pair; Band-Pass Four, 45/- set; first quality materials and construction to specification guaranteed.—28, Premier Place, High St. Putney, S.W.15. [1228

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AMPLIFIER Valve.—If you require power you cannot do better than one of these (or matched in pairs if required).

FILAMENT Volts 6, plate volts 400 (maximum), grid bias 84 volts (approx.), impedance 800 ohms, amplification factor 3.8, mutual conductance 4.35 m.a./volts; price £5/10; see article "The Wireless World," 24th July, 1929, then send to North London Valve Co., Ltd., 22½, Cazenove Rd., Stoke Newington, London N.16. [1143

COMPONENTS, ETC., FOR SALE.

BELLING-LEE Panel Fittings are designed to give an expert finish to any home-constructed set; catalogue post free.—Belling and Lee, Ltd., Queensway Works, Ponders End, Middlesex. [0018

COMPONENTS Lent on Hire.—Details from Alexander Black, Wireless Doctor, 55, Ebury St., S.W.1. Sloane 1655. [0329

FERRANTI Meters for Sale; particulars stamp.—Clarke, c/o 49, Leonard Rd., Hanley. [1215

RADIO HOUSE, HUDDERSFIELD, issues the Reliability Wireless Guide, which will be sent post free upon request by Messrs. J. H. Taylor and Co., 15, Macaulay St., Huddersfield. [7823

PART Exchange.—See our advertisement under Receivers for Sale.—Scientific Development Co., 57, Guildhall St., Preston. [0228

GOVERNMENT Surplus Mark II 2-valve Transmitters. 10/6; B.T.H. generators, H.T.950, 37/6; Mark III 2-valve sets, 17/6; Veeder counters, 1/-; Headphone cords, 6d.; hot wire ampmeters, 3/6; Rotax 8-way switchboards, 2/6; Amplion units, A.R.58, 7/6; 3-valve amplifiers, 17/6; plus carriage.—Camden Surplus Mart, 25, King St., Camden Town, N.W.1. [1224

PYE Mains Transformer, input 100, 200, 230, output 350 volts, 25/-; Varley pick-up, 12/-; 2 Mazda A.C. S.G. and valve holders, £1; also large number of chokes, transformers, valves; particulars on application.—Perkins, Brooklyn, Aberystwyth. [1222

ELECTRICAL Clearance.—2-valve transmitting sets, 15/-; Morse transmitting sets, 12/6; 1in. spark coils, 6/-; 2in. spark coils, 17/6; super microphones, 2/6; microphone transformers, 2/6; television motors, electric, 110 or 220v., D.C., 10/-; ¼h.p. motors, 110v., 30/-; 50v. 4a. dynamos, 35/-; 20v. 6a., 40/-; 100v. 10a., slow speed, £7; portable telephones, 17/6; earphones, 1/3; telephone H.T. generators, 6/6; Morse keys, 3/6; buzzers, 2/6; 1 mfd. condensers, 1/6; hand telephones, 5/-; shunt regulators, 10/- to £1, all sizes; 1,000 ohms chokes, 1/-; magnetic relays, 12/6; P.O. relays, 6/-; Ford ignition coils, 4/-; ¼h.p. 220v. motor, shunt wound, 50/-; Mark III Star crystal sets, 40/-; D.III buzzers, platinum contacts, 5/-; Dewar switches, 1/-; 12v. car dynamos, 25/-; 6 or 12v. car starter motors, 12/6; cash with order or c.o.d.; all goods guaranteed; send now, list now ready.—Galpin, Binfield Heath, nr. Henley-on-Thames. [1219

LEWCOS Dual Binocular D.B.A. and D.B.G., 8/6 each; Cyldon Junilog 0.0005, 2 at 5/- each; R.I. Astatic H.F. choke, 4/-; all perfect.—Box 7173, c/o *The Wireless World*. [1242

AIR Force 2-valve Transmitters, Mark II, contains transformer, choke, high voltage condensers, ammeter, multi-cables, and many other useful parts, made by G.E.C., new and unused, complete in carrying case, 10/-, carriage extra; Fultograph picture receivers, 30 only, £2/5 complete.—Modern Radio, 37, Lisle St., W.C.2. [1235

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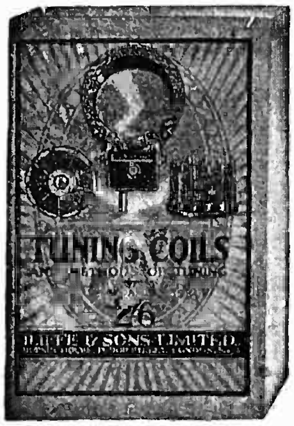

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A VERY useful manual giving the maximum of information on the subject. Following a simple explanation of the principles of wireless, the author discusses the many methods of tuning circuits, with explanations of spade, condenser and variometer tuning. Other chapters treat in detail of the choice, construction and design of coils, and give particulars as to size of coil required, the best shape, size of wire, type of insulation, and special uses of the various coils.

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THE BARNES RADIO SERVICE.—Repairs, rebuilding, demonstrations, radio gramophones and scratch filters; reproduction specialists; any distance.—53, High St., Barnes, S.W.13. Prospect 5633. [9705

GUARANTEED Repairs by Experts.—Loud-speakers, headphones, cone units, pick-ups, any type, rewound, remagnetised, and adjusted post free 4/-; transformers, from 4/-.—Howell, 91, Morley Hill, Enfield, Middlesex. [9555

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SCOTT SESSIONS and Co., Great Britain's Radio doctors, officially approved as wireless repairers by Radio Society of Great Britain and Wireless League; old sets of every type repaired, rebuilt, modernised; send set for immediate quotation.

SCOTT SESSIONS and Co.—New sets constructed with your or our components, guaranteed finest workmanship; we specialise in "The Wireless World" circuits; remember, we have satisfied customers throughout the British Isles and in three Continents; if you so desire, we will design and construct high grade apparatus to suit your especial circumstances for quality, range and selectivity.—Tel.: Tudor 5326. Muswell Hill, London, N.10. [0262

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EASY Payments.—We supply, by easy payments, components, accessories, and sets, any make; 10% down, balance spread over 11 months.—Send list of requirements to London Radio Supply Co., 11, Oat Lane, London, E.C.2. [0337

ENGINEERS, novice or expert, £300, £400, £500 per year or more is within your grasp. In our handbook "Engineering Opportunities," Prof. A. M. Low explains where the good posts abound. This handbook has shown the way to better things to over 20,000 of your fellows; it contains details of A.M.I.Mech.E., A.M.I.E.E., A.M.I.C.E., A.M.I.A.E., A.M.I.Struct.E., Matric, C. and G., G.P.O., etc., exams., outlines home study courses in all branches of electrical, mechanical, motor and wireless engineering, and shows the unique advantages of our appointments department; why stay in the Hammer and File Brigade? Send for our free handbook at once, stating branch, post or exam. which interests you.—British Institute of Engineering Technology, 87, Shakespeare House, 29-31, Oxford St., London, W.1. [1185

VOLTMETER.—Weston Standard portable model, unused, A.C. and D.C., range 0-600v. (guaranteed to 25%).—Offers to Box 7159, c/o *The Wireless World*. [1216

LOUD-SPEAKERS.

BAKER'S SELHURST RADIO 36-page Booklet, "Sound Advice is Yours for the Asking"; write now for new edition; see displayed advertisement on page 12. [0231

CELESTION Loud-speaker, perfect condition; cost £6, sell £2/10.—Bird, 112, Maidstone Rd., New Southgate, N.11. [1220

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W.W.37a.

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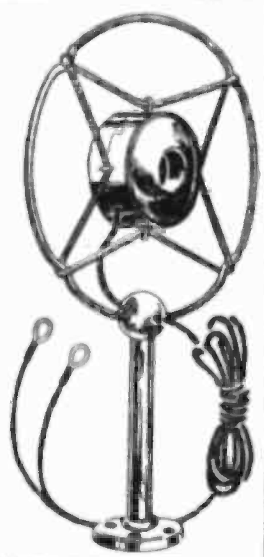

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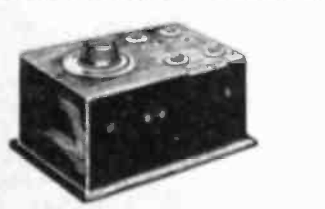

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INDEX TO ADVERTISEMENTS.

	PAGE
Adolph, Fredk.	11
Apollo Gramophone Co., Ltd.	
Appleby, E. Hetherington	8
Baker's "Selhurst" Radio	12
Bayliss, Wm., Ltd.	Cover iii.
Burton, C. F. & H.	Cover i.
Cossor, A. C., Ltd.	7
Day, Will, Ltd.	
Dubilier Condenser Co. (1925), Ltd.	
Eastick, J. J., & Sons	
Edison Swan Electric Co., Ltd.	Cover ii. & p. 3
Electradix Radios	12
Electrocet Radio Co.	12
Exide Batteries	
Ferranti, Ltd.	1
General Electric Co., Ltd.	
H. and B. Radio	8
Hughes, F. A., & Co., Ltd.	
Impex Electrical, Ltd.	2
Jackson Bros.	
Lyons, Claude, Ltd.	Cover i.
Marconiphone Co., Ltd.	6
McMichael, L., Ltd.	
M-L Magneto Synd., Ltd.	2
Mullard Wireless Service Co., Ltd.	Cover iv.
Paroussi, E.	12
Partridge and Mee, Ltd.	
Perseus Manuf. Co., Ltd.	12
Radiogramophone Development Co.	4
Regent Radio Supply Co.	
Rich and Bundy, Ltd.	12
Rigby & Woolfenden	12
Rowley, Thomas A., Ltd.	9
Rothermel Corporation, Ltd. (Centralab)	5
Supremus Specialities, Ltd.	9
Tannoy Products	8
Telegraph Condenser Co., Ltd.	3
Telsen Electric Co., Ltd.	Cover i.
Thomas, Bertram	4
Transformer Repair Co.	12
Tungsram Electric Lamp Works (Great Britain), Ltd.	Cover i.
Ultra Electric, Ltd.	
Westinghouse Brake & Saxby Signal Co., Ltd.	5
Weston Electrical Instrument Co., Ltd.	5
Wilkins & Wright, Ltd.	2
Wingrove & Rogers, Ltd.	12

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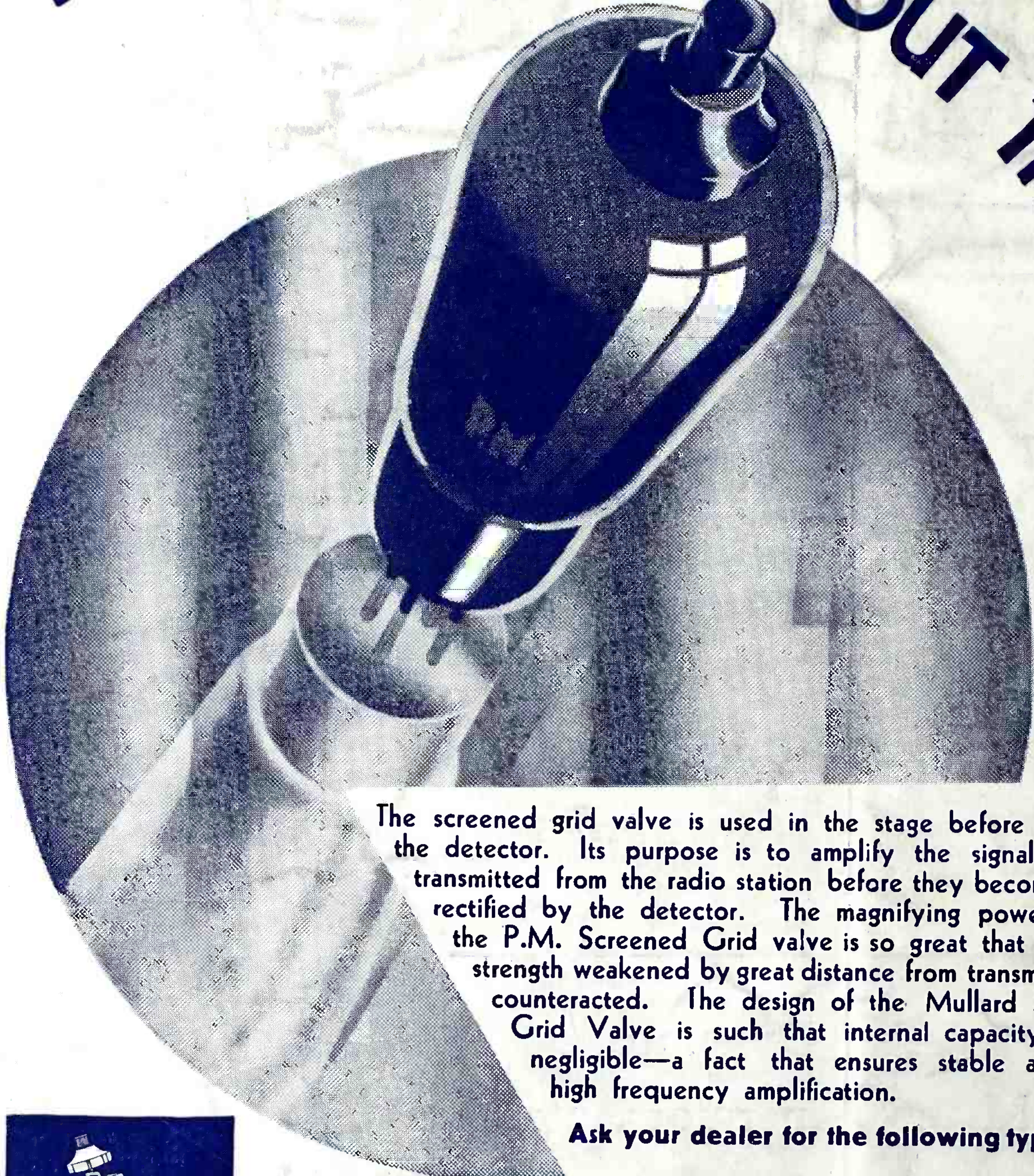

The screened grid valve is used in the stage before the detector. Its purpose is to amplify the signals transmitted from the radio station before they become rectified by the detector. The magnifying power of the P.M. Screened Grid valve is so great that signal strength weakened by great distance from transmitters is counteracted. The design of the Mullard Screened Grid Valve is such that internal capacity is almost negligible—a fact that ensures stable and efficient high frequency amplification.

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BAND-PASS UNIT

4D

The Wireless World

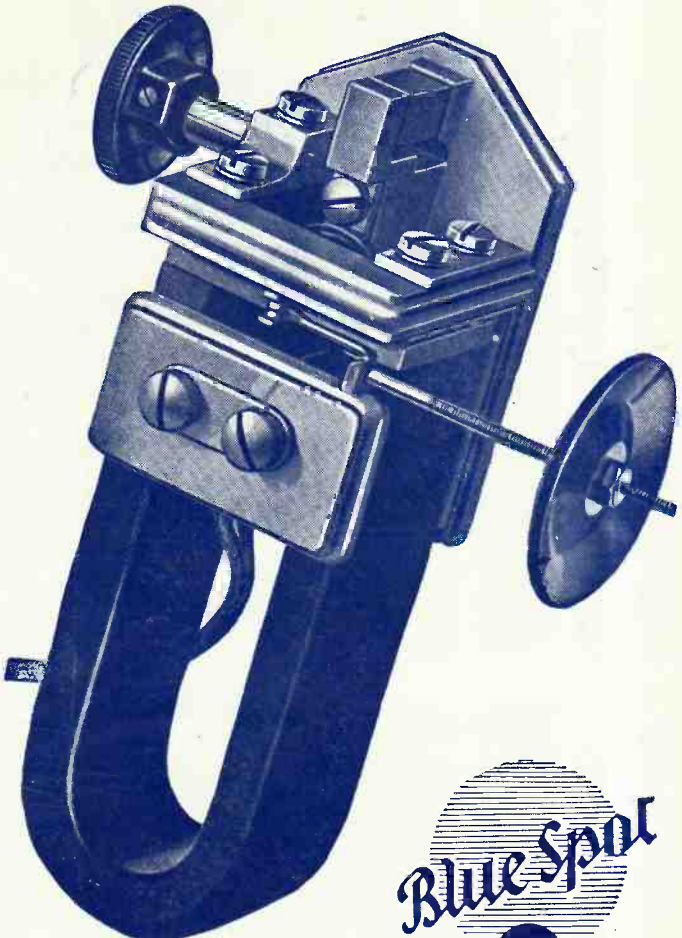
AND RADIO REVIEW

The Paper for Every Wireless Amateur

Wednesday, August 27th, 1930.

No. 574. Vol. XXVII. No. 9.

BLUE SPOT 66P



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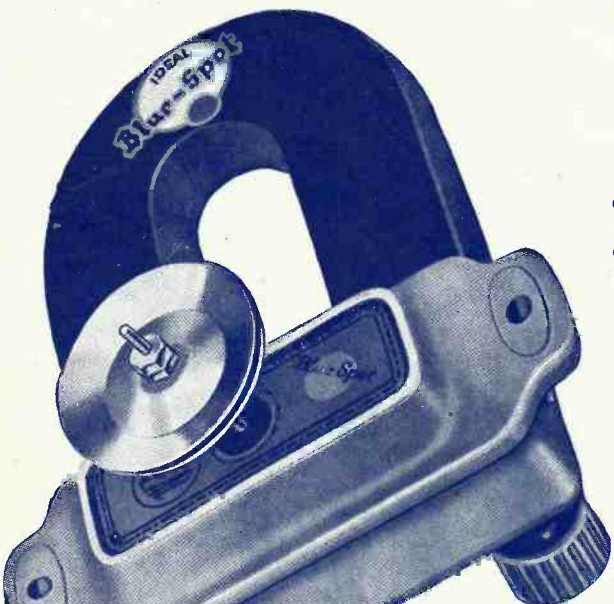

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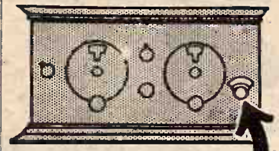

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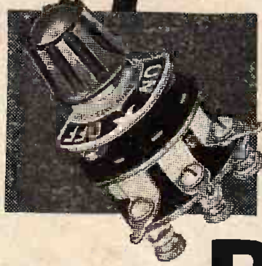

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The Wireless World AND RADIO REVIEW (18th Year of Publication)

No. 574. WEDNESDAY, AUGUST 27TH, 1930. VOL. XXVII. No. 9.

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As many of the circuits and apparatus described in these pages are covered by patents, readers are advised, before making use of them, to satisfy themselves that they would not be infringing patents.

CONTENTS OF THIS ISSUE.

	PAGE
Editorial Views	185
Band Pass Unit. By W. I. G. Page	186
Effective Screening. By R. L. Smith-Rose	190
Current Topics	193
Broadcast Receivers Reviewed: Dubilier A.C.3	194
Laboratory Tests on New Apparatus	196
All D.C. Three (Concluded). By H. B. Dent	197
Broadcast Brevities	203
Wireless Theory Simplified. By S. O. Pearson	204
Correspondence	207
Readers' Problems	208

RADIO PROSPERITY AND PROPAGANDA.

THE Radio Corporation of America has generally been considered to reflect in its earnings the prosperity of the radio industry as a whole in the United States. The Corporation licenses nearly all the radio manufacturers in America, so that if the manufacturers of broadcast apparatus prosper the earnings of the R.C.A. may be expected to mirror their successes.

Much comment has been made over the surprising reduction in the earnings of the R.C.A. Whereas in 1929 the earnings were set down as $4,996,000, the net income for the corresponding six months to June 30th of this year is shown as $505,000. We know that much of this reduction in income can be attributed to the general trade depression, but the comparison seems to be too great to be entirely dismissed with this explanation. Comment in the United States has definitely held sponsored programmes and advertising to be responsible for a remarkable setback in the popularity of radio listening.

Dr. Lee de Forest, who has been described as the father of broadcasting in America, has recently denounced the use of broadcasting for publicity purposes as likely to "kill the goose that lays the golden egg." Coupled with these observations we hear from an entirely different source that the ownership and use of broadcast receiving apparatus in America is coming to be looked upon as almost "vulgar," and that listening is out of favour with the discriminating citizen.

Whether these reports are a true picture of the state of affairs in America, or are exaggerated, there yet must be sufficient in them to serve as a warning to us and a reminder that the success of broadcasting as a public service, as a medium for well-intentioned education, and general entertainment, is dependent entirely upon the ability of the broadcasting service to hold the interest and maintain the confidence of the listener.

BAND-PASS THE KEY TO SELECTIVITY.

IT has been customary to assume that a degree of selectivity which would provide for adequate separation of the stations of the Regional scheme would necessitate a high-frequency stage preceding the detector, unless recourse was to be had to the employment of rejector circuits, or, at least, an aerial circuit and closed circuit both separately tuned.

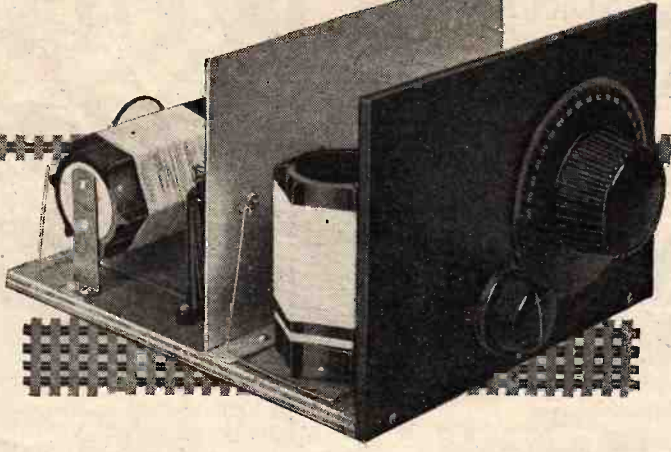
In this issue there is described a band-pass unit which has been designed to provide single-dial control for receivers which are not preceded by an H.F. stage. The unit provides the sole tuning device in the receiver, and gives a degree of selectivity which, we believe, has not hitherto been obtained with a single tuning control and detector stage. As far as we are aware, no commercial set has yet made use of the principle as a means of obtaining selectivity where no H.F. stage is employed.

A point of great importance is that, while extreme selectivity is attained, the fact that the two circuits of the filter are ganged on a single control enables the adjustment (of the two circuits) to be made in such a way that selectivity does not suffer as it would if an attempt were made to keep two independent controls in step. The flat-topped curve obtained serves to retain the side bands for quality, whilst maintaining the narrow response curve characteristic of band-pass tuning.

Another feature which is of particular interest in connection with the employment of capacity-coupled filters as described, is the simplicity with which it is possible to calculate, without complicated mathematics, the width of the flat top which the resonance curve will embrace when the constants of the circuit are known.

BAND PASS UNIT

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



A Simple Ganged Filter giving High Selectivity without Loss of Sidebands.

IT has often been stated that extreme selectivity, so necessary in the face of powerful local transmissions, is only obtained conveniently with high-frequency amplification. By increasing the number of uncoupled tuned circuits, that is, circuits in cascade, the selectivity of a set can be progressively enhanced—at a price. The greater the number of these circuits the more serious is the high-note loss due to cutting of sidebands; in fact, improvement in selectivity is possible only with a corresponding increase in distortion. Often enough sets with high-frequency stages of low-loss design, with single tuning circuits in cascade, are incapable of reproducing notes of 5,000 cycles upwards, and the loud speaker emits a characteristic deep tone devoid of all "crispness."

IN this article constructional details are given of an inexpensive band pass filter with single-dial control specially designed for detector-L.F. sets. The filter forms the sole tuning device in the receiver and is not an auxiliary selectivity unit. When tested with a 100 ft. outside aerial five miles from Brookmans Park the degree of selectivity was remarkable; using a tuning scale with 100 divisions there were 17 and 21 divisions of silence between the two stations for leaky grid and anode bend detectors respectively and the plotting of a resonance curve under working conditions showed the presence of the "double-hump" necessary for the retention of sidebands. The capacity-coupled filter undoubtedly affords a solution of the selectivity-with-quality problem and is likely to find extensive application with the incidence of the Regional Scheme.

Such are the properties of the band pass filter that a solution is at once afforded to the problem of local station interference, even with detector-L.F. sets. It is a form of tuning in which two different frequencies are at resonance at the same time, giving the well-known "double - hump" effect lately discussed at length in the pages of this journal. Not only does the "square-top" of the response curve very nearly fit the transmitted carrier wave, together with its sideband frequencies, but also it is an inherent property of capacity-coupled filters that the sides of the curves are steep. Thus the important combination of good quality and high selectivity can be obtained with a single tuning control. In an ordinary receiver the valve capacities, the wiring, the leaky grid detector and resistance amplifier, if these be used, and the moving-iron loud speaker, all tend to reduce the higher notes. It is only with the band pass filter that these frequencies can be over-accentuated to make up for their loss elsewhere, at the same time not affecting the proper rendering of the bass.

The unit to be described has been designed for use as the sole tuning device for sets in which the first valve is a detector. A universal input band pass unit would not be easy to construct without a knowledge of the intervalve coupling where a high-frequency stage is concerned. In the latter case the usual aim is to make the tuned anode or tuned transformer coupling of such a nature as to fill up the depression between the two peaks formed by the aerial filter, thus permitting the use of band pass coils having quite a low loss. An input filter on these lines would have the two tuning peaks overpronounced if it formed the only tuning circuit as in a detector set. There is thus a limit to the "goodness" of the coils that we can use. Furthermore, in a set with high - frequency amplification, comprehensive screening and certainly waveband switching would be desirable in the aerial filter.

The circuit of the tuner is given in Fig. 1, from which it will be seen that the input arrangements of the "Regional One" receiver [1] recently described have been closely followed. The differential condenser has been replaced by an ordinary two-electrode variable condenser C_4 having a capacity of 0.0003 mfd. The increase in capacity has made the control of reaction smoother, and there may be cases where the aerial constants are such that this modification will be an advantage with the "Regional One." Dimensions and winding data for the

[1] See *The Wireless World*, August 13th, 1930.

Band Pass Unit.—

two matched coils of 225 μH inductance are given in the table in the appendix. The only change in the filter layout, as compared with that of the one-valve receiver already referred to, is that the secondary coil has been placed in the compartment nearest the control panel so that the output leads to plate and grid (marked P and G) need only take short paths to the terminal strip. On the far side of the vertical screen the aerial coil L_1, the trimmer C_3, and the coupling condenser C_m are housed. If the unit is used before an anode bend detector the terminal G is connected directly to the grid, and arrangements must be made to provide negative bias. When employed before a power-grid or leaky-grid detector the condenser C_5 and resistance R_1 (not provided in the unit) must be given normal values. R_1 may be taken to filament positive.

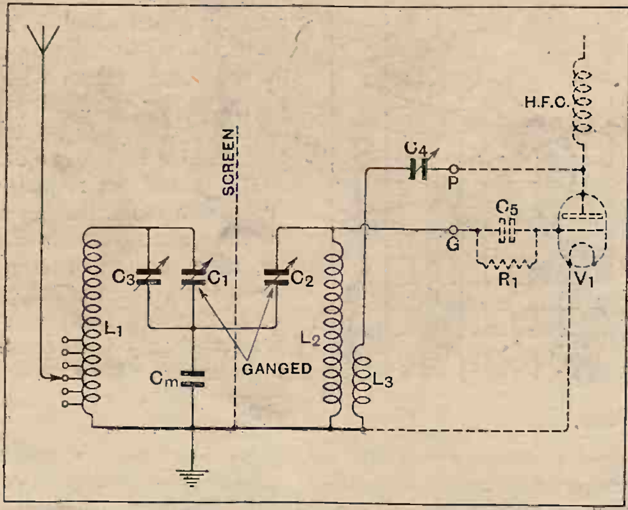


Fig. 1.—Circuit diagram of the band pass unit. The portion of the circuit in dotted lines represents the detector valve and its components which are not included in the unit. C_1, C_2, 0.0005 mfd. ganged condensers; C_3, 1.5 to 50 $\mu\mu$F. trimming condenser; C_m, 0.01 mfd.; C_4, 0.0003 mfd. variable condenser. The coil data are given in the appendix.

The band pass unit was tested with a 100ft. outside aerial five miles from Brookmans Park, and the response at resonance, as given by a meter in the anode circuit of both anode bend and leaky grid detectors, is shown in Fig. 2. For simplicity of comparison, the standing currents passed by each detector are shown as zero, and only the rise (anode bend) and depression (leaky grid) of current at resonance are plotted. In each case a low-frequency amplifying stage was added, and 'phones were used to check the point at which silence was obtained on either side of the signal. The test conditions must be considered exacting, as with a loud speaker the stations would appear to cover even a smaller frequency band. The broken scale in the middle of the illustration represents those portions of a 0 to 100-division tuning dial with which we are concerned when tuning in the National and London Regional stations, with both anode bend and leaky grid detector valves directly connected to the filter.

It will be seen that the National station occupies no more than 3.5 divisions, and that there are 21 divisions

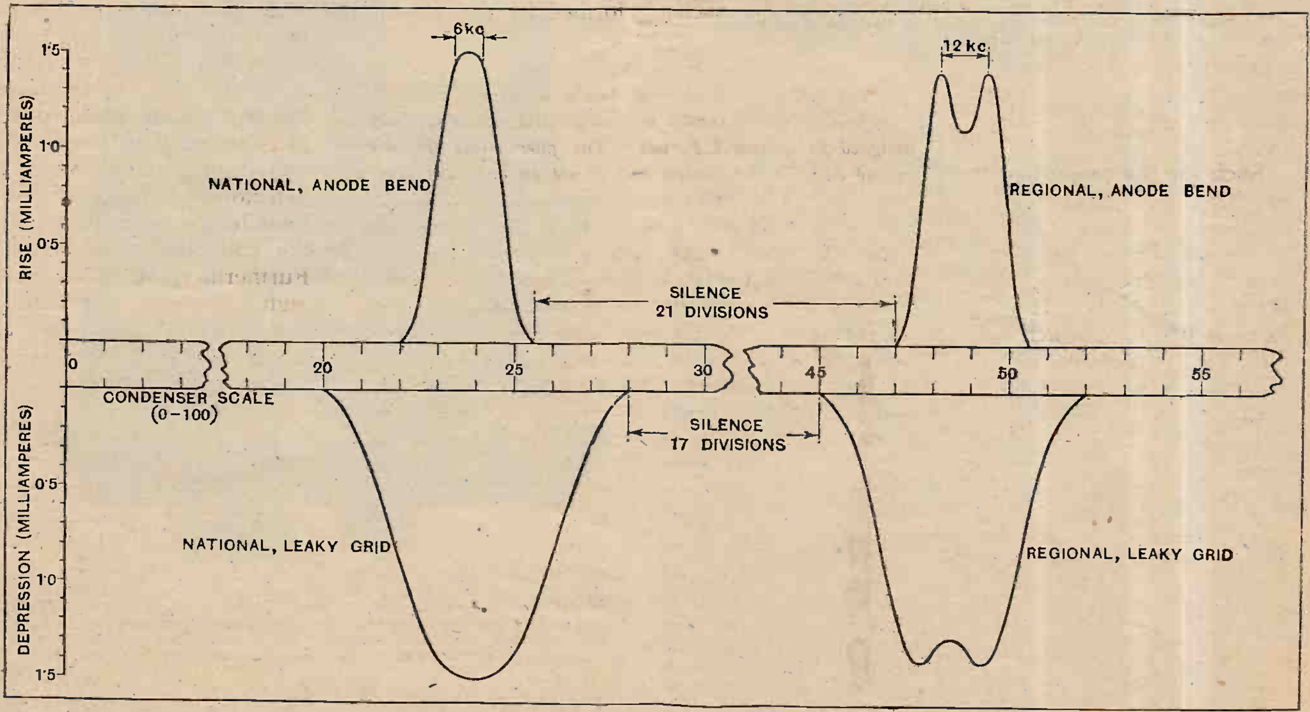


Fig. 2.—Resonance curves of the National and London Regional transmissions. These curves refer to the band pass unit when used with a 100 ft. outside aerial five miles from Brookmans Park. The broken scale in the centre of the illustration represents those portions of a 0 to 100-division tuning scale covered when tuning in the two stations with anode bend and leaky grid detectors connected directly to the filter. The vertical scale shows the rise (anode bend) and depression (leaky grid) of current at resonance as indicated by a milliammeter in the detector anode circuit.

Band Pass Unit.—

of silence between this and the Regional station under anode bend conditions. It is also noteworthy that the frequency bands occupied by both these stations are much

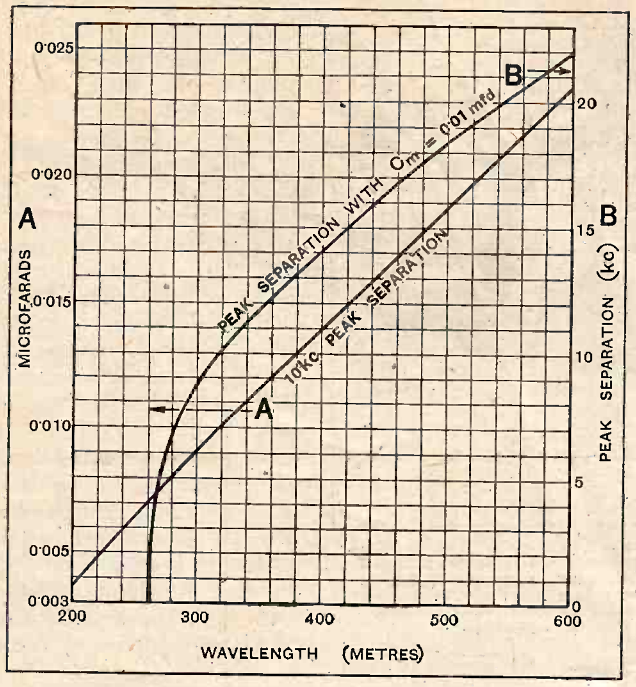


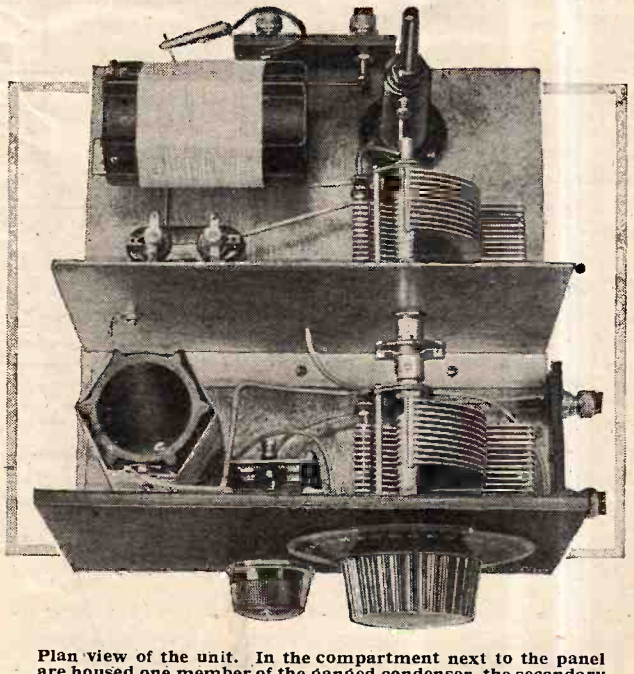
Fig. 3.—Filter characteristics of the band pass unit. Curve A to be read in conjunction with the vertical scale on the left shows the coupling capacity necessary to give the optimum peak separation of 10 k.c. at any wavelength between 200 and 600 metres. Curve B to be used with the vertical scale on the right gives the peak separation at various wavelengths which will be obtained when using a fixed coupling capacity (C_m) of 0.01 mfd.

the same, although the ratio of capacity to inductance is much higher where the London Regional station is concerned. In other words, the selectivity remains nearly constant, a condition which does not obtain with single-circuit tuning. The double hump in the resonance curve is clearly seen in the case of the Regional station, the measured peak separation being 12 kc., almost exactly the figure predicted from a mathematical consideration of the tuned circuit constants. As we pass to the lower wavelength of the National station the reactance of the 0.01 mfd. coupling condenser drops from 20 to 14 ohms, and so the volts developed across it become smaller, and consequently the coupling is loosened, resulting in a single peak in which the sidebands, luckily, are not unduly cut, owing to the high-frequency resistance of the coil rising rapidly at this wavelength.

The response curves for an ordinary leaky grid detector (PM6D), with grid leak and condenser of 2 megohms and 0.0003 mfd. respectively, show surprisingly good selectivity in view of the heavy load, due to both grid current and reverse phase feed-back, which the valve imposes on the tuned circuit. There are 17 divisions of silence between the two stations, and the double hump, although not so pronounced, is still present with the Regional transmission. The effect of reaction is not quite the same as that with a single tuned circuit. The high-frequency resistance of the whole circuit is reduced, and the peaks not only become more pronounced but are more widely separated, therefore the sidebands which carry the high notes receive preferential treatment. Reaction with a band pass filter thus increases the high notes—an opposite effect to that usually experienced. By judicious use of reaction a small double-hump was found to exist when tuning in the National station with an anode-bend detector. As Fig. 3 shows, the peak separation is zero at 260 metres; evidently the double-hump has been extended to lower wavelengths by the use of reaction.

The plotting of resonance curves by taking the rise or depression of current as read by a milliammeter in the detector anode circuit cannot be claimed to give great accuracy, but the presence of a double-hump and the general degree of selectivity can be seen well enough.

No mention has been made of inductively-coupled filters, because with them the selectivity drops off seriously at the lower wavelengths, and we are only discussing filters suitable to precede directly a detector which may load the input considerably. There is room for research in a combined inductance- and capacity-coupled filter, designed to give constant peak separation and constant selectivity over the waveband. The capacity filter of the type being described has nearly constant selectivity, but the peak separation varies across the waveband, and it is only by dint of the natural high-frequency resistance at the lower wavelengths that the single peak is broad enough to prevent



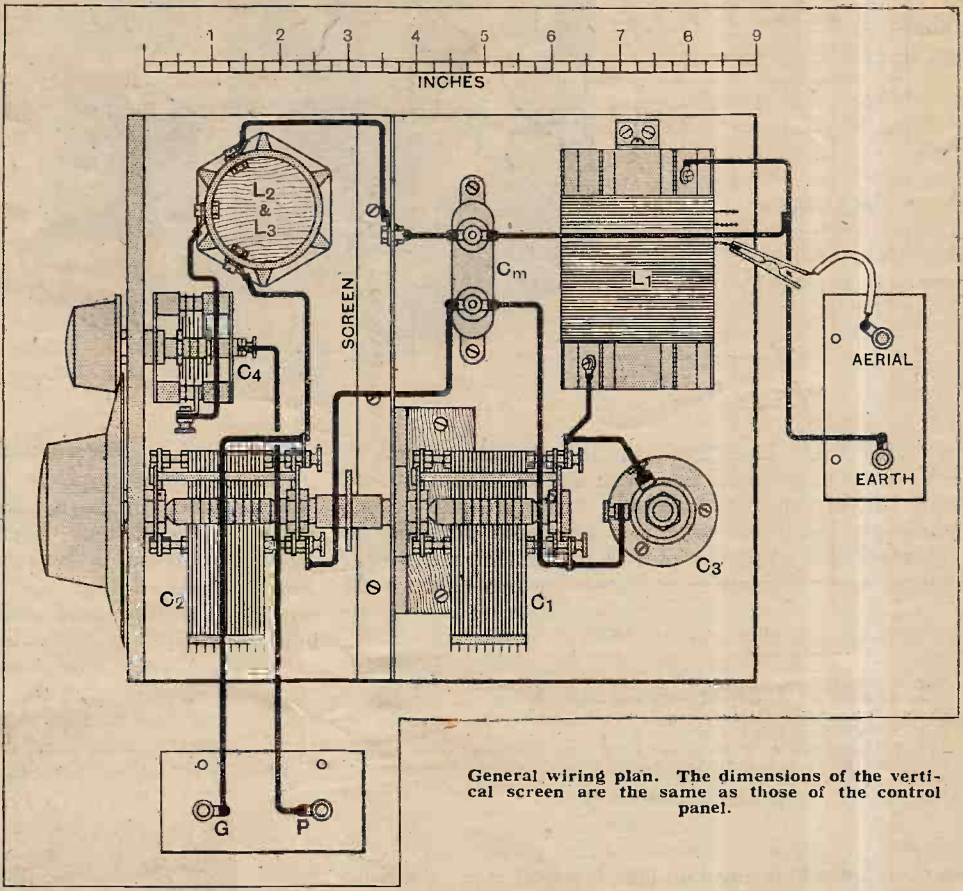
Plan view of the unit. In the compartment next to the panel are housed one member of the ganged condenser, the secondary coil with reaction winding, and the reaction condenser. A slow-motion dial will probably be found more satisfactory for controlling the ganged condenser.

undue loss of sidebands. If the filter is designed to give the optimum peak separation of 10 kc. at about the middle of the medium broadcast band, there will be rather wide separation at the higher wavelengths; with

Band Pass Unit.—
5GB, for instance, the peaks will be separated by 17.5 kc. (See Fig. 3, curve B, for 480 metres.)

In Fig. 3 are given the filter characteristics, showing (A) the coupling capacity necessary to give 10 kc. peak separation at the various wavelengths between 200 and 600 metres, and (B) the peak separation that is obtained with the 0.01 mfd. fixed coupling condenser (C_m) used in the unit. Those readers who only listen to one station can choose their coupling condenser to give 10 kc. peak separation at the wavelength required. If the condenser of correct capacity is not on the market, then use must be made of two condensers in series or in parallel.

Let us take an example. Suppose that the local station transmits on a wavelength of 400 metres, and it is desired to design the filter to give a 10 kc. peak separation at this wavelength. An examination of curve A shows that the coupling condenser must have a capacity of 0.014 mfd. *The Wireless World* radio data charts for calculating capacities in series shows that this can be made up by combining condensers of 0.02 mfd. and 0.05 mfd.—both values being on the market. Another example, if the filter with a 0.01 mfd. coupling condenser is used on a wavelength of 550 metres, what will be the peak separation? Curve B shows this to be 20.5 kc. In the appendix the formula is given from which these curves are plotted. Information is also given with regard to the effect of changing the various constants as a guide to the general design of capacity filters.



General wiring plan. The dimensions of the vertical screen are the same as those of the control panel.

Little need be said with regard to the operation of the band pass unit, as full details were given in the description of the "Regional One" receiver, to which the reader is referred. It would seem fairly safe to predict that once a ganged filter has been pressed into service and the remarkable selectivity and quality experienced, single uncoupled circuits will not be employed again.

APPENDIX.

The formula for peak separation in cycles in a capacity-coupled filter is:

$$\frac{\sqrt{\frac{1}{C_m{}^2\omega^2} - r^2}}{2\pi L}$$

where ω = $2\pi \times$ frequency.

C_m = common coupling capacity in farads.

r = the equivalent series resistance of the whole tuned circuit (see Fig. 2, p. 109, January 29th, 1930).

L = the inductance of one filter coil in henrys.

(1) *Wavelength* when reduced causes the peak separation to be diminished.

(2) *Coupling Condenser* (C_m) when reduced causes the peak separation to be diminished.

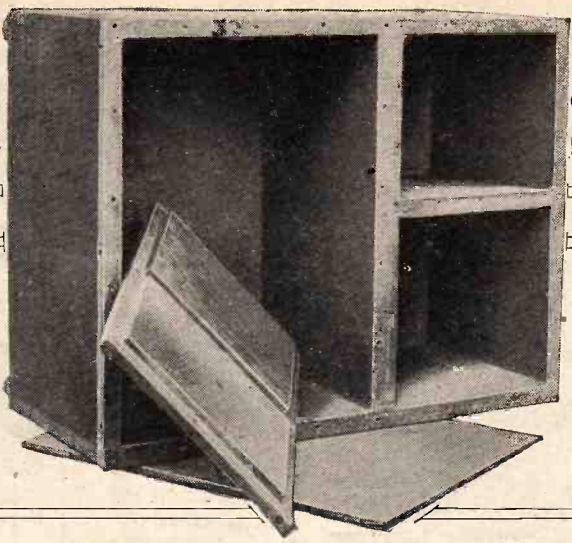
(3) *Reaction* when used causes r to be reduced and the peaks become more separated and more pronounced.

(4) *Inductance* when increased causes the peaks to get closer together and C_m must be reduced to prevent change in separation.

COIL TABLE.

Dia. of 6-ribbed ebonite former ..	$2\frac{1}{4}$in. overall.
Effective dia.	2.05in.
No. of turns (wound touching) ..	80.
Wire	No. 26 D.C.C.
Winding length	2.2 in.
Inductance	225 μH.
Waveband covered with 50 to 500$\mu\mu$F. tuning capacity	200 to 630 metres.
Average dynamic resistance	120,000 ohms (approx.).
Aerial tappings, L_1	14, 18, 22, 26, 30 and 35 turns from earthed end.
Common coupling capacity C_m ..	0.01 mfd.
Reaction winding spaced 0.3in. from low-potential end of L_2	12 turns No. 34 D.S.C.

EFFECTIVE SCREENING



Part I. Modern Methods Explained.

By R. L. SMITH-ROSE, D.Sc.

A VERY important feature in the progress of modern wireless research has been the development and use of effective screening arrangements. Some eight years ago it was evident to advanced workers that very elaborate screening of the component parts of a receiver was necessary if various spurious effects were to be avoided in the making of accurate measurements of the field intensity and direction of arrival of electromagnetic waves from distant transmitting stations. These research workers soon learnt that, if screening were to be of any use at all, it must be carried out in a very thorough manner, and special investigations were made to ascertain the best and most efficient methods by which this shielding could be obtained. Gradually during the past few years the use of screens has found its way into commercial transmitting and receiving apparatus, and recently into the more advanced types of broadcast receivers.

SO familiar are we with the fitting of screens to receiving sets that the fundamental reasoning for the inclusion of screening is often overlooked. Without a knowledge of the effect of screening errors may occur in the arrangement or suitability of the screens so that undesirable couplings persist.

Screening is of first importance in modern receiver design, and this article clearly explains the points to be observed in order that instability may be avoided

The popularity of the use of screened compartments in receiver design has been largely caused by the introduction of the screen-grid valve. In order to take full advantage of the improvements in the way of stage amplification which is offered by this valve, it is necessary to complete in a fairly thorough manner the separation of the circuits connected to the input and output sides of the valve, which is accomplished within the valve by the introduction of the screening grid. Also, the design and development of broadcasting receivers is now being carried out in a more scientific manner than formerly, and this has given rise to the necessity for somewhat elaborate and accurate methods of testing the overall performance of such receivers under practical conditions. The development of such methods of measurement has in itself given rise to a desire for efficient screening arrangements.

Electrostatic Screening.

The simplest type of screening is that known as electrostatic, since it deals with stationary electric charges and fields. Ever since the earliest days of electricity, it has been known that no charge is found inside a closed box of conducting material placed in a steady electric field. The classical experiment with "Faraday's Cage" provided a striking demonstration of this principle, and it is well known to all students of electricity.

Suppose that in Fig. 1 a positive charge at A is producing an electrostatic field at the apparatus B. If, now B is surrounded by a metallic box C, induced charges will be set up on this box as indicated, and the electric field at B will now be calculated from the original charge A and the induced charges on the shield C. These induced charges are always such that the net electric field inside the screen is zero, and we may therefore say that the inside of the box C is perfectly screened from the static charge at A.

Since all the charges under consideration are stationary, no currents will be flowing in the screening box C, and, therefore, the resistance of the material of the box is not very important, provided that it is sufficiently conducting to allow the induced charge to distribute itself freely. For similar reasons it is not essential for the material of the box to be continuous; a box of perforated sheet or copper gauze will still give the perfect screening required, since the induced charges can distribute themselves in such a way as to render the presence of the holes, if not too large, negligible.

If it is desired to connect the apparatus at B to earth, then, as indicated in Fig. 2, charges may be induced from A in the connecting wire D, and so be

Effective Screening.—

conducted to the apparatus B, which is evidently then not perfectly screened. To mitigate this trouble, the earth-connecting wire D must be connected to the screen at its point of entry O, when it becomes part of the screen C, and so B is once more completely protected. Continuous metallic box screens of this nature adequately connected to earth are sometimes employed for the protection of powder magazines and oil dumps from the effects of lightning discharges; for the building up of the charges prior to a flash usually takes place so slowly that the conditions approximate very closely to the electrostatic case.

Screening for High-frequency Impulses.

It will be noticed that in the cases so far considered the shielding is accomplished by the combined action of the induced charges and the original charge. If, instead of dealing with a steady charge at A we have a charge which is varying in magnitude, with or without a change in sign, then the charge induced in the shield C will be continually varying, and there will be a flow of current around the screen as the charges endeavour to accommodate themselves to the conditions required by the charge at A.

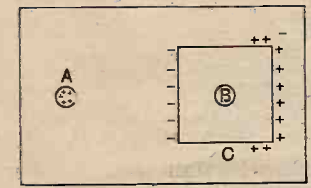


Fig. 1.—The effect of the charge at A on the apparatus situated at B is neutralised by the induced charge on the shield C.

Thus, if the field produced at B by the charge at A is of an alternating nature, the shielding effect of the screen C will depend very much upon its conductivity, and as the frequency is raised so will the conductivity become the more important. For screening assemblies of apparatus or individual components from an alternating electric field in their neighbourhood, it is thus necessary to surround them with a metallic screen of moderately high conductivity. This is the method adopted, for example, in the shielding of standard variable condensers to ensure that the capacity of the condenser at any reading of the scale shall be independent of the presence of any external fields or bodies.

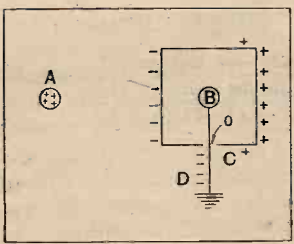


Fig. 2.—This diagram illustrates the change in the distribution of the charges when the apparatus B is connected to earth. If C is to continue to shield B, the earth lead D must be connected to C at its point of entry O.

In a similar manner a simple metallic plate screen has now become familiar in many designs of screened valve receiver, the intention being to ensure that the grid and filament end of the valve is efficiently screened from the anode end outside, as well as inside, the valve. In most cases, however, it is usually found that in either the audio or the radio-frequency end of a receiver, such simple methods of screening are not sufficient, particularly when high amplification and sensitivity are required. Many cases of instability in a radio receiver can be traced to stray coupling between successive stages, a fault which can be completely cured only by effectively screening individual stages. In considering how to obtain adequate screening for practical purposes, the action of the magnetic field, as well as that of the electrostatic field must always be taken into account.

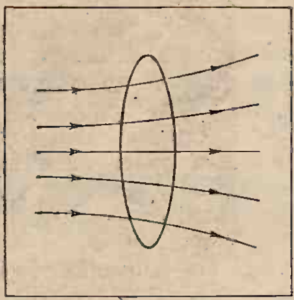


Fig. 3.—The magnetic field threading a conducting loop is opposed by the current which it induces in the loop.

Electromagnetic Screening.

Suppose that we place a single closed loop of wire in an alternating magnetic field, as depicted in Fig. 3. The elementary laws of electromagnetic induction can be applied to such a case, and show that the result will be the flow of an induced current in the ring, which, in turn, produces a secondary magnetic field inside the ring in a direction opposite to that of the primary field. In normal cases in which the loop is reasonably small for the wavelength employed, and its resistance is low compared with its inductive reactance, this secondary magnetic field will tend to eliminate the primary field within the ring, and to increase the field just outside the ring.

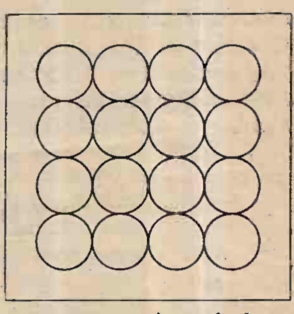


Fig. 4.—A series of loops arranged to screen a plane area from an alternating magnetic field.

We have thus obtained a space within the ring which is "screened" from the effect of the original magnetic field. By placing a number of such loops side by side over a plane, the dimensions of the screened area can be considerably increased (see Fig. 4). It will readily be seen that such a collection of loops can be replaced by a sheet of ordinary wire "rabbit netting." The efficiency of the screening will depend upon the stoutness of the wire and the mesh of the netting employed.

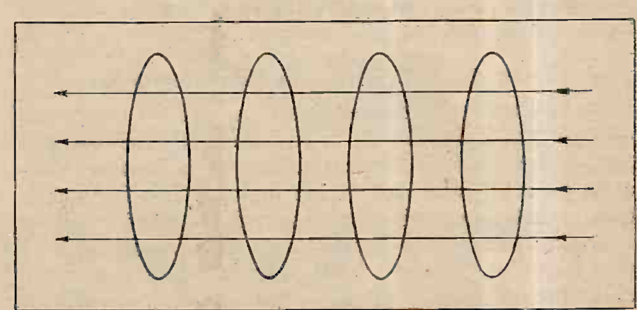


Fig. 5.—An arrangement of loops giving more effective screening for fields parallel to the axis of each loop.

Now, the reduction of the field by such a sheet extends only to a comparatively short distance on either side

Effective Screening.—

of the plane of the loops, for the path of the secondary field is only parallel to the primary field, while actually passing through the sheet. On either side it tends to curve back on its return path, although the distance at which such curvature becomes serious increases with the size of sheet employed.

Now, supposing that, instead of placing several loops side by side, as in Fig. 4, they were placed one behind the other on a common axis, as in Fig. 5. It is now evident that the screened space comprises a cylinder enclosed by the rings, but—and this is the important point—the rings are only effective in neutralising a magnetic field which is perpendicular to their planes. For a magnetic field parallel to the plane of the loops, no currents are induced in them, and hence no reduction of the field can result.

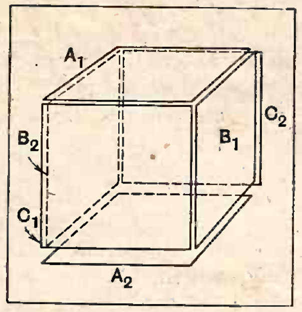


Fig. 6.—Three pairs of closed loops arranged mutually at right angles to screen a cubic space.

A little consideration of this case will show that, in order to screen a given space from an alternating magnetic field in any direction, it is essential to have the space enclosed by a combination of three series of loops whose planes are mutually perpendicular to each other. In Fig. 6 is illustrated a cube composed of three pairs of loops arranged mutually at right angles. In order to increase the dimensions of such a space, each loop may be replaced by a sheet of gauze or netting. If each of these six sheets is joined to the adjacent sheets along all four edges, then the enclosed space will be such that any plane within it will intersect the screen in a closed loop of low resistance and high reactance, and this is the essential condition for obtaining effective screening. It is thus important to ensure that good metallic contact is made along all the edges of the sheets of metal, gauze, or netting employed to screen a comparatively large enclosed space.

For example, suppose a cube of netting is made up as in Fig. 7, with all edges efficiently joined or bonded except along A G. Then only the end surfaces of the cube are effective in screening fields perpendicular to A, B, C, D; whereas, by bonding the edge A G, a very large number of intermediate loops is brought into action, and the screening properties for such fields is much more efficient. This question of making adequate connection at all points which are to form part of conducting loops is found to be of the utmost importance in screening.

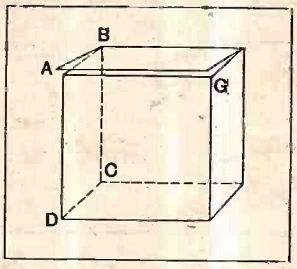


Fig. 7.—An incomplete screening box in which only the end surfaces are effective in screening fields perpendicular to A, B, C, D, until contact is made along the edge A G.

(*To be concluded.*)

EXPERIMENTING WITH INDOOR AERIALS.

Some Alternative Suggestions.

THE old idea of using the electric light mains as an aerial is not often tried out nowadays, possibly because in so many cases results are extremely poor. This is by no means always the case, however, and flat dwellers and others not in a position to erect a good outdoor aerial or a good "loft" aerial would do well to experiment in this matter, as occasionally this type of energy collector is highly effective. Special precautions are, however, necessary to avoid earthing the mains and to prevent risk of shock.

Using the Bell Wiring or the Telephone.

The best arrangement consists of a variable condenser —which can, if desired, be of the so-called semi-variable type—connected in series with a large-capacity fixed condenser (2 mfd.) and one of the mains. The fixed condenser must be of the type designed for use in battery eliminators; that is to say, it must have been tested to twice the mains voltage. Its purpose is, of course, to isolate the variable condenser and all other apparatus from the mains, and it should, therefore, be mounted in a box, through the side of which should pass a length of "flex" terminating in a wall plug or bayonet adapter for connection to the mains. The variable condenser is not strictly speaking necessary, but will be found an invaluable aid in so much that it permits the electrical characteristics of the "aerial" to be adjusted independently of the tuning controls of the receiver.

The electric bell wiring of a house will often provide a useful substitute for an aerial, and since these devices are usually operated from a low-voltage source of supply no special precautions need be taken. A series condenser is, however, nearly always necessary, in order to shorten the electrical time period of the wiring system. Connection can be made to any convenient bell-push.

Yet another experiment can be tried in order to get over the difficulty of providing an aerial of some sort under awkward circumstances, as an ordinary G.P.O. desk telephone may be pressed into service. The instrument may be placed upon a metal tray to which a wire, attached to the aerial terminal of the receiver has been soldered. "Connection" to the telephone wire is formed by the electrical capacity existing between the tray and the metal in the telephone instrument, and therefore there is no tampering with P.O. property. Owing to the fact that this capacity is small, it offers a high resistance to the passages of speech-frequency energy, and there is, therefore, no fear of introducing "cross-talk." This arrangement is often more effective than a really good indoor aerial of the conventional type.

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624 B.U.	Full Wave Rectifier	2·0 amp.	550	60 m.a.	20/-
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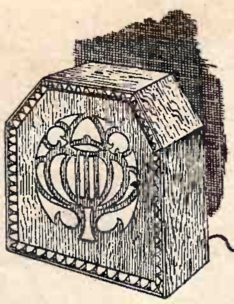

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CURRENT TOPICS

Events of the Week in Brief Review.

THE HEROES OF HOLMFIRTH.

Wireless heroes are showing their mettle at Holmfirth (Lancs), where the local Urban Council has forbidden tenants on the Council's housing estates to fix aerials round the chimney-pots. Several staunch followers of Marconi have given notice to terminate the tenancy.

oooo

FIRE ON THE "ELETTRA."

All wireless amateurs will be glad that the serious fire on Marchese Marconi's yacht, *Elettra*, at Civita Vecchia, failed to damage the radio apparatus. At the time of the outbreak Marchese Marconi was transmitting short-wave messages to London. It is believed that the fire was due to a short circuit.

oooo

A NOTABLE ANNIVERSARY.

This year's Radio Show at Olympia is being regarded as a Celebration Exhibition to mark the tenth anniversary of the first programme broadcast in this country. It was in 1920 that Dame Nellie Melba's voice was heard by a small band of listeners who tuned in the Marconi transmitter at Chelmsford.

The National Radio Exhibition, which will be held from September 19th to 27th, promises to be the largest and most complete ever held in the Empire.

oooo

THE VATICAN CALLING.

Within six weeks' time it is hoped that the Pope will have a world-wide audience through the medium of the Vatican wireless station, now approaching completion. The station, which has been presented to His Holiness by the Marconi Company, will employ two wavelengths, viz., 19.84 and 50.26 metres. The power of its aerial feeder system will be about 12 kilowatts, and the radiation system will consist of two Marconi Franklin uniform aerials.

It is probable that addresses by the Pope will be given from a small studio in his private apartments.

oooo

REPORTS, PLEASE.

Reports from listeners are invited by the Electro-Technical Institute of the University of Bucarest (Roumania), which has opened a short-wave broadcasting station for test purposes. A special programme consisting of gramophone records or of a relay of the Bucarest studio entertainment is transmitted on Wednesday and Saturday evenings on a wavelength of 21.5 metres and an aerial power of 300 watts. Reports should be addressed to the Institut Electrotechnique Universitaire, rue Victor Emmanuel III, 16, Bucarest, Roumania.

oooo

RADIO CENSUS DELAYED.

A probable delay of more than a year in the compilation of the census of radio receiving sets, taken recently as part of the population census, is reported from the U.S. Census Bureau. This will be a disappointment to broadcasting stations eager to have official data on their "circulation areas," to manufacturers desirous of having an accurate market index, and to the Federal Radio Commission, which wants the figures in order to allocate broadcasting facilities more equitably.

oooo

DUNDEE OBJECTS.

The Dundee Town Council has refused an application for permission to install a radio relay service in the city. Objection was raised to the erection of private lines across the streets.

oooo

OUR HUMAN GUARDIANS.

"It is easier to get a wireless installation in the workhouse paid for out of the Guardians' own pockets than to get baths or warmth in the casual wards paid for out of the rates."—A Ministry of Health inspector giving evidence before the Poor Law Committee.

oooo

POCKET WIRELESS: POLICE MODEL.

One more threat at the liberty of the criminal is contained in the news that the Brighton police are experimenting with a pocket wireless set. By means of the apparatus it is hoped that constables will be within call of headquarters at distances up to seven or eight miles.

oooo

WHERE SHORT-WAVE SETS ARE BANNED.

The use of short-wave wireless in the capture of bandits by the police of St. Paul, Minnesota, has necessitated a bylaw forbidding short-wave equipment in private cars.

oooo

NATIONAL RADIO THEATRE.

A State Radio Theatre for France is a serious possibility in the near future, according to the Paris *Soir*, which reports that M. Masson, of the Opéra Comique, is planning such a venture with the intention of furthering the musical education of the French people. M. Masson aims at installing loud speakers in 36,000 communes so that all classes of people would be able to hear the State broadcasts.

oooo

WIRELESS AND THE AMERICAN DROUGHT.

While America prays for a deluge to end the drought, another kind of deluge threatens to overwhelm the broadcasting stations, newspapers, and the U.S. Weather Bureau. A flood of letters has descended on harassed officials demanding that all wireless activities shall cease until the weather breaks. Our Washington correspondent reports that only one letter contains a constructive suggestion. It comes from a man who offers to precipitate a downpour by means of a short-wave apparatus of his own invention. The offer has not yet been accepted.

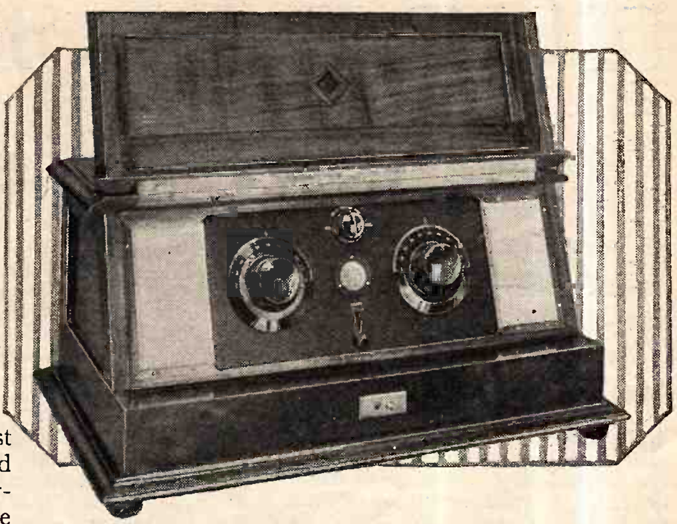
oooo

A DANGEROUS TAX.

The recent tax imposed on all public loud speakers in Vienna has placed the Austrian Government in a perplexing situation. Vienna is earning the name of the City of Loud Speakers, writes a Continental correspondent. Loud speakers are everywhere: in the streets, public halls and cafés, those in cafés alone numbering more than 2,000. Hoping to establish a new source of revenue, the Government recently imposed a tax on these instruments, to the great joy of professional musicians, but to the intense chagrin of the general public, besides wireless manufacturers and amateurs. A public protest has now been organised, and the Government are wondering which would be more profitable: to keep the musicians "on the dole" or repeal the tax.

WHERE WIRELESS PROSPERS. The new Mullard service depot which has just been opened at 33, Park Place, Leeds, to deal with ever increasing business. Technical service is a feature of the facilities offered.

BROADCAST RECEIVERS REVIEWED



DUBILIER A.C. THREE

DESIGNED essentially as domestic broadcast receivers, the Dubilier all-electric sets are housed in cabinets admirably in keeping with the surroundings in which they will be used. The appearance is equally attractive whether the lid covering the sloping tuning panel is open or closed, and for local-station reception, once the controls have been set, there is no necessity to open the lid to operate the set, as the press-button on-off switch is mounted on the outside of the cabinet and the pilot light can be viewed through a coloured glass window in the lid.

The receiver tested was designed for A.C. mains, but a D.C. model is also available at the same price, and the layout is arranged so that an easy conversion may be effected from D.C. to A.C. should the nature of supply current be changed at some later date.

The Circuit Arrangement.

There are three stages in the A.C.3 (H.F., det., and L.F.), employing the following indirectly heated Mazda valves: H.F.—A.C./S.G., detector—A.C./H.L., power—A.C./P. The high-tension circuit is supplied through a U30/250 half-wave rectifier. As might be expected in a Dubilier set, the smoothing arrangements are well designed and the condensers are of unusually generous proportions, with the result that mains hum in the loud speaker is negligible. Automatic grid bias is derived from the anode circuits of the valves.

> A Domestic Broadcast Receiver with an Unusually Versatile Aerial Circuit.

The screening arrangements, although complicated in construction, are simple electrically. A large central compartment contains all the components associated with the anode circuit of the H.F. valve, the detector stage and the power amplifier. Outside this compartment are the aerial tuning circuits and the apparatus associated with the mains supply to the filaments and H.T. circuits. The screen-grid valve is mounted halfway through the screen, with the anode terminal inside the centre compartment and the grid terminal outside.

The aerial terminals (four in number), earth and loud speaker terminals, and the primary connections to the mains transformer, are all mounted on a 4in. × 3⅜in. panel over the mains transformer in the back left-hand corner of the set. As the terminals are of the unshrouded type and the positive loud speaker terminal is live, some care is necessary in making connections to avoid the possibility of short-circuits through frayed strands of flex or wires insecurely fixed. To minimise the risk of accidents the makers have provided a two-pin plug at the back of the set, which should invariably be disconnected before making or changing connections on the terminal panel. Incidentally, the provision of a mains plug at the receiver end enables two or more flex leads to be kept for use when the receiver is taken into other rooms or operated from other types of power sockets.

The aerial tuning inductances for both long and medium waves take the form of toroid coils mounted side by side in the left-hand front corner of the cabinet. Each tuned secondary coil is coupled to the aerial by means of aperiodic primaries, which are joined direct to the aerial in the case of Terminal 1 and through 0.0003 and 0.00005 mfd. fixed condensers in the case of Terminals 2 and 3 respectively. An additional terminal SA is connected directly to the grid end of the tuned secondaries and is intended for short indoor aerials not exceeding 10ft. in length.

The A.C./S.G. valve is coupled to the detector by H.F. transformers in which the secondaries are tuned. The medium-wave transformer is wound on a ribbed ebonite former with single-layer windings of heavy-gauge solid wire, and the long-wave transformer is wound in the form of a toroid. The small external field of the toroid permits the transformers to be mounted side by side without upsetting the inductance values when switching from one range to the other.

Reaction is applied to the H.F. transformers from the anode-bend detector through a small paxolin-dielectric variable condenser and a few turns coupled

Broadcast Receivers Reviewed—Dubilier A.C. Three.—

to the transformer windings. The detector is followed by an R.I. "Hypermu" L.F. transformer which is connected in the conventional manner with the detector anode current passing through the primary. A high-frequency choke prevents stray H.F. currents from traversing the windings.

In connection with the power output valve we need only note that the loud speaker terminals are connected directly in the anode circuit, so that unless an external transformer or choke-filter circuit is incorporated in the loud speaker the windings will be called upon to carry the D.C. component of the anode current.

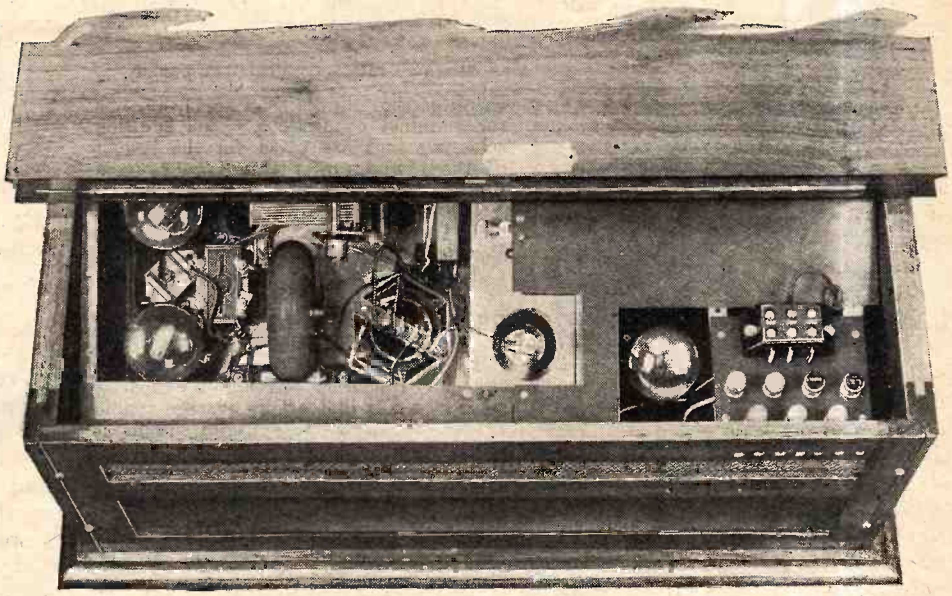
The controls are symmetrically arranged on a sloping crystalline black metal panel. On either side of the panel are frames carrying calibration charts upon which the settings of the principal long- and medium-wave stations may be recorded. The two large black bevel dials have both direct and slow-motion drives; the left-hand dial tunes the aerial circuit and the right-hand the H.F. transformer secondaries. Above the pilot-lamp window, between the main dials, is the reaction control, and below it the wave-change switch.

Tuning is simplified for the beginner by a printed indicator chart showing the approximate settings of the principal European broadcasting stations in relation to the scale reading of the right-hand dial. As a matter of fact, when using aerial terminals other than SA the left-hand dial closely follows the right-hand, and many powerful transmissions can be first tuned in by setting both dials to the figures given by the chart.

One's first impressions of the performance of the set are apt to be deceptive. The local B.B.C. stations and the two Daventrys come in with satisfactory volume and quality, but at other parts of the dial there seems to be a lack of that quality of liveliness which generally foretells a good performance in the matter of range. One then makes the discovery that the successful reception of distant stations is rather more than usually dependent on close adjustment of the reaction control, and from this it would be very easy to fall into the error of supposing that the greater part of the H.F. amplification is due to reaction. But reaction alone would not account for the performance on an indoor aerial only 5ft. in length. The fact that eleven Continental stations were received in addition to four B.B.C. transmissions on the medium-wave band alone proves that the H.F. amplification is of no mean order. The conclusion to be drawn is that the maximum H.F. amplification is not attained until the H.F. resistance of the circuits in the screen-grid valve anode has been reduced by reaction. The fact remains, however, that there is nothing wrong with the final result and that the range is obtained in the Dubilier set with a commendable absence of mush.

Satisfactory Selectivity.

By making use of all three terminals provided for an external aerial twenty stations in addition to B.B.C. transmissions were logged on the medium-wave band. With Terminal 1 in use, giving the greatest volume and the least selectivity, easy separation of the Brookmans Park transmissions was possible at a distance of five miles, and eight distant stations were received above 375 metres. The spreading of the local transmitters prevented the reception of foreign stations below this wavelength. Aerial Terminal No. 2 increased the separation of the London stations and permitted the reception of an additional eight stations, five of these lying between the National and Regional wavelengths. The decrease in signal strength, however, resulted in the loss of some of the weaker stations recorded on Terminal No. 1. With maximum selectivity (Terminal No. 3) four more stations were brought to light, bringing the total "bag" up to twenty.



This illustration shows the mains smoothing and rectifying equipment on the right. In the left-hand compartment the H.F. components, including the toroidal transformer, can be seen.

The long waves produced nine stations at full loud speaker strength, and Königswusterhausen could be received clear of Radio Paris and 5XX by making use of Terminal No. 2.

To sum up, the Dubilier A.C.3 satisfies every requirement as regards external appearance, quality, range and selectivity, though a little experience with the controls is necessary if the receiver is to reveal its full capabilities.

The price of both A.C. and D.C. models is £25, including valves, detachable mains lead, and full equipment.

LABORATORY TESTS.

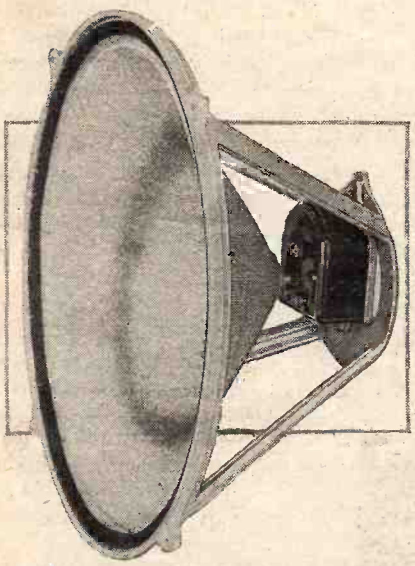
New Apparatus Reviewed.

LISSEN CONE LOUD SPEAKER.

In principle this unit does not differ from the earlier design reviewed in the issue of this journal dated February 5th, 1930, but certain constructional modifications have resulted in an improved characteristic. The high frequency cut-off is at about 4,500 cycles, but the output is well maintained up to this point, where before there was a falling off from 2,000 cycles upwards. The bass reproduction has also been improved, and the bass resonance has been lowered from 500 down to 150 cycles with a gradual cut-off below this point.

A marked improvement in sensitivity has also been effected, and the performance in this respect is now definitely above the average. The gain in sensitivity has been made without any sacrifice of power-handling capacity, and it is possible to apply an input of 1,400 milliwatts at 200 cycles without overloading the unit.

No change appears to have been made in the windings, however, as the impedance values are approximately the same as those of the original unit. The



Lissen cone chassis with improved balanced-armature drive.

measured values for the specimen submitted for test were as follows :—

Frequency.	Impedance (ohms.)
50	2,170
100	1,870
200	2.940
400	4,310
800	6,870
1,600	10,220
3,200	16,100
6,400	26,400

The improvements in the performance of the redesigned unit can be briefly summarised as follows :—First, a marked improvement in sensitivity, and, secondly, an extension of the useful frequency response which now extends from 100 to 4,000 cycles.

The makers are Lissen, Ltd., Worple Road, Isleworth, Middlesex, and the price of the complete loud speaker is 22s. 6d.

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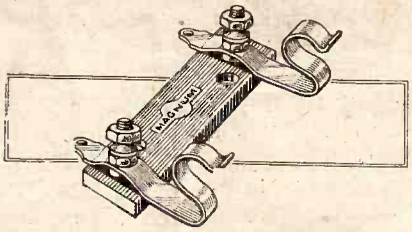
MAGNUM GRID LEAK HOLDER.

The base of this grid leak holder consists of a thin strip of paxolin, the two stout spring clips being held in position by countersunk screws and nuts. The



Magnum miniature grid leak holder.

shank of the fixing screws serve, also, as the terminal connections. In addition soldering tags are fitted for the benefit of those who prefer this type of connection.

The makers are Messrs. Burne-Jones and Co., Ltd., Magnum House, 296, Borough High Street, London, S.E.1, and the price is 6d.

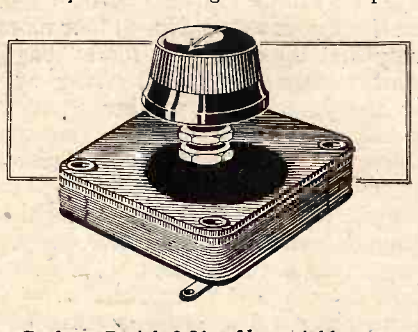
o o o o

GRAHAM-FARISH LARGE CAPACITY VARIABLE CONDENSER.

There are many occasions where a variable condenser having a capacity some 20 times that of the average tuning condenser can be very useful. This is particularly so in the case of L.F. circuits where a condenser of this type is required for a tone-control or band-pass filter.

Such a component has quite recently been placed on the market by Messrs. Graham Farish and Co., Ltd., Mason's Hill, Bromley, Kent, and the price is 15s. for capacities of 0.005 mfd. and 0.01 mfd.

In spite of the high maximum capaci-



Graham-Farish 0.01 mfd. variable condenser, in which bakelite sheets form the dielectric.

ties attained, the minimum value of the nominal 0.01 mfd. sample tested was only 7.5 micromicrofarads : an achievement indeed ! The maximum capacity of this sample was found to be 0.00765 mfd. This is slightly lower than the rated value.

These condensers have two banks of fixed plates, cut from very thin aluminium, and two sets of moving vanes made of very thin brass. Each bank of fixed plates is connected with one of the moving sets; thus there is no waste of space, and the overall size is $2\frac{1}{4}$in. × $2\frac{1}{4}$in. × $\frac{11}{16}$in. Taking into account the single hole fixing bush and the metal cover protecting the inter-section connections, the total depth taken up, behind a panel for example, is $1\frac{11}{16}$in. only. The plates are interleaved with thin sheets of bakelite and end pieces of a similar material are employed.

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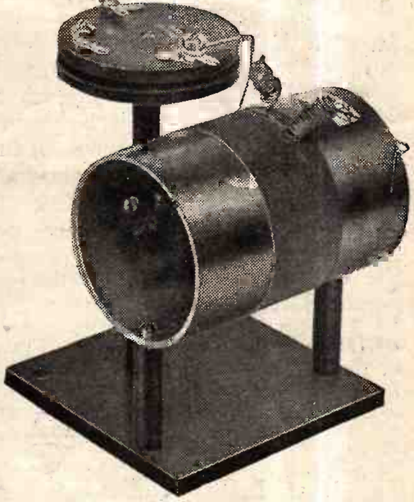
"BAND-PASS FOUR" COILS.

A kit of coils for the above receiver manufactured according to specification has been submitted for test by Messrs. Wright and Weaire, Ltd., of 740, High Road, Tottenham, N.17.

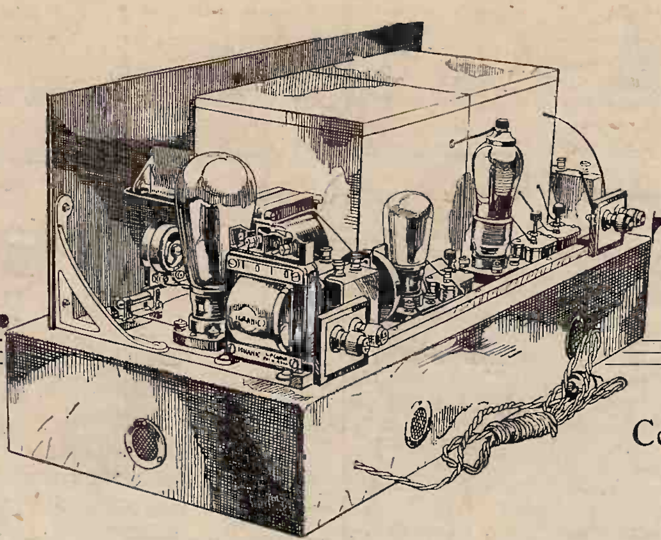


Dual range coils for the "Band Pass Four" made by Wright and Weaire.

The medium waveband coils are wound on paxolin formers, and the long wave windings on turned ebonite formers. They are mounted in pairs of one M.W. and one L.W. coil on small ebonite bases by means of ebonite pillars.

Tested in a receiver, their performance was excellent, signal strength and selectivity being quite up to standard. Accuracy of matching is of great importance in a ganged receiver, and in this respect also they proved satisfactory; the ganging being accurate over the 250-550 metres waveband. On the 1,000-2,000 metres range, where slight differences in the coils are intentional in order to provide good quality, the ganging is sufficiently accurate to avoid an excessive loss of signal strength and selectivity.

Mechanically these coils are well constructed, their finish is good, and they should prove satisfactory.



All D.C. Three

Design for an Entirely Mains Operated Set.

Constructional Details

By H. B. DENT.

(*Concluded from page 162 of previous issue.*)

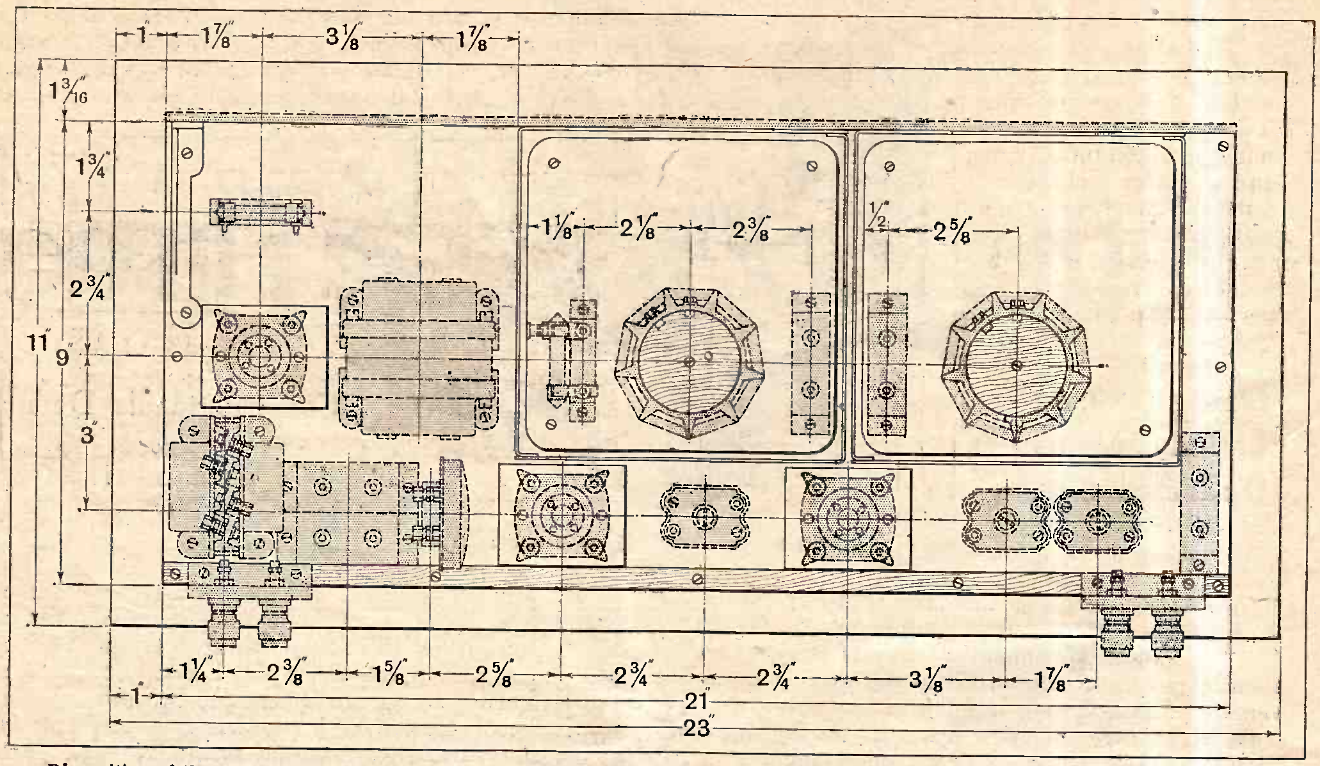
HAVING discussed the circuit principle and described the constructional details of the tuning coils and special heavy current-carrying choke, attention may now be turned to the making up of the various resistances and the general assembly.

Panel drilling comprises holes for taking the variable condensers and rejector switches, and slots must be cut to allow free movement of the change-over switch levers. These may then be fitted and the boxes screwed down to the base, after drilling clearance holes in the aluminium. These components can then be removed and laid aside until the small wooden sub-bases have been assembled. Before lowering these into position, wires, of the approximate length, should be soldered to the points that join to the variable condensers and wave-change switches. Also drill the holes that pass the wires from the low potential end of the aerial-grid coil and the H.F. transformer primary through to the underside of the plinth. Flex may be used for these leads, and the holes in the wood can be drilled to just clear the lead, while the corresponding ones in the aluminium may be drilled slightly larger, so that the metal cannot damage the insulation. The switches should be fixed in position first and their connections made before mounting the variable condensers.

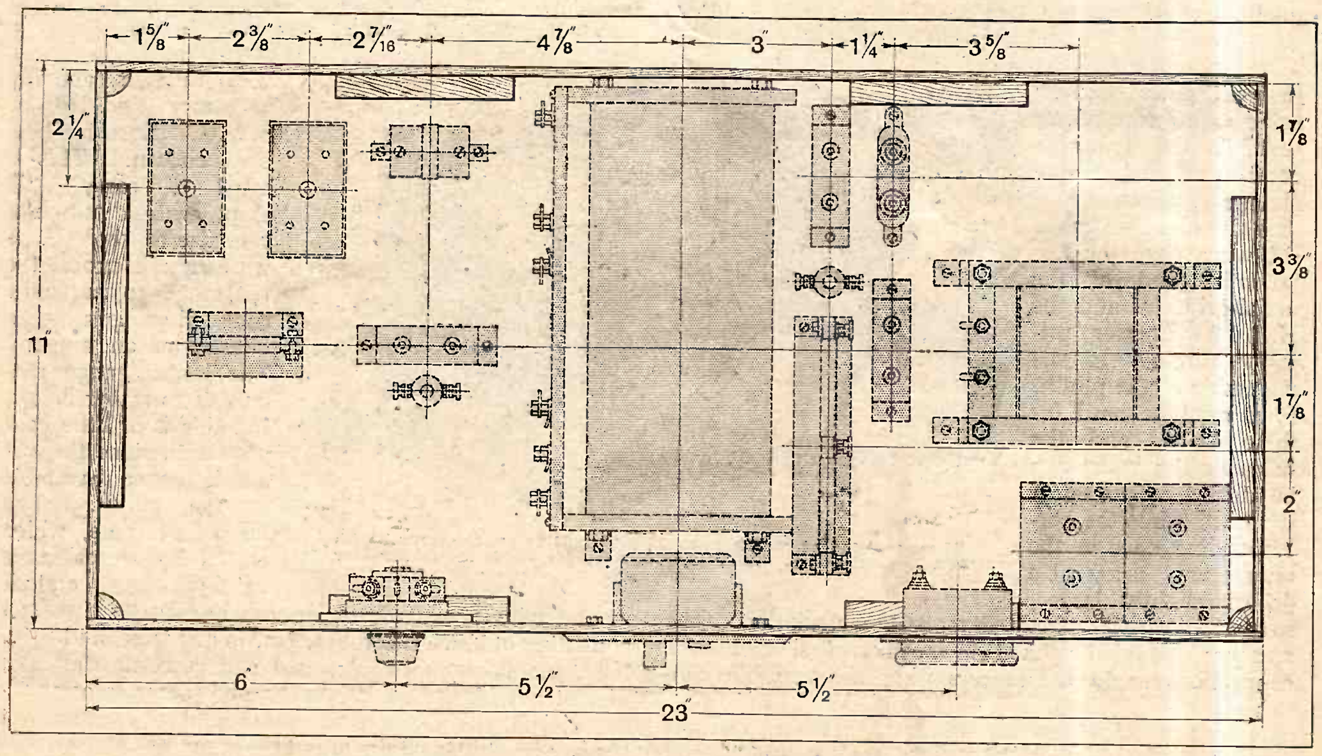
These resistances, which carry 250/280 milliamps, are wound with No. 28 Eureka wire. The principal resistance, R_3, is the rectangular assembly.

Now a word about the rejector. Two condensers are fitted, and either can be connected across the coil by the switches provided. These condensers are mounted outside the boxes to facilitate tuning. The turns on the wavetrap coil have been adjusted to suit London conditions, and reject either the London Regional or the National programmes, hence the two switches and the two condensers. Both transmissions cannot be rejected simultaneously; this would necessitate two rejector coils. Where the rejector is required to suppress a higher wavelength transmission, such as the Midland Regional, the wavetrap winding should be increased by ten turns, making thirty in all.

To avoid an undue temperature rise in the resistances R_6, R_7, R_8, and R_{10}, it was decided to use a somewhat larger size of wire than is actually necessary, and No. 28 S.W.G. Eureka has been chosen. This is rated to carry 0.76 amp. with a temperature rise of 100° C., so we can well expect the resistances to run quite cool when passing a quarter of an ampere. The larger gauge renders them rather bulky, but this is of little consequence, since there is ample space available in the plinth. The largest of these, which is R_8, has a resistance of 630 ohms, and is wound with 160 yards of No. 28 Eureka on a former consisting of four glass tubes, ½in. in diameter, and 8¼in. long, mounted on two wooden end pieces. Half-inch diameter holes are sunk into the end pieces to approximately half the depth of the wood, and in the centre of these are drilled holes just to clear 2B.A. screwed



Disposition of the components on top of the base showing the position of the coils in the screening boxes. Tuning condensers associated with the detector winding are carried on the baseboard immediately behind the tuned aerial unit. Large capacity fixed condensers within the tuning units define the H.F. circuits within the screening compartments. An adjustable bypass condenser is provided in the anode circuit of the detector and facilitates the critical adjustment of reaction control as well as the efficient performance of the detector.

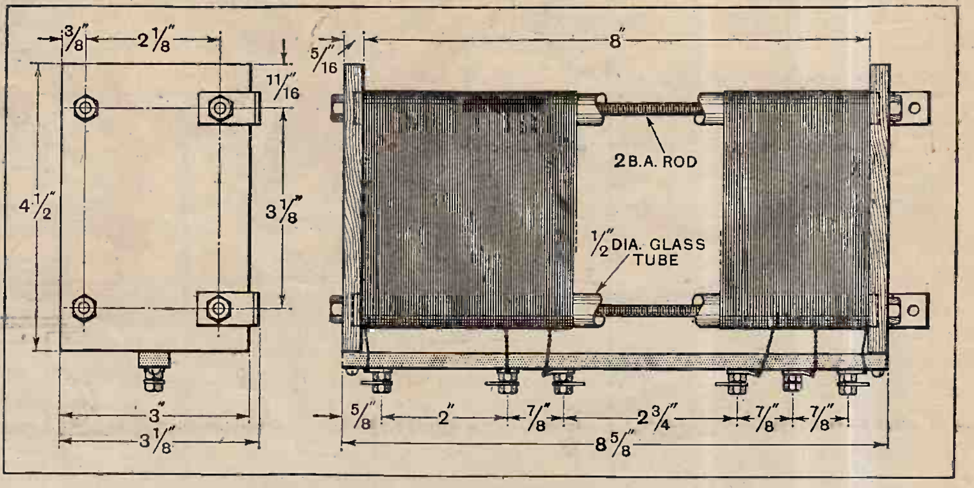


Layout of the smoothing equipment, grid bias resistances and H.T. supply resistances on the underside of the base.

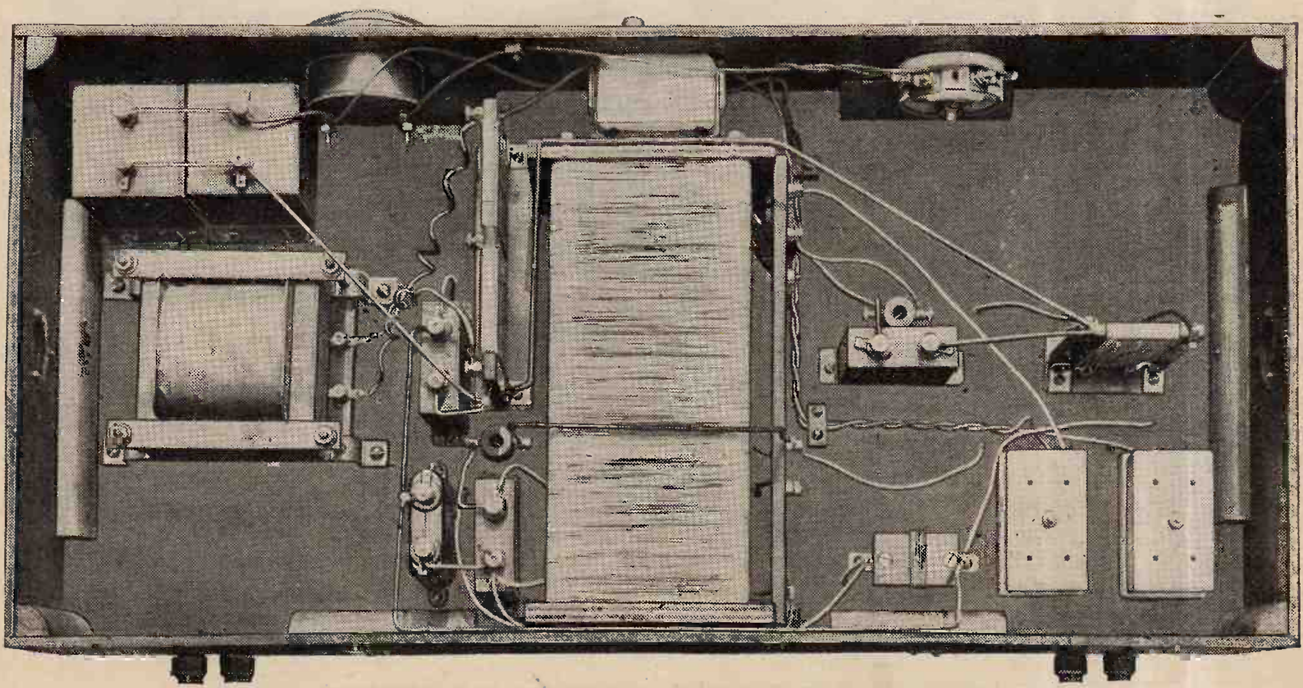
All D.C. Three.—

brass rod. The glass tubes are threaded on to the brass rods, the end pieces placed in position, and the whole drawn up tight by running on 2B.A. nuts. Constructional details of this former are given in the drawing. This former is wound with 460 turns, with tappings taken out of the 135th, 180th, 370th, and 415th turns. These tappings, together with the ends of the resistance, are attached to permanent anchorages on a paxolin strip 8½in. long × ½in. wide × ¼in. thick, screwed to the two wooden end pieces. Needless to say, this terminal strip cannot be placed in position until the winding has been completed. The power valve grid bias resistance, R_7, is wound with 74 turns of No. 28 Eureka on a paxolin strip 3in. long × 2¼in. wide × ¼in. thick. It has a resistance of 54 ohms. The edges are slightly rounded to avoid sharp bends in the wire which might cause it to break. This is stood off from the base by small brass feet, as shown in the illustrations.

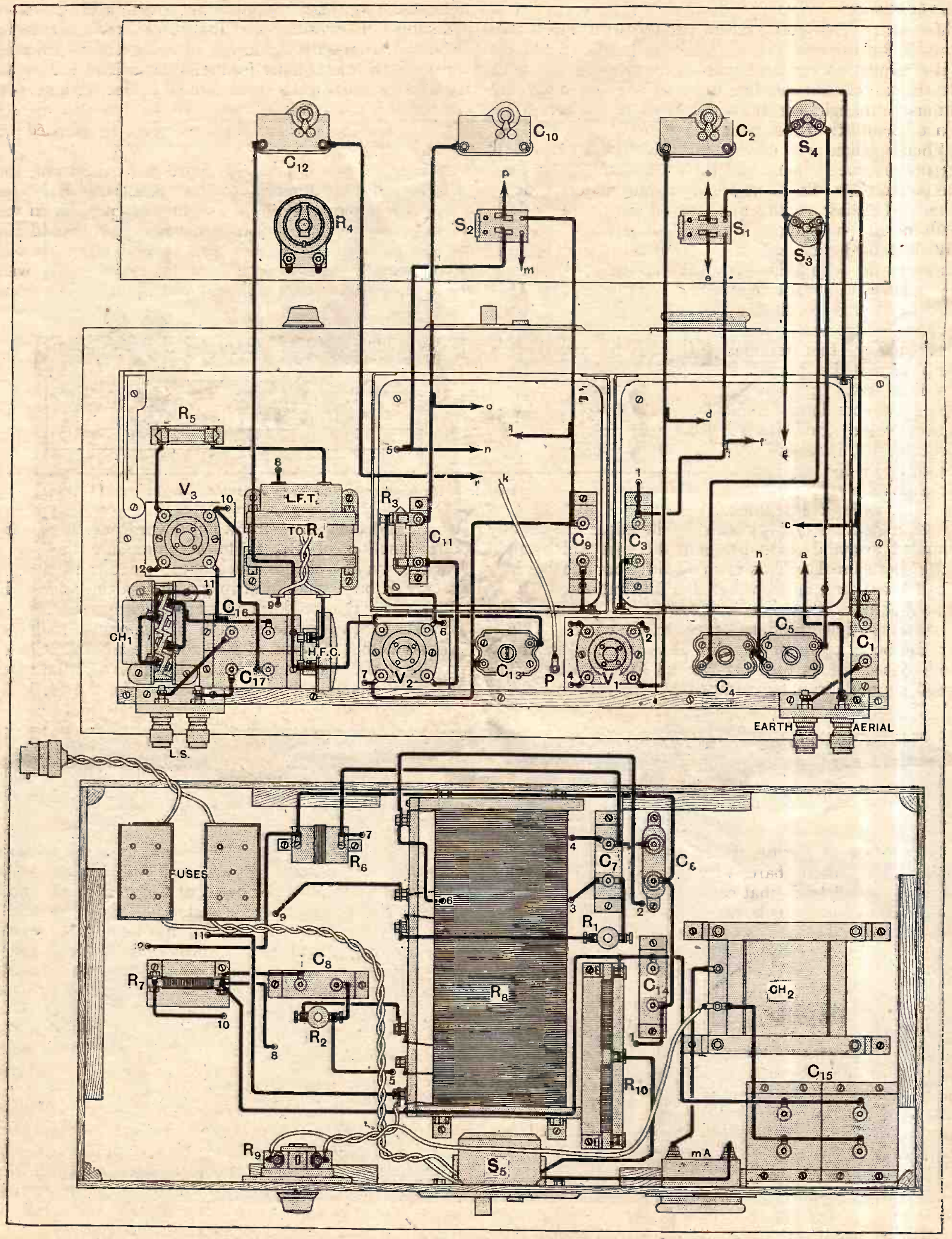
A 4-ohm resistance is required at R_6 to give about 1 volt negative grid bias to the H.F. valve. This is wound on a piece of paxolin 1in. × 1½in. × ¼in. thick, and consists of 15 turns of No. 28 Eureka wire. The small supports can be clamped by the screws holding the soldering tags in position, but if this course is adopted it is essential that the wood screws, fixing the feet to the baseboard, do not pass far enough through to touch the metal plate on the upper side of the plinth. A wise course would be to mount it first on a strip of wood, and then screw the wood down to the baseboard. The function of R_{10} is to accommodate the set to various mains voltages, such as 200, 220, and 240. It is carried on a paxolin strip 5in. long × 3in. wide × ¼in. thick, with the longitudinal edges slightly rounded. It consists of two sections, each of 80 ohms, and each wound with 110 turns of No. 28 Eureka wire. Soldering tags, 4B.A. screws, and terminal nuts afford a ready means of selecting the tapping required for the particular



Details of the former for the large resistance R_8.



View of the underside of the sub-base showing the smoothing choke, voltage regulating resistances and the 8 mfds. condensers on the left.



Practical wiring diagram. Figures indicate holes where leads pass through the base. The lettering refers to the coil connections and corresponds with similar lettering on the theoretical diagram.

All D.C. Three.—
mains voltage between 200 and 240 volts on which the set is to be used.

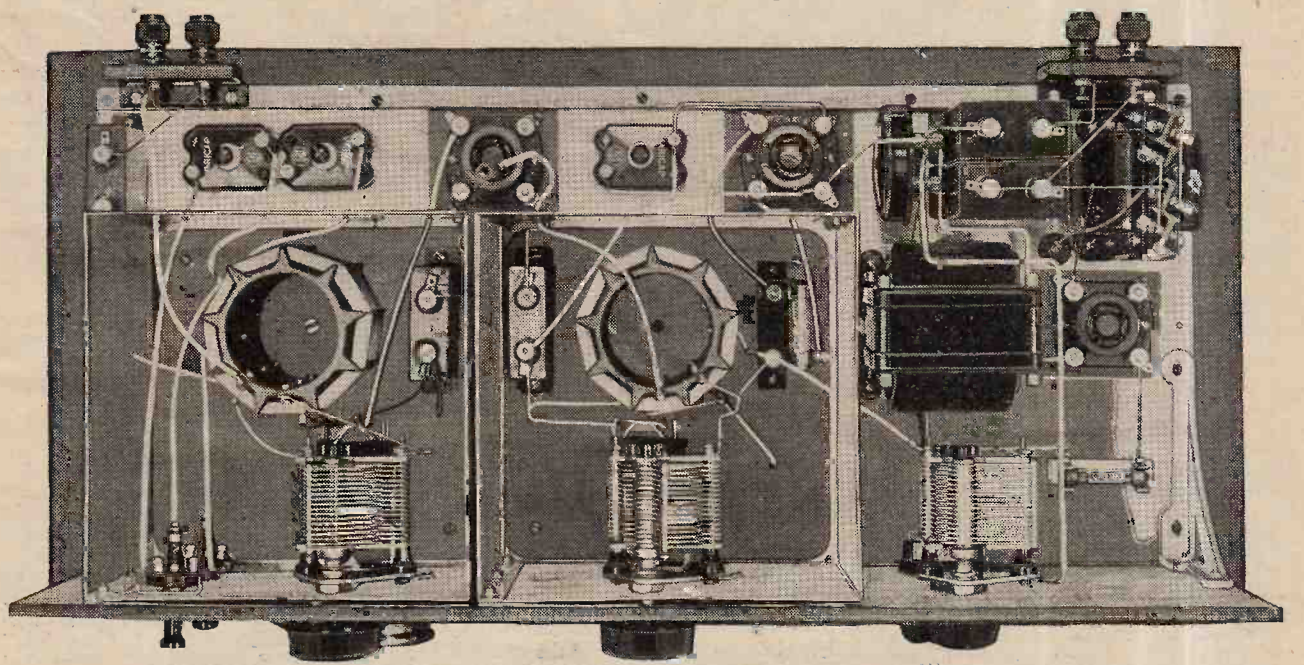
The temperature rise of these resistances is not such that the use of heat-resisting material is justified for the formers, although, of course, there is no objection to its use, should the constructor so desire.

When assembling the valve holders it is advisable to interpose between them and the aluminium a piece of thin paxolin, or other suitable insulating material, as a protection against short circuit, should any of the underneath metal parts tend to sag downwards. No. 18 S.W.G. tinned copper wire in insulating sleeving can be used for wiring the filament circuit. Elsewhere flex, bare wire, or sleeved wires may be used. The constructor must decide where to use insulated conductors and where bare wire is permissible. As a general rule, all leads that carry H.T., filament current and grid bias should be insulated, as these are in contact with the mains.

The only other matter that requires comment in connection with the assembly and wiring is the mounting of the mains switch. This is a standard push-button lighting pattern obtainable from the G.E.C., and breaks both mains leads. It is mounted on porcelain, and an escutcheon plate can be obtained to cover the hole in the wood, thus imparting a neat finish. Prior to mounting the switch, connect four flex leads, of the approximate length required, to the contact screws, as once the switch is secured in position, these contacts will be inaccessible.

The position of the smoothing choke, as shown in the principal diagrams and sketches reproduced here, presupposes a condition where the negative supply main is earthed. Although the set could be used in this state elsewhere, there will be a residuum of hum, possibly of sufficient magnitude to mar the reproduction. It is advisable, therefore, to change over the smoothing choke to the negative main, and it should be inserted between the lead coming from the switch and joining to the selector lead on the resistance R_{10}. This change will remove the last trace of hum. In the practical wiring plan, the leads concerned have been lengthened to facilitate this change.

A word or two is possibly demanded concerning the function of the Igranic 50-ohm resistance R_9. Its purpose is to compensate for slight discrepancies in the actual values of the various resistances. It should not be used as a means of switching on and off, as it will be breaking a circuit with a fairly high inductance, with the consequence that small arcs will occur, and neither the contact strip nor the wire will stand up to this manner of treatment for long. Use it as a fine adjustment of the current, which should be set at 270 to 280 milliamps. It is for this reason that the meter—a luxury, perhaps, but a very necessary one, to wit—has been incorporated in the design. Furthermore, it affords a means of keeping a check on voltage fluctuation, and acts, also, as a polarity indicator when inserting the adaptor into the lamp socket.



Plan view of the set with valves and screening box covers removed. The aerial-grid coil and the rejector condensers are on the left.

It will be seen from the theoretical diagram that the screen voltage and the detector H.T. are drawn from separate tappings on the main resistance R_8. At the 135th tapping, from which the detector draws its H.T., a voltage of about 50 is available, and at the 180th tapping can be obtained 65 volts, or so, for the screen in the H.F. valves. Two alternative tappings are provided for the H.F. valve anode voltage, the 370th turn tap gives approximately 130 volts, while the 415th turn tap allows 145 volts. In general, 130 volts will be ample for the valves recommended here.

When the wiring has been completed, and all circuits

All D.C. Three.—

carefully checked, it would be well to carry out a further test on the following lines before inserting the valves. Make up two resistances, one of 8 ohms and the other of 24 ohms, and connect the former across the filament sockets on the H.F. valve holder, and the 24-ohm resistor across the power valve filament sockets. Two yards of the No. 28 Eureka wire will give approximately 8 ohms and six yards, as near as no matter 24 ohms.

The set may then be connected to the mains, and the total current checked by the meter without fear of damage to the valves, should a wrong connection have been made by mistake. The meter should read 250 milliamps—the full scale is 500 milliamps—with the resistances adjusted for the particular supply voltage. On a 200-210-volt main the wander lead to R_{10} should be connected to the terminal marked 1 on the theory diagram. For 220-230-volt supplies connect to 2, and for 240-250-volts use No. 3. Adjust R_9 to give the required current. If all is well, the valves may then be inserted in the following order:—

In the H.F. position a valve taking 0.15 amp. at 2 volts must be used. Its characteristics might quite well be of the order of the Marconi and Osram S.215. For the detector stage a 2-volt 0.1 amp. class of valve is required, and preferably of the H.L. class. A valve with an A.C. resistance not exceeding 20,000 ohms is advised. In the output position the Marconi and Osram P.625, or its equivalent in other makes, will be required. In a set of this nature, where the grid-bias valves are fixed, it is not possible to provide a wide choice of valves, and the constructor would be well advised not to depart far from the rather rigid specifications laid down here with regard to the permissible types of valves. The model illustrated in these pages was designed for, and tested with, the Marconi and Osram S.215, H.L.210, and the P.625.

The design of the set is such that the constructor can make a simple cabinet if he wishes, and the detailed drawings of the woodwork are given as a guide. The finished appearance will be enhanced by fitting a baseboard with a moulded edge. This should measure 24in. × 12in. × ½in. thick. There should be no difficulty in obtaining a suitable base, as most cabinet-makers and woodwork supply merchants have moulding machines on the premises. As a precautionary measure a piece of heat-resisting material can be screwed to the ornamental base immediately below the large resistance. However, this is not essential. Six large holes—about 2in. diameter, and spaced equally apart—should be cut in this base to allow free circulation of air, which will necessitate raising the base slightly by screwing on four rubber feet. The total cost of the material for the cabinet will work out at approximately 12s.

This receiver is available for inspection by readers at the Editorial Offices, 116, Fleet Street, London, E.C.4.

TRANSMITTERS' NOTES.

The 7 and 14 Megacycle Waveband.

The letter from G2CJ, Mr. S. Townsend, Gloucester, which we published in our issue of August 6th, has aroused considerable interest among amateur transmitters, and it will probably be of service to those who are studying the relation between atmospheric conditions, sunspots and reception, if we give extracts from some of the letters received from various parts of the country.

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Work on Short Waves Unsatisfactory.

G6PP, Mr. M. W. Pilpel, London, laments that conditions on all amateur bands continue to be very bad, and thinks it probable that amateur work below 150 metres will be unsatisfactory for the next three years or more. He prophesies that we shall have to wait till 1938-1939 before experiencing another season like 1927 for long-distance working.

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Medium Distances Only.

G2ZN, Mr. J. E. Johnson, London, writes that on various evenings during the month of July conditions on the 7 mC. band have approximated to those generally experienced during winter months, but it has been exceptional to hear a station within 400 miles or beyond 1,000 miles range. Communication seems to be restricted to the neighbourhood of about 600 miles radius.

On Sunday, August 10th, he found conditions on the 2 mC. (150 metre) band abnormally good, and communication over comparatively long distances with inputs of 2 to 3 watts was easily accomplished.

His observations regarding the effect of sunspots on reception agree, in the main, with those of G6PP, but he is inclined to think that it is wrong to attribute bad conditions to the prevalence of sunspots, which are at present at a minimum. 1927 was a year of maximum solar disturbances and short-wave working exceptionally good, 1934 will again see a minimum of sun-spots when conditions may again be bad, but possibly the next maximum in 1938 may bring about a repetition of the experiences of 1927. Against this supposition must be set the fact that 1922, though a year of few sun-spots, was good for Transatlantic broadcast reception.

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Short-Wave Stations.

G6RG, Mr. B. Groom, Galashiels, finds that signals from Denmark and Finland on the 7 mC. waveband fade out quickly at dusk but come on again with renewed strength after dark. The same phenomenon was also noticeable in working with French and Dutch stations.

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R.S.G.B. Annual Convention.

The fifth annual conference of the R.S.G.B. will be held on Friday and Saturday, September 26th and 27th, beginning with an informal gathering at the Institution of Electrical Engineers, Savoy Place, S.W.3, at 5 p.m., which will be followed at 6 p.m. by the presidential greetings and a discussion opened by Messrs. J. W. Mathews (G6LL) and G. W. Thomas (G5YK) on "The Progress of 28 megacycle Transmission and Reception." On Saturday, September 27th, there will be a meeting of delegates at 10 a.m., presentation of Society trophies and general business meeting at 2 p.m., and the Convention will close with a dinner at Pinoli's Restaurant at 6.30 p.m. Mr. H. B. Old (G2VQ), of Nottingham, who is the provincial district representative on the council, will act as secretary to the meeting.

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A Correction.

In our issue of July 16th an error occurred in the address of G2NM, which should read: Gerald Marcuse, The Ranch, West Drive, Sonning-on-Thames, *Berks*, and the wavelength on which he is testing is *20.95*, and not 29.5.

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New Call-signs.

G2QF J. L. Roberts, Mon Abri, Kylemore Avenue Mossley Hill, Liverpool.

G2ZN J. E. Johnson, Lagos, 25, Clivedon Rd., Highams Park, E.4. (Change of address).

G2ZV (Portable station of G5JK) L. R. and E. J. Harper, The Knoll, Bieldside, Aberdeen.

G5MR (ex 2AFG) V. G. Mellor, 1, Guilford Lawn, Dover. C.W. and telephony on 7 and 14 mC. wavebands, experimenting to ascertain possible effect of the moon on range and fading and welcomes reports, from all distances.

BROADCAST BREVITIES

By Our Special Correspondent.

The B.B.C. at Olympia.

A feast for the technically minded is in preparation for the B.B.C. stand at Olympia. From the details available I imagine that this year's B.B.C. display will possess that vital quality that distinguishes an exhibition from a museum, and that it will, therefore, be an improvement on its immediate predecessors.

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A Giant Amplifier.

A major attraction will be the giant amplifier working more than three hundred loud speakers in various parts of the exhibition. It may not be generally known that the B.B.C. also provided the amplifier last year, when loud speaker demonstrations were permitted for the first time. Modesty, apparently, induced them to conceal the fact. This year the amplifier will be fully exposed for public inspection.

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A Relic of 1922.

Those who listened in 1922 and 1923 can probably be classed as veterans among the B.C.L.'s, and it will be the veterans, I think, who will linger longest in another corner of the B.B.C. stand. Here they will fix their sentimental gaze on the actual transmitter used at Marconi House in the days when technical breakdowns were accepted almost as everyday occurrences, and when a cough in the control room set the valves "ponging" like a dropped toast rack.

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Gear from Brookmans Park.

Indications of progress since those days will be afforded by several interesting pieces of gear taken from the London Regional station at Brookmans Park. Among these will be a main closed circuit coil of the type now in use, a variable oil dielectric condenser, and a modern water-cooled valve jacket. The latest portable apparatus for line testing will also be on view.

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Microphones and Valves.

A reliable guide to the advances made in broadcasting is to be found in the variety of microphone types used in the last few years. Several different specimens will be seen at Olympia, including the Round experimental type, the Western Electric, the Magnetophone, and the now common Reisz. Progress will also be revealed by a collection of transmitting valves.

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Power Drop at Brookmans Park.

Many listeners must have been blaming their sets recently for their inability to "bring in" the National transmission at normal strength. The real explanation is an actual reduction in transmitting power, which occurred during a period of about ten days, terminating a week ago. The drop in power became necessary during certain alterations in the aerial circuit. I hear that the actual aerial power of London National is now in the neighbourhood of 45 kilowatts, while London Regional, using the longer wavelength, is covering the same service area with 35 kilowatts.

A Hint to the Engineers.

When a B.B.C. station reduces its power, even for a short period, I think it would be commendably polite on the part of the engineers to inform the public of the change. Nowadays the listener reposes such faith in the B.B.C. that he is naturally inclined to suspect his receiver when anything goes wrong. A timely announcement would save distress in many a humble home.

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Geneva and the Power Question.

The power rating of broadcasting stations is causing some concern at Geneva, and I understand that the question will probably come up for discussion at the next meeting of the International Broadcasting Union.

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Deceptive Figures.

The trouble arises from the lack of any recognised standard of measurement. Although our National transmitter is operating with 45 kW. in the aerial, there are stations on the Continent with a nominal rating of 50 and 60 kW. whose actual output falls far short of that from Brookmans Bark.

The International Broadcasting Union will probably request M. Braillard and his technical committee at Brussels to repeat in the realm of power measurement the excellent work they have already accomplished in the regulation of broadcast frequencies.

FUTURE FEATURES.

National (261 and 1,554 metres).

AUGUST 31ST.—Symphony Concert relayed from The Kursaal, Ostend.
SEPTEMBER 1ST.—"Yes and Back Again" (De la Mare), a paraphrase by K. B. Indoe.
SEPTEMBER 2ND.—Promenade Concert.
SEPTEMBER 3RD.—"Diversions" (from Manchester).
SEPTEMBER 4TH.—Promenade Concert.
SEPTEMBER 5TH.—Vaudeville programme.
SEPTEMBER 6TH.—Students' Songs.

London Regional.

AUGUST 31ST.—Chamber music.
SEPTEMBER 1ST.—Promenade Concert.
SEPTEMBER 2ND.—"Yes and Back Again."
SEPTEMBER 3RD.—"From the Operas," orchestral concert.
SEPTEMBER 4TH.—Vaudeville programme.
SEPTEMBER 5TH.—Military Band concert.
SEPTEMBER 6TH.—"Parlour Tricks," an Interlude devised by Charles Brewer.

Midland Regional.

SEPTEMBER 1ST.—"The Invalid," a Staffordshire comedy by Frank G. Layton.

West Regional (Cardiff).

SEPTEMBER 6TH.—"S.O.S.," a Gower Lifeboat Man's Story.

North Regional (Manchester).

SEPTEMBER 5TH.—Dance music by Brahms.

Glasgow.

SEPTEMBER 6TH.—Eye-witness Account of Scottish League Association Football Match, Leith Athletic v. Queen's Park, by Mr. A. D. Stuart.

Belfast.

SEPTEMBER 6TH.—Running commentary on International Ulster Grand Prix Motor Cycle Race.

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Broadcasting at all Costs.

One of the most graceful compliments ever paid to the B.B.C. was contained in a letter received a few days ago. Here is an actual quotation :—

"I am not *bound* to stay at Brighton, but should like to. If my one-valve set really is no use here, then could you tell me within what radius of London I should live for my set to be as it used to be at Croydon?"

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Ireland to Try "Sponsored" Programmes.

British listeners who enjoy programmes sponsored by advertisers will have new opportunities to satisfy their taste in the late autumn. The broadcasting authorities of the Irish Free State have decided to test the value, financial and otherwise, of sponsored programmes during a trial month beginning on October 20th.

The advertisers' programmes will go out from Dublin and Cork, and will be limited to one hour each evening.

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B.B.C. Burlesqued.

The company who took part in Mr. Philip Ridgeway's period vaudeville programmes will come back, practically intact, to the microphone for his new series, "The Ridgeway Parade," which opens on September 10th (National) and 13th (Regional). In these Mr. Ridgeway will, I understand, burlesque many B.B.C. activities.

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A Railway Centenary.

Centenary celebrations in connection with the opening of the Liverpool and Manchester Railway, which occurred on September 16th, 1830, will provide several broadcasts for Northern listeners next month. On September 13th the opening ceremony will be relayed from St. George's Hall, Liverpool, followed by the after-luncheon speeches from the Town Hall, Liverpool. On the actual anniversary, September 16th, Sir Edwin Stockton, the well-known railway director, will tell listeners some interesting facts about railway transport and its development.

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Slowit?

Much as we may admire the B.B.C.'s latest publication, "Broadcast English II," with its recommendations regarding the pronunciation of English place names, we cannot say that it settles the big question of how to pronounce Slaithwaite. According to the B.B.C., the name of this now famous village should be pronounced as "sláythwayt," "sláthwayt," "sloit," or "slowit."

Announcers will use the first pronunciation on Mondays, the second on Tuesdays, and so on.

WIRELESS THEORY SIMPLIFIED

By
S. O. PEARSON,
B.Sc., A.M.I.E.E.

(Continued from page 175 of previous issue.)

The Valve as a Detector.

BEFORE the modulated high-frequency oscillations representing a radio telephonic transmission can be made to operate a loud speaker it is necessary for the low-frequency components of the electrical variations to be separated out from the high-frequency component. Radio-frequency currents are far above the audible range and only serve as a means of conveying the speech frequency variations through the intervening space between the transmitter and the receiver. Even though the amplitude of these high-frequency oscillations may be varying at an audible frequency they will not produce audio-frequency vibrations of a mechanical nature in any electro-magnetic device such as a telephone ear-piece or a loud speaker.

Principle of Rectification.

When a high-frequency current wave has its amplitude modulated in the manner indicated by Fig. 1 (*a*) at an audible frequency the mean value of the current as measured over one complete cycle of the H.F. wave is zero. So for any number of complete cycles the mean current is zero, and the amplitude does not affect the mean value of the current at all.

What we require, however, is that the current delivered to the loud speaker shall vary in exact accordance with the *amplitude* of the high-frequency oscillations. Now, although the mean or average value of the current during one complete cycle of high frequency is zero, the mean value taken over *one half* of a cycle will obviously be proportional to the height of the particular half-wave in question. For a sine wave the average value taken over exactly one half of a cycle between two zero values is 0.636 of the maximum value or amplitude. If, then, we could suppress completely all the half-waves of current, as shown at (*b*) in Fig. 1, the current would no longer be an alternating one, but would consist of unidirectional pulses of current, the amplitude of these pulses varying according to the original modulation as time elapses. An oscillation in which all the negative half-waves are suppressed in this manner is said to be "rectified," that is, converted into a current which flows in one direction only.

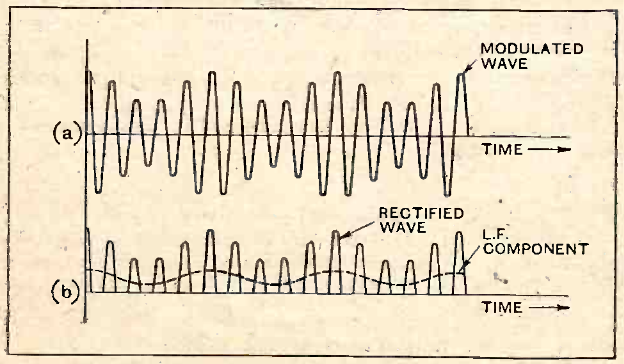

Fig. 1.—(a) Normal type of modulated wave representing the product of a high-frequency and a low-frequency component. (b) Rectified wave which is equivalent to the sum of high-frequency and low-frequency components, together with a D.C. component.

A succession of unidirectional pulses of current of the kind shown in Fig. 1 (*b*) is equivalent to the sum of a direct current, a low-frequency alternating current and a high-frequency alternating current, and by providing a circuit with three suitable branches each of these components can be made to take a separate path.

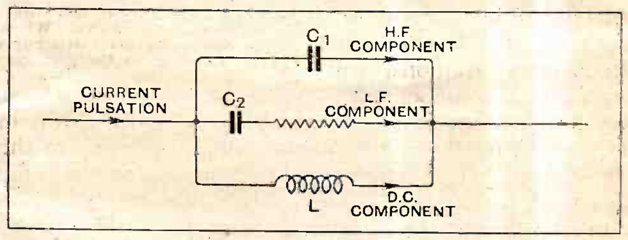

Fig. 2.—The current pulsations of Fig. 1 (b) are equivalent to the sum of a high-frequency component, a low-frequency component and a D.C. component. These three components can be separated by a circuit of the type shown.

For instance, in Fig. 2 the upper branch contains a condenser C_1, whose capacity is adjusted to offer a low impedance to high-frequency currents but a comparatively high impedance to the low-frequency component. The bottom branch L is a low-frequency choke, which offers a high impedance to both high- and low-frequency alternating currents but allows direct current to pass freely, according to Ohm's Law. The centre branch passes the low-frequency current which is rejected by the other two branches. C_2 is a condenser of high capacity included to prevent any direct current from flowing.

This circuit is a simple filter arrangement capable of separating out high-frequency, low-frequency and D.C. components of a complex current, which is equivalent to the *sum* of the three components. The modulated wave of Fig. 1 (*a*) is really the *product* of a low-frequency wave and a high-frequency wave, and therefore the H.F. and L.F. components cannot be separated by ordinary means. Rectification converts this product into the *sum* of the equivalent components, and thus enables them to be separated by suitable circuits. The

Wireless Theory Simplified.—

rectifier itself does not effect the actual separation of the components.

Average Value of Current Pulsations.

Inspection of curve (*b*) of Fig. 1 shows clearly that there is a space between each half-wave, each space being equal to the width of the half-wave at the base. Now, as mentioned above, the mean value of the current as measured over the time interval represented by one half-wave is 0.636 of the maximum height of that wave. But over the next time interval of equal duration there is no current at all, and therefore the average value of the current during a time interval equal to one whole cycle of the original high-frequency wave will be just one-half of the value as determined over a half-cycle, namely, 0.318 of the height of the high-frequency pulsation. Thus the mean value of the current, taken cycle by cycle relative to the high-frequency variations, will vary in accordance with the peak values of the current pulsations, as shown in Fig. 1 (*b*) by the dotted curve, which is drawn to the same scale. The boundary curve drawn through the peaks of the high-frequency pulses does not give the correct value of the "rectified" current.

The broken-line curve of Fig. 1 (*b*) is the sum of the low-frequency and direct-current components, which may or may not be separated from each other, as required by the particular apparatus used in the circuit.

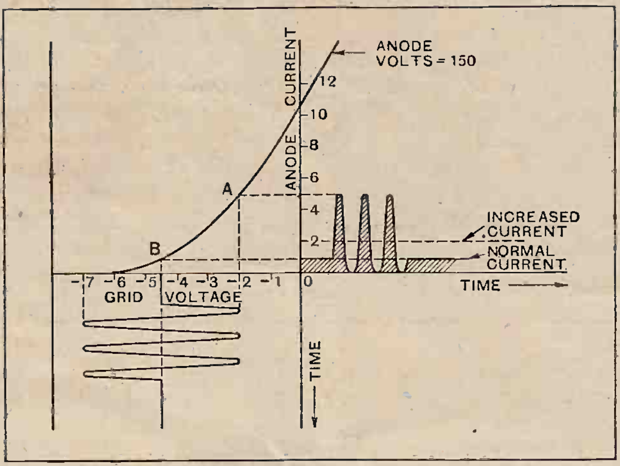

Fig. 3.—Diagram showing the rectifying properties of a three-electrode valve. When working on the lower bend of an anode characteristic curve, an alternating voltage causes a change in the D.C. component of the plate current.

Conditions for Detection.

We turn now to consider the conditions under which a three-electrode valve can be made to act as a rectifier or detector. It has already been explained that when a valve is operated over the straight part of the working characteristic curve the variations of current set up in the anode circuit are exactly proportional to the variations of voltage applied to the grid. Under such conditions, when a high-frequency voltage, whether it be modulated or not, is applied to the grid the anode current will vary in exact accordance about a particular mean value determined by the mean voltage of the grid (grid bias); but the mean value of the plate current is not disturbed in any way, and so no rectification occurs. For a valve to act as a detector *a change in the amplitude of the high-frequency voltage applied to the grid circuit must cause a change in the mean value of the anode current.*

There are two distinct methods of making a three-electrode valve act as a detector, rectification being effected in both cases by virtue of the one-way or unidirectional conductivity which is a special property of the valve. When use is made of the one-way conductivity between the anode and cathode of the valve the method is referred to as *anode rectification* or *anode bend* detection. On the other hand, *grid rectification* is the name applied to the method based on the unilateral conductivity between the grid and the cathode (or filament), and is probably the most popular method to-day.

Anode Bend Detection.

The simpler method to understand, from the theoretical point of view, is the one depending on the curvature of the grid voltage/anode current characteristic curve of the three-electrode valve. In Fig. 3 an anode characteristic curve is given for the same valve as was treated in an earlier instalment as an amplifier. If the normal or mean grid potential is adjusted by means of a potentiometer or grid battery so that the corresponding point on the curve occurs just at the centre of the lower bend, as indicated by A in Fig. 3, then any change in grid potential towards a more positive value will cause a moderately large increase of anode current; but an equal change of grid potential in the negative will only result in a comparatively small decrease of plate current. Suppose, for instance, that the mean grid potential is set to -4.5 volts so that the normal anode current is about 0.9 milliampere. Imagine now that an alternating voltage whose amplitude is 2.5 volts is superimposed on the normal grid-bias voltage, so that the actual grid potential fluctuates between -2 volts and -7 volts, as shown in the bottom left-hand portion of Fig. 3.

At an instant when the actual grid potential becomes -2 volts the anode current has an increased value of 5 milliamps., as indicated by point B on the curve. On the other hand, when the grid voltage reaches the maximum negative value of -7 volts there is no anode current at all.

If the curve giving the relationship between grid voltage and time is drawn in the position shown in the left-hand bottom corner of the diagram the curve showing how the plate current varies with time can be deduced in the manner indicated in Fig. 3, the last named curve being given in the top right-hand corner. The assumption is made here that there is no resistance or impedance in the anode circuit of the valve, so that the anode potential does not vary.

When no alternating voltage is applied to the grid the plate current has a steady value of about 0.9 milliampere, but when an applied alternating voltage causes the grid potential to "swing" between -2 volts

Wireless Theory Simplified.—

and -7 volts (in which case the "grid swing" is said to be 5 volts) the plate current fluctuates between zero and 5 milliamps., and the mean or average value of the anode current will now be something like 2 milliamps. Thus when an alternating voltage is applied to the grid of a valve operating on the lower bend of an anode characteristic curve the mean value of the anode current is increased, and under these conditions the valve will act as a detector.

Modulated Waves.

Any change in the amplitude of the alternating voltage applied to the grid will cause a corresponding change in the mean value of the anode current. Consequently if the alternating voltage applied to the grid is in the nature of a high-frequency voltage whose amplitude is modulated at a low or audible frequency the *mean value* of the plate current (as measured over one cycle of the H.F. wave) will have a frequency of variation equal to that of the low-frequency modulation of the original wave.

The diagram of Fig. 4 is constructed on the same lines as that of Fig. 3, but in the latter case the high-frequency voltage applied to the grid is modulated to a depth of 40 per cent.: that is to say, the amplitude varies above and below the mean value of 2.5 volts by one volt. The resulting plate current fluctuates in the manner shown by the top right-hand portion of the diagram, the peak values themselves fluctuating between 3 milliamps and 7.5 milliamps.

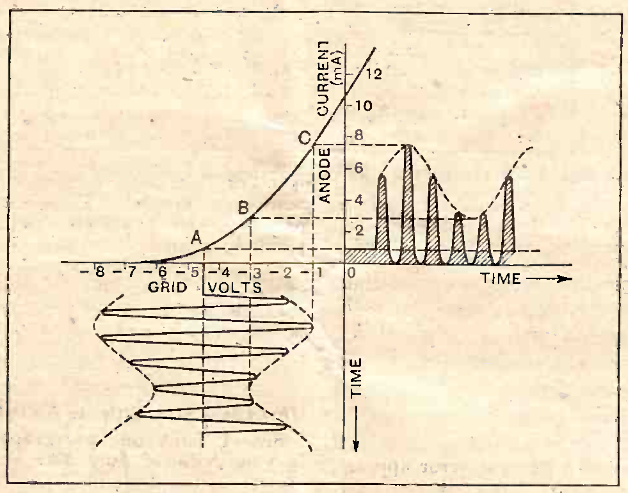

Fig. 4.—Diagram showing how the anode current varies when a modulated H.F. voltage is applied to the grid of a valve biased to operate on the lower bend of its anode characteristic curve.

The mean value of the anode current taken over one period of the high-frequency wave is roughly proportional to the peak value of the anode current occurring during that period. Thus the low-frequency component (together with the D.C. component) of the anode current will follow the same law as the broken-line curve passing through the peak values of the fluctuating anode current, but, as explained in the first part of this section, its actual height above the zero line will be only about one-third of the height of the boundary curve shown.

Possibility of Distortion.

In order to obtain a true reproduction of the original low-frequency wave it is necessary that the change of anode current should be exactly proportional to the change in amplitude of the high-frequency voltage applied to the grid. This ideal condition can only be secured provided the portion of the anode-current curve falling within the limits of the modulation is a straight line. For instance, in Fig. 4 the modulation causes the amplitude to vary between the limiting points B and C on the curve, and obviously true proportionality can only be obtained if the portion BC of the curve is perfectly straight. If BC is curved, distortion of the low-frequency wave shape will result.

The curvature becomes of less importance in this respect as the percentage modulation is reduced: that is, when the points B and C become closer together. The greater the depth of modulation the longer will be the portion of the curve between B and C, and therefore with high percentage modulation the distorting effect will become more pronounced. At a later stage the degree of distortion obtained with anode bend rectification will be compared with that produced by other methods.

It must be realised that throughout the foregoing explanation the anode voltage of the valve was assumed to be maintained constant, no impedance being connected in the anode circuit. But under such conditions it would be impossible to obtain any voltage output from the valve. It is the low-frequency voltage variation set up across a resistance or impedance in the anode circuit that is required, whilst at the same time high frequency voltage variations at the anode must be suppressed or the conditions which we have seen to be necessary for rectification will be badly upset. The arrangement of the anode circuit is therefore of the greatest importance, and will form the subject of a separate section after the principle of grid rectification has been considered. In the next instalment consideration will be given to the function of the grid leak and condenser in leaky grid detection.

(*To be continued.*)

Catalogues Received.

Ferranti, Ltd., Hollinwood, Lancashire.—Constructor's broadsheets for building Ferranti H.T. supply units types 1, 2, 7 and 8. Type No. 2 embodies a valve rectifier, while types 1, 7 and 8 include the Westinghouse rectifiers.

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The General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2.—Descriptive folder dealing with the Osram photo-cells, type C.M. The active material on the cathode consists of a thin layer of cæsium carried on a suitably prepared silver conductor.

Monel-Weir, Ltd., Cathcart, Glasgow.—Illustrated booklet showing the applications of Monel Metal and Malleable Nickel in industries where acid-resisting and non-corrosive metals are essential. Its particular interest to the wireless engineer lies in its suitability as a lining for accumulator compartments.

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, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

DUPLICATE 5XX.

Sir,—I should like to support the proposition which has been put forward in recent issues of *The Wireless World* that 5XX should be duplicated. The question of available wavelength must, of course, be considered, but if such wavelength could be found vacant, there is nothing which would give greater satisfaction to a vast body of listeners who live in coastal districts and on the outskirts of the British Isles than that another long-wave station with a power at least equal to that of 5XX should come into being.

I often wonder if the B.B.C. officials are really conversant with the conditions of reception in the coastal districts which are out of range of stations other than 5XX.

While, with a good set, both London and Midland Regional stations can be received during daylight and after dark, yet they are subject to such violent and continuous interference as to make them quite useless for entertainment purposes. After dark the further trouble of continuous fading comes into action, making both these stations even more useless than in daylight. 5XX is the only station that can be received so as to be of entertainment value, and we are therefore entirely bound down to one programme, except for certain foreign transmissions, and at present without any hope whatever of a better state of affairs materialising for some years to come. Even if a southern regional station were erected, it is doubtful if it would be of service unless the wavelength were chosen so as to be free from spark and other interference.

I sincerely hope that *The Wireless World* will do all in its power to urge the authorities to seriously consider this question of providing one more long-wave station before it is too late. In my opinion, a lot of the expense and difficulty of erecting dual regional transmitters could be avoided by improving both the power and quality of the present 5XX and the erection of the one more long-wave station proposed. GRAHAM HUNT.

Torquay.

TELEVISION.

Sir,—I wish to call your attention to a flagrant error appearing on page 39 of your July 9th issue. The Alexanderson system has never employed a multi-electrode neon tube. The Bell Laboratories employed such a system in their 1927 demonstration, but have since discarded this method of producing a large image. Alexanderson uses a Kerr cell in conjunction with a high-intensity arc and a Jenkins lens disc. Surely the recent publicity regarding the Schenectady demonstration was sufficiently widespread and detailed enough to remove any doubt as to the apparatus employed.

With regard to the Baird apparatus described in the article under discussion, I believe that such a system comes under the head of "substitution of persistence of light for persistence of vision." I saw such a commutator and grid demonstrated in Mr. Jenkins' own laboratory in Washington some two years ago, and understand that his patent applications have met with interference from applications of Dr. Ives, of the Bell Laboratories. Unless I am in error Mr. R. T. Beatty holds British patents on a system not entirely dissimilar.

I would like at this time to protest against the minimising of American achievements in the field of television by certain British publications. Although I have at times attempted to retaliate by criticism of the Baird Company, my editors have always deleted the objectionable and uncalled-for comments.

In particular I wish to protest against Mr. Moseley's reference to the "ABC of Television," by Yates, as being "patently American." I hold no brief for Mr. Yates or for his competence in the field of television. Moseley's own book is too patently "Baird" to allow for any slurs on his part. If it be purely a matter of temperament, I feel that Moseley has received too generous a support on this side of the water to allow for his acting as a *prima donna.*

Mr. Baird has done altogether too much good for television to allow his work to be torn asunder by such petty jealousies as are exhibited from time to time by his satellites. Unless I am in great error nothing has ever been said on this side of the water to injure the Baird interests. From time to time I am inclined to think that they receive quite unwarranted credit. For example—a recent despatch concerns itself with the fact that Baird televises the face of a clock as a time signal. For over a year the Jenkins station in Jersey City has done the same by special arrangement with a manufacturer of synchronous timepieces. Adding the feature of commerce to the fact.

Trusting that I have not infringed upon your rights by so long-winded a note, I will close before I make any "further ass of myself." C. H. W. NASON.

New York City.

FROM D.C. TO A.C.

Sir,—I was very interested to read you leading article in your issue dated July 16th regarding the change over from D.C. to A.C. throughout the country.

The fact that an A.C. mains receiver can be satisfactorily operated from D.C. mains or private D.C. plant may not be generally realised. Prospective purchasers of mains-driven receivers who now have D.C. available should not hesitate in purchasing an A.C. mains set.

Such a receiver can, by means of a small rotary transformer, be operated from their existing D.C. supply.

There are a number of excellent machines for this purpose on the market, some of which are regularly advertised in your columns. R. H. WOODALL.

BROADCAST PROPAGANDA.

Sir,—I think one paragraph of Mr. Bertram Munn's letter in your issue of July 30th should not be allowed to pass unanswered. I allude to the one in which he says that we listen-in because we've nothing else to do at the moment, and do not anticipate an evening's radio enjoyment in the same way as we do an evening at the theatre or the pictures.

Mr. Munn writes from Twickenham, and this explains much. He has numerous theatres with the best companies, and a great variety of cinemas a 'bus ride away. He need not listen to concerts on the wireless, he can go to the concert halls themselves. He is very lucky.

He does not probably realise the position of inhabitants of small provincial towns in the matter of entertainment. The programmes on the wireless are generally far better than the fare provided in the local places of amusement, and people really do stop at home and listen-in rather than go to a show which always falls far short of London standards. Orchestral concerts and good singing are impossible to hear locally.

Moreover, we in these parts are not so well catered for in the way of wireless programmes as Mr. Munn is. Both Brookmans Park transmissions are unreliable, especially after dark, when they are badly interfered with by foreign stations, and subjected to fading, and our programmes are usually obtained through 5GB or 5XX. I expect Mr. Munn receives all four stations satisfactorily.

I cannot see why a programme is more acceptable when it is interspersed with advertising matter, but I think if I lived at Twickenham I should not, perhaps, be quite so keen on listening to the wireless. GEORGE CRAYTON.

Salisbury.

READERS' PROBLEMS.

"The Wireless World" Supplies a Free Service of Technical Information.

The Service is subject to the rules of the Department, which are printed below; these must be strictly enforced, in the interest of readers themselves. A selection of queries of general interest is dealt with below.

Discouraging !

After reading your suggestions regarding "The Periodical Overhaul" in your issue of August 6th, I decided that my original "Everyman Four" was overdue for attention of that kind. I cleaned it thoroughly and attended to all the connections, etc., working in the manner suggested, with the unfortunate result that, although the set worked quite well before, it now "motor-boats" violently unless anode voltage is reduced to an extremely low value. Will you suggest what I may have done to bring about this state of affairs? C. T. F.

We are sorry to hear that our suggestions have led you into trouble, but we think that the matter can be simply explained, and that your overhaul has really been successful enough, as it has probably brought to light an unsuspected weakness in the receiver.

The "motor-boating" of which you complain is certainly due to a high internal resistance in the H.T. battery; the fact that this resistance did not produce low-frequency oscillation before the set was overhauled may be explained by the fact that there was some high-resistance connection or leakage that reduced magnification sufficiently to prevent it; this fault has now been rectified.

We are afraid that it will be necessary either to obtain a new H.T. battery or to fit decoupling resistances in the anode circuits of the detector and first-stage L.F. amplifier. As a palliative, you could try the effect of reversing the primary winding of the L.F. transformer.

○ ○ ○ ○

Power Pentode Output.

Will you please tell me if an indirectly heated pentode (Mazda AC/Pen) could be used in the "Power Pentode Two," and, if so, what alterations would be necessary in the receiver? My set is to be built exactly to the published specification, but is to be fed from an existing eliminator of a design similar to that described. W. J D.

An indirectly heated pentode is highly suitable for use in this receiver; its connections are shown in Fig. 1, from which you will see that no important circuit alterations are necessary.

It will be essential to reduce the value of the grid bias resistance R_6 to some 350 or 400 ohms, as shown. We are not quite clear as to whether your eliminator is to be arranged to deliver exactly the voltage specified in the constructional article, but in any case a priming grid resistance (R_4) of from 10,000 ohms, as shown, to 15,000 ohms is likely to be correct.

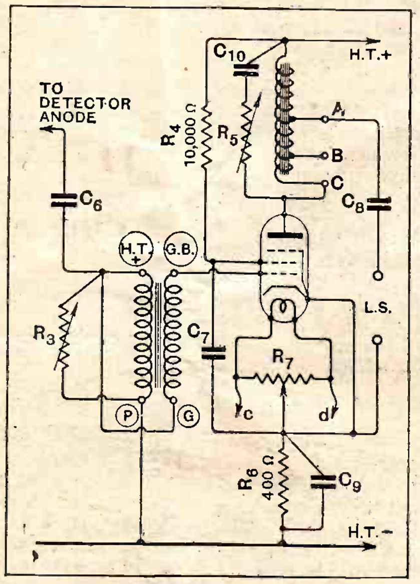


Fig. 1.—The "Power Pentode Two" with an indirectly heated pentode in place of the original directly heated output valve.

Capacity of Variable Condensers.

I intend to buy some new variable condensers, and should be glad to have your opinion as to what is the best all-round maximum value—mainly for use in the construction of experimental receivers. I notice that capacities of from 0.0003 to 0.0005 mfd. are specified in various constructional articles in your journal. M. K. R.

The most generally useful condenser is probably of 0.00035 mfd., as, with a properly chosen value of inductance, and allowing for stray capacities of reasonable values, it allows the normal broadcast waveband to be covered comfortably with fair spacing between the settings corresponding to various stations.

Larger condensers of 0.0005 mfd. have the advantage that they can be used with any value of inductance likely to be specified; they are perhaps a rather safer choice, but are sometimes a little more difficult to operate, due to overcrowding of the scale.

○ ○ ○ ○

Eliminator Wattage.

My eliminator gives a rated output of 20 milliamperes at 125 volts; do you consider that this will be sufficient for feeding a set capable of operating satisfactorily with a moving-coil loud speaker? M. M. P.

This is not an easy question to answer definitely, because some moving-coil loud speakers are quite as sensitive as, say, those of the cone type driven by a balanced armature unit. But it may be stated that an eliminator output of 2.5 watts—that of your own instrument—would generally be considered as being on the low side, even for the output valve only of a set working with this type of loud speaker; of course, the current requirements of the other valves in your set must be deducted from the maximum output before that available for the power stage can be determined. In any case, we do not think that your eliminator delivers a sufficient wattage.

RULES.

The free service of THE WIRELESS WORLD Technical Information Department is *only* available to registered readers and subscribers. A registration form can be obtained on application to the publishers.

(1.) Every communication to the Information Department must bear the reader's registration number.

(2.) Only one question (which must deal with a single specific point) can be answered. Letters must be concisely worded and headed "Information Department."

(3.) Queries must be written on one side of the paper and diagrams drawn on a separate sheet. A self-addressed stamped envelope must be enclosed for postal reply.

(4.) Designs or circuit diagrams for complete receivers or eliminators cannot ordinarily be given; under present-day conditions justice cannot be done to questions of this kind in the course of a letter.

(5.) Practical wiring plans cannot be supplied or considered.

(6.) Designs for components such as L.F. chokes, power transformers, complex coil assemblies, etc., cannot be supplied.

(7.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World"; to standard manufactured receivers; or to "Kit" sets that have been reviewed used in their original form and not embodying modifications.

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is:

12 words or less, 2/- and 2d. for every additional word.

Each paragraph is charged separately and name and address must be counted.

SERIES DISCOUNTS are allowed to Trade Advertisers as follows on orders for consecutive insertions, provided a contract is placed in advance, and in the absence of fresh instructions the entire "copy" is repeated from the previous issue: 13 consecutive insertions 5%; 26 consecutive, 10%; 52 consecutive, 15%.

ADVERTISEMENTS for these columns are accepted up to FIRST POST on THURSDAY MORNING (previous to date of issue) at the Head Offices of "The Wireless World," Dorset House, Tudor Street, London, E.C.4, or on WEDNESDAY MORNING at the Branch Offices, 19, Hertford Street, Coventry; Guildhall Buildings, Navigation Street, Birmingham; 260, Deansgate, Manchester; 101, St. Vincent Street, Glasgow, C.2.

Advertisements that arrive too late for a particular issue will automatically be inserted in the following issue unless accompanied by instructions to the contrary. All advertisements in this section must be strictly prepaid.

The proprietors retain the right to refuse or withdraw advertisements at their discretion.

Postal Orders and Cheques sent in payment for advertisements should be made payable to ILIFFE & SONS Ltd., and crossed & Co. Notes being untraceable if lost in transit should not be sent as remittances.

All letters relating to advertisements should quote the number which is printed at the end of each advertisement, and the date of the issue in which it appeared.

The proprietors are not responsible for clerical or printers' errors, although every care is taken to avoid mistakes.

NUMBERED ADDRESSES.

For the convenience of private advertisers, letters may be addressed to numbers at "The Wireless World" Office. When this is desired, the sum of 6d. to defray the cost of registration and to cover postage on replies must be added to the advertisement charge, which must include the words Box 000, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. 000, c/o "The Wireless World," Dorset House, Tudor Street, London, E.C.4. *Readers who reply to Box No. advertisements are warned against sending remittance through the post except in registered envelopes; in all such cases the use of the Deposit System is recommended, and the envelope should be clearly marked "Deposit Department."*

☛ DEPOSIT SYSTEM.

Readers who hesitate to send money to unknown persons may deal in perfect safety by availing themselves of our Deposit System. If the money be deposited with "The Wireless World," both parties are advised of its receipt.

The time allowed for decision is three days, counting from receipt of goods, after which period, if buyer decides not to retain goods, they must be returned to sender. If a sale is effected, buyer instructs us to remit amount to seller, but if not, seller instructs us to return amount to depositor. Carriage is paid by the buyer, but in the event of no sale, and subject to there being no different arrangement between buyer and seller, each pays carriage one way. The seller takes the risk of loss or damage in transit, for which we take no responsibility. For all transactions up to £10, a deposit fee of 1/- is charged; on transactions over £10 and under £50, the fee is 2/6; over £50, 5/-. All deposit matters are dealt with at Dorset House, Tudor Street, London, E.C.4, and cheques and money orders should be made payable to Iliffe & Sons Limited.

SPECIAL NOTE.—Readers who reply to advertisements and receive no answer to their enquiries are requested to regard the silence as an indication that the goods advertised have already been disposed of. Advertisers often receive so many enquiries that it is quite impossible to reply to each one by post.

RECEIVERS FOR SALE.

SCOTT SESSIONS and Co., Great Britain's Radio Doctors.—Read advertisement under Miscellaneous. [0264

HIRE a McMichael Portable Set, by day or week, from Alexander Black, Wireless Doctor and Consultant, 55, Ebury St., S.W.1. Sloane 1655. [0328

STRAIGHT Five Portable, makers' 12 months' guarantee; 8 guineas, complete.—Mosby, 507, London Rd., Sheffield. [1169

PHILIPS Model 2511, all mains, brand new, with moving coil speaker, list price £50, 215-230v. A.C., owner moving to country with 32v D.C. set, bought middle June, guarantee not even taken out; price for quick sale, £29, no offers.—G. Colley, Hillingdon, Hellesdon Rd., Norwich. [1254

Receivers for Sale.—Contd.

APPLEBY'S.

19[19-1931]?

SEASON 1930-31.—A comprehensive catalogue of new season's radio apparatus of convenient size for the pocket will shortly be issued; price 9d., post free; as this catalogue will be a pocket guide to modern radio material, it will be in wide demand; those desiring to secure a copy, would greatly assist us by kindly making application now, enclosing 9d. in stamps; a copy will then be forwarded as soon as issued, about the time of the exhibition; the 9d. may be deducted from any following order before the end of 1930, in excess of £1.

PLEASE Apply Early! Please send in your radio material for part exchange credit early—and avoid the rush; it will be a great season, good sets, good components, and fine workmanship.

APPLEBY'S, where radio part exchange began.—Chapel St., St. Marylebone, London. Tel.: Paddington 8828 (3 lines). [0340

SEVERAL Wireless Sets, amplifiers, and parts; cheap for quick sale, cash wanted.—Hammond, Yews, Oldcotes, Worksop. [1266

BERCLIF D.C.2 All Mains Receiver, 200 to 250 volts D.C.; price £14/10; with valves and royalties, suitable for M.C. speaker; particulars free; trade inquiries specially invited.—Simmonds Bros., 38, Rabone Lane, Smethwick. [8734

MARCONI Model 47 4-valve All Electric Receiver, 200-250 A.C., in use 2 months and in perfect condition; £17/10.—Box 7237, c/o *The Wireless World*. [1286

5-VALVE Cosmos Wireless Set, with loud-speaker; cost £35, will sell £6, no offer.—Welsford, Oban, Boxgrove Av., Guildford. [1275

KILO-MAG Four, slightly used for demonstration, with valves; £14/10.—Stott, 1a, Duke St., Rochdale. [1285

ACCUMULATOR HIRE.

DON'T Buy Dry Batteries, join our service: we keep you continuously supplied with fully charged C.A.V. high tension accumulators by regular exchanges, anywhere within 12 miles of Charing Cross, for less than the cost of unreliable dry batteries; nothing to buy—no deposit, payment on each delivery or by quarterly subscription; if your dry batteries have been in use for one month or more, we definitely guarantee that accumulators will give better and more selective reception; we also give the same service with low tension accumulators or maintain your own at equally advantageous terms, from the smallest portable size upwards; over 10,000 satisfied users.—Write or 'phone now to London's largest, most efficient and complete wireless accumulator service, for their interesting folder B2, post free.—Radio Service (London), Ltd., 105, Torriano Av., Camden Rd., N.W.5. 'Phone: North 0623 (3 lines). [8751

BATTERIES.

ZINCS.—Best quality (wired), No. 1, 8d. per doz.; No. 2, 9d. per doz.; order valued 5/- carriage paid, otherwise 6d. for postage.—British Battery Co., Clarendon Rd., Watford, Herts. [0258

CHARGERS AND ELIMINATORS.

TANTALUM and Lionium for A.C. Rectifiers, blue prints for inexpensive H.T. and L.T. chargers.—Blackwells Metallurgical Works, Ltd., Garston, Liverpool. [1209

PHILIPS Type 3002 H.T. Eliminator, 240 volts, as new; £3.—S.M., 213, Willesden Lane, N.W.6. [1267

ZAMPA New and Improved H.T. Eliminator Kits.—Assembled rectifying unit (incorporating mains transformer, fuse, Westinghouse metal rectifier), also necessary condensers, heavy duty choke, etc., ready mounted on baseboard; output 120 volts at 20 m.a., complete with 60-volt tapping, 49/6; 150 volts at 25 m.a., 59/6; 200 volts at 28 m.a., 69/6; 7 days' approval against cash; other Zampa kits and transformers on request; let us quote to your own specification.—Mic Wireless Co., Market St., Wellingborough. [1271

RADIELLE D.C.100 (200-250 D.C.), output 200 volts 100 m.a., and 2 variable tappings; cost £9/10, sell £3; brand new; sent c.o.d.—Priestley, 8, Grosvenor Gardens, Muswell Hill, N.10. [1272

MAINS Transformer, B.T.H., as new, cost £4/10, Primary 110, 200, 230 volts, secondary 370+370, rectifier 7.5 3 amp. L.T., 6 volt, £2; pair matched P625s, 17/6; Woodroffe pick-up, £1; other surplus.—Write J. Hardy, Cleveleys Hydro, Blackpool. [1260

ALL the "Wireless World" Set Transformers and Chokes Made to Order; special windings or non-standard outputs quoted for per return; write us now for catalogue and lists of well made eliminators designed to give trouble-free service and generous output; they are reasonable in price, too; we specialise in mains apparatus and can supply any output up to 1 kilowatt; special keen prices for quantities.—Ellison Manfg. Co., Ltd., Dragon Works, Harrogate. [1244

Chargers and Eliminators.—Contd.

ELIMINATOR Kit Ready for Wiring.—The Westinghouse 20 milliamp, 120 volt model kit consists of transformer, choke, Westinghouse rectifier, 8 mfd.'s of condensers, 2 resistances for S. G. and detector.

SUPPLIED, screwed to baseboard and safety plugs and sockets mounted.

CRACKLE-ENAMELLED Metal Case is Supplied Ready to Screw to Baseboard.

ONLY Requires Wiring to Drawing Supplied, and can be used within 15 minutes.

GUARANTEED for 12 Months, and sent on 7 days' approval against cash; no risk whatever; the postage is paid, and the whole outfit ready to wire is 60/-.

ELIMINATOR Kits, transformer, choke, condensers, valve, valve holder, resistance, terminals; 36/-, post free.

100 Metal Cases, suitable eliminators, blue crackle enamel, size 9½×7×5½in., 4/-, post free.—Fel-Ectric Radio, Garden St., Sheffield. [9963

PHILIPSON'S Safety H.T. Supply Units are Famous for Reliability and Silent Working.

OUR New Prices Again Make Them Famous for Value; for D.C. mains model D.C.4 gives 120v. at 15 m.a., 27/6; D.C.5, 150v. at 25 m.a., 1 fixed, 2 var. tappings, 35/-; for A.C. mains model A.C.7, 120v. at 20 m.a., £3; A.C.5, 150v. at 30 m.a., 1 fixed, 2 var. tappings, £3/17/6; A.C.6, for 25 cycle mains, £5.

PHILIPSON'S Safety H.T. Supply Units are Guaranteed for 12 months; write for our booklet, "Radio Power."

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038. 'Grams: Safety, Bolton. Est. over 50 years. [0318

CHESTER BROS.—All types of mains transformers and chokes to any specification.—Chester Bros., 495, Cambridge Rd., London, E.2.

CHESTER BROS.—Type V.3 220+220v., 35 m.a., 5v. 1.6a., C.T., 4v. 4a. C.T., 27/6.

CHESTER BROS.—Type W.10, for H.T., 3 or 4, output 135v. 50 m.a. and 4v. 4a., C.T.; 23/6.

CHESTER BROS.—Smoothing chokes, constant inductance, type C.B.2, 45 henrys, 25 m.a.; 15/-.

CHESTER BROS.—Write for lists of standard models. Please note change of address. [9798

SAVAGE'S Specialise in Wireless Power from the Mains; reliable apparatus at reasonable prices.

SAVAGE'S Transformer Laminations and Bakelite Bobbins; intending home constructors should write for list.

SAVAGE'S Reliable Smoothing Condensers, 1,500 volts D.C. test, 1 mfd. 2/-, 2 mfd. 3/-, 4 mfd. 5/3; 500 volts D.C. test, 1 mfd. 1/6, 2 mfd. 2/3, 4 mfd. 3/9.

SAVAGE'S Power Chokes for the Power Pentode Two, smoothing L.C.36G, 18/-; output L.C.36P.G., 19/6; many other types available, write for list.

SAVAGE'S Mains Transformer for Westinghouse H.T.4 Unit, with additional winding, 4 volts, centre tapped, 3 amps., 23/-; transformers for other Westinghouse units available.

SAVAGE'S New Foreign Listeners' Four Equipment.—Transformer, N.F.L.4, 33/-; smoothing choke, C32G, 20/-; output choke, C32/0, 20/-.

SAVAGE'S Mains Transformer, B.T.4. 500-0-500 volts 120 m.amps., 7½ volts 3 amps., 6 volts 3 amps., 4 volts 2 amps., 4 volts 1 amp., 4 volts 1 amp., all centre tapped, specially developed to facilitate automatic bias in all stages; 57/6.

SAVAGE'S Mains Transformer, V.T.37, 250-0-250 volts 60 m.amps, 4 volts 1 amp., 4 volts 1 amp., 4 volts 1 amp., 4 volts 2 amps., all centre tapped, a useful instrument for modern receivers with automatic bias in every stage; 35/-.

SAVAGE'S Mains Transformers and Power Chokes are carefully constructed from first class materials with an exceptionally generous margin of safety; they are fully guaranteed and may be purchased with confidence.

SAVAGE'S, 146, Bishopsgate, London, E.C.2. 'Phone: Bishopsgate 6998. [1283

EKCO A.C. Eliminator, 2A10, used half-hour, perfect; £2/12.—Selby, 22, Ely Place, E.C.1. [1282

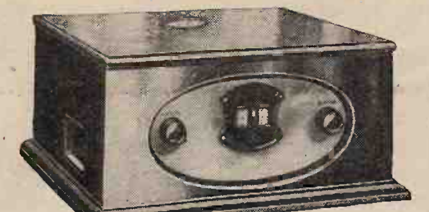
LOUD-SPEAKERS.

BAKER'S SELHURST RADIO 36-page Booklet, "Sound Advice is Yours for the Asking"; write now for new edition; see displayed advertisement on page 15. [0231

CELESTION C12 (mahogany), perfect (used only with filter), £4, or nearest; Lewcos binocular transformer, B.S.S. and B.R.T., high and low, £1, or nearest.—Clucas, 112, Nightingale Lane, Balham, S.W.12. [1250

AMPLION Lion Chassis, £6 model, perfect condition; 57/6.—Lebbon, Kepstorn, Heath Grove, Harrogate. [1247

What do you look for in a Wireless Set?



Performance? Appearance? Low Running Costs?

On each of these points, the Lotus 3-valve S.G.P. All Electric Receiver scores full marks. Unequalled for width of range, giving perfect trouble-free reception under all conditions — ample volume, highly developed sensitivity and selectivity (enabling unwanted stations to be cut out with ease) and crystal clarity of tone.

In appearance, an elegant piece of furniture of which you can be proud—not merely a cabinet.

Running costs practically nil. No batteries needed—all power being taken direct from the electric light mains.

Price, £21 cash, or 12 monthly payments of £1 : 19 : 9.

Ask your dealer for a free demonstration and full details of this remarkable set.

LOTUS

ALL ELECTRIC RECEIVER

Garnett, Whiteley & Co., Ltd.

(Dept. W.W.10)

Lotus Works, Mill Lane, Liverpool.

Causton

Loud-Speakers.—Contd.

EPOCH Moving Coil Speakers are Masterpieces, designed and produced by master engineers.

EPOCH Moving Coil Speakers are the Standard by which other Speakers are Compared.

EPOCH Moving Coil Speakers are in Use in Many Editorial Offices.

EPOCH Moving Coil Speakers are in Use in Several Famous Laboratories.

EPOCH Moving Coil Speakers are in Use in Many Broadcasting Stations.

EPOCH Moving Coil Speakers are in Use by Most Prominent Musicians.

EPOCH Moving Coil Speakers Bring Unbounded Joy to Thousands upon Thousands of Homes.

EPOCH Moving Coil Speakers, the only speakers that give clear, uncoloured reproduction.

EPOCH Moving Coil Speakers do Render Speech Perfectly and Music Correctly.

EPOCH Moving Coil Speakers Provide the Perfect Illusion of the Artist's Presence.

EPOCH Moving Coil Speakers Represent the Finest Intrinsic Value Ever Offered.

EPOCH Moving Coil Speakers are Guaranteed for a Year, but last for ever.

EPOCH Moving Cool Speakers Bring the Grand Concert out of the Most Modest Set.

EPOCH.—You can hear a hundred moving coil speakers, but Epoch is different.

EPOCH.—If you own the best set, only by Epoch can you confirm it.

EPOCH.—Away with the tin can and cracked banjo reproduction, and install an Epoch.

EPOCH.—Away with the drumminess, droniness, and huskiness of the average moving coil speakers.

EPOCH.—The clearest, sharpest, cleanest, reproduction—a marvel of accuracy and beauty.

EPOCH Moving Coil Speaker Models from £2/10 to £30.

EPOCH Moving Coil Speakers.—Models for every requirement and taste.

EPOCH Permanent Magnet Moving Coil Speakers.—Nine models from £3/15.

EPOCH Permanent Magnet Moving Coil Speakers Require no Mains or Batteries.

EPOCH Permanent Magnet Speakers are more Sensitive than most Energised Moving Coil Speakers.

EPOCH Energised Models are the Finest ever put on the Market.

EPOCH Super Cinema Speaker has Created the Biggest Sensation for Many Years.

EPOCH Super Cinema Model is many times as Sensitive as the so-called Supers.

EPOCH Super Cinema Speakers give Enormous Volume from a 1-watt Amplifier.

EPOCH Super Cinema Speakers are used on many 100-watt Amplifiers and never "rattle."

EPOCH Super Cinema Model is Standard on several Talkie Equipments.

EPOCH Super Cinema Model is already in use in over 200 Cinemas.

EPOCH Super Cinema are the only Moving Coil Speakers used in Large Theatres, unaided.

EPOCH Super Cinema Speakers provide alone the Upper as well as the Lower Register.

EPOCH.—Other Moving Coil Speakers require the help of exponential horns to provide depth.

EPOCH.—A list of many prominent cinemas using the Speakers supplied on request.

EPOCH Speakers are not Made of Tin or Aluminium Stampings, but are sound, solid, engineering jobs.

EPOCH Heartily Invite Comparison, on all counts, with any make, regardless of price or claims.

EPOCH.—Don't accept our quality claims without verification, but don't accept any other maker's either.

EPOCH.—Order one on 7 days' approval, and test with a switch-over; the only real test.

EPOCH Moving Coil Speakers may be heard in our Demonstration Room Daily.

EPOCH.—Our demonstration room is in the heart of London.

EPOCH.—Its accessibility has been studied for the convenience of callers.

EPOCH.—If you cannot call, write for booklet W.S.3. and approval terms.

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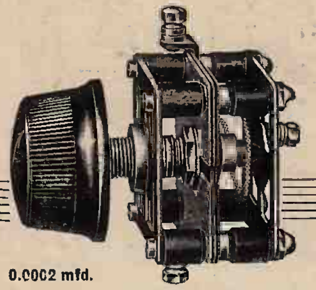

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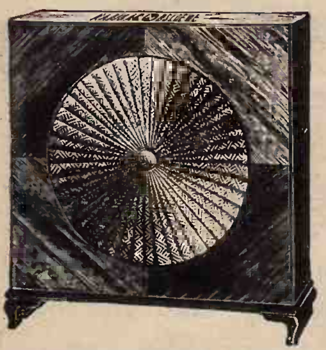

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INDEX TO ADVERTISEMENTS.

	PAGE
Appleby, E. Hetherington	10
Baker's "Selhurst" Radio	15
Belling & Lee, Ltd.	10
Benjamin Electric, Ltd.	2
Burne-Jones & Co., Ltd. (Magnum)	13
Busby & Co., Ltd.	12
Carrington Manf. Co., Ltd.	15
Clarke, H., & Co. (Manchester), Limited	8
Cole, E. K., Ltd.	Cover i.
Cossor, A. C., Ltd.	7
Darwins, Ltd.	16
Dubilier Condenser Co. (1925), Ltd.	2
Eastick, J. J., & Sons	14
Edison Swan Electric Co., Ltd.	1 and Cover iii.
Electradix Radios	12
Exact Manf. Co.	14
Garnett, Whiteley & Co., Ltd.	11
General Electric Co., Ltd.	
Graham Amplion, Ltd.	5
H. & B. Radio Co.	15
Heayberd, F. C., & Co.	12
Holzman, Louis, Ltd.	Cover i.
Hughes, F. A., & Co., Ltd	Cover i. & ii.
Imperial Airways, Ltd.	4
Lamplugh, S. A., Ltd.	13
Loewe Radio Co., Ltd.	13
London Electric Wire Co. & Smiths, Ltd.	3
London Radio Supply Co.	15
Marconiphone Co., Ltd.	6
M-L Magneto Synd., Ltd.	5
Mullard Wireless Service Co., Ltd.	Cover i.
Parker, W. H.	14
Perseus Manf. Co., Ltd.	14
Pertrix, Ltd.	Cover iv.
Philips Lamps, Ltd.	8
Player's	8
Potter, H. B., & Co., Ltd.	16
Radio Gramophone Development Co.	2
Sheffield Magnet Co.	16
Siemens Brothers & Co., Ltd.	9
Stratton & Co., Ltd.	15
Tannoy Products, Ltd.	10
Thomas, Bertram	14
Transformer Repair Co.	14
Varley (Oliver Pell Control), Ltd.	Cover iii.
Westinghouse Brake & Saxby Signal Co., Ltd.	3
Wingrove & Rogers, Ltd.	14

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