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The Wireless World

AND RADIO REVIEW

The Paper for Every Wireless Amateur

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Wednesday, August 7th, 1929.

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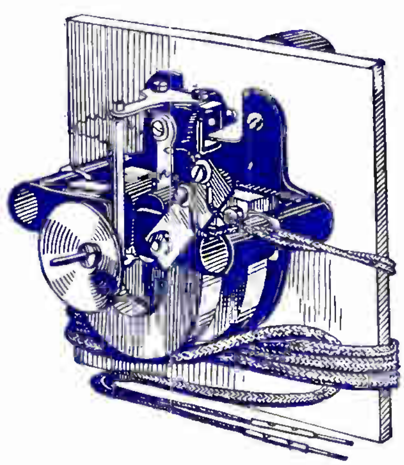

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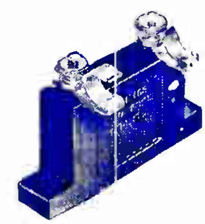

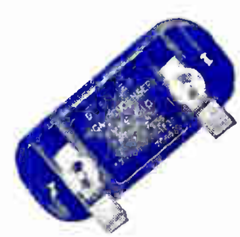

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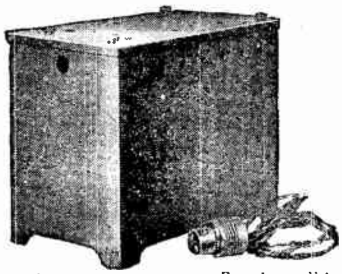

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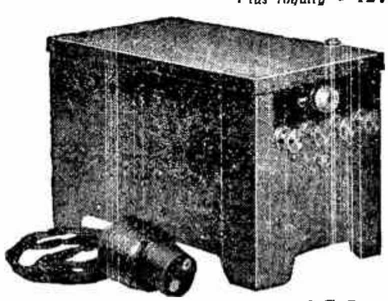

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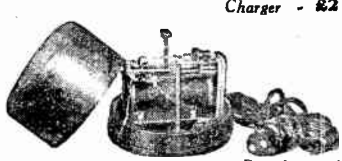

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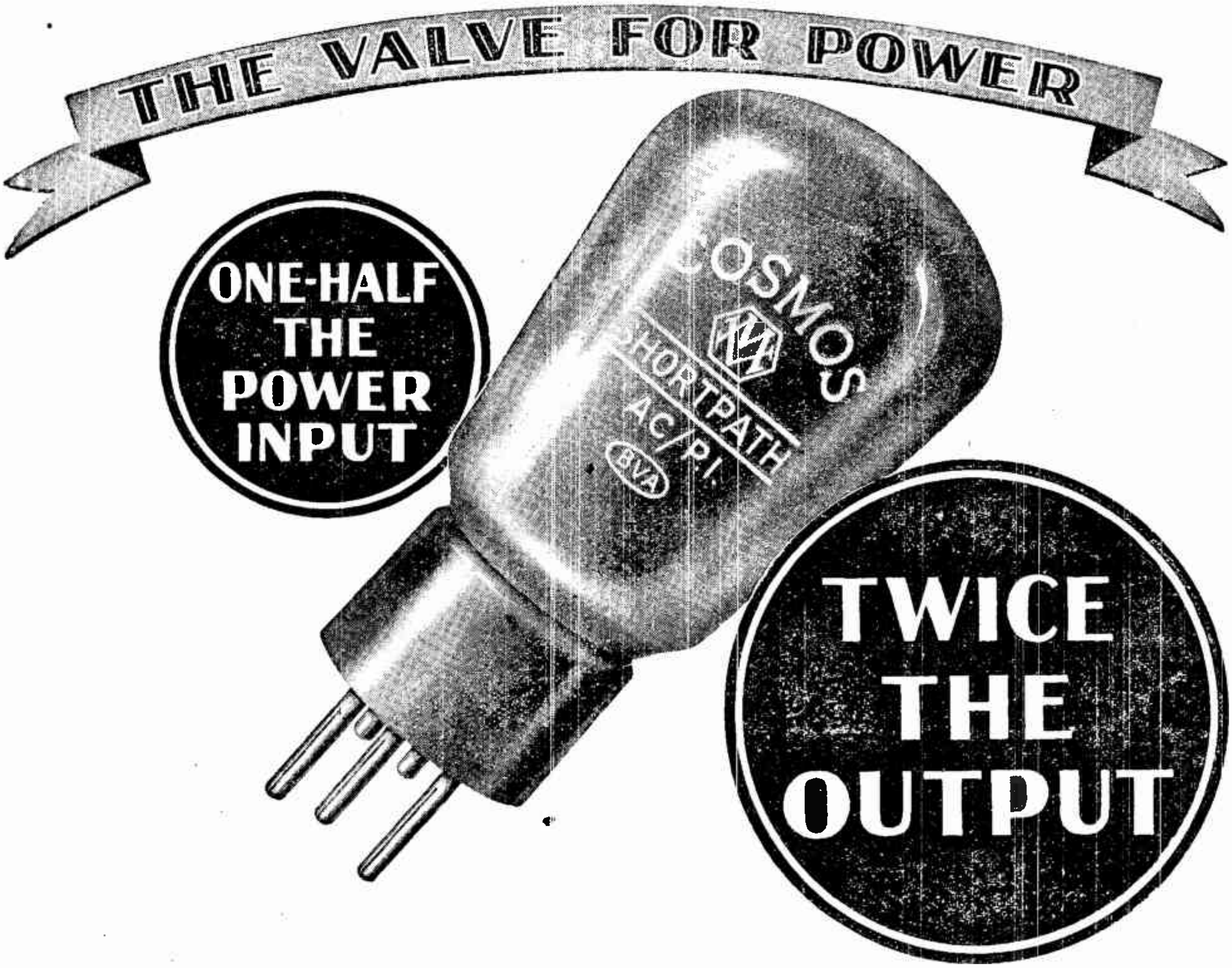

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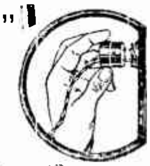

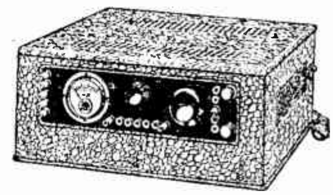

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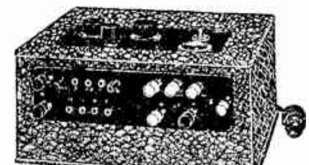

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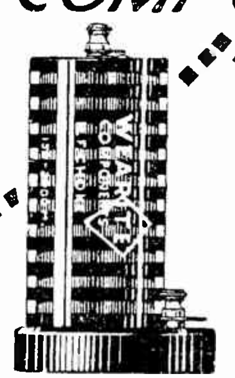

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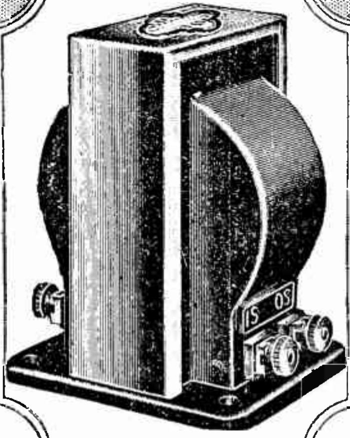

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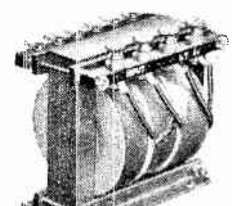

This transformer provides from A.C. mains both H.T. and L.T. current, replacing batteries and accumulators. Two windings provide H.T. current at 120 volts through a rectifying valve, and another supplies up to 8 amps. at 3·5 to 4 volts for the filaments of indirectly heated valves. Windings, insulation and core area are of generous proportions. Model "C" is for mains of 200-240 volts, model "D" for 100-120 volts, both at any frequency above 40 cycles. Specially suitable valves are Marconi KH1 and KL1 and, for the rectifier, U5. Price (either model), £1 17s. 6d.

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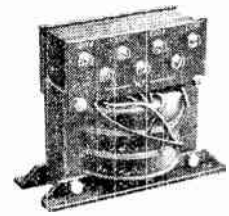

Four separate outputs are provided by this transformer, for supplying from A.C. mains both high and low tension current. The primary has three tappings for accurately adjusting the filament output voltages. The H.T. output, when smoothed and rectified, is approximately 150 volts at 30 m.a.—45 m.a. may be taken at a slightly lower voltage. For the filament of the rectifying valve there is a winding giving 5·5 volts (centre tapped) at 1·6 amps. A third output gives 3·5 to 4 volts and up to 2 amps., and a fourth provides 0·8 volt and up to 2·5 amps. Model "L" is for 200-250, Model "M" for 100-125 volt mains Specially suitable for KH1, KL1 and Point 8 Marconi valves; for the rectifier Marconi U5 is recommended. Price (either model), £1 17s. 6d.

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The Wireless World

AND RADIO REVIEW
(17th 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.

SELECTIVITY.

WE learn that the equipment of the new 2LO is already undergoing tests and that soon the needle of the aerial ammeter will move across the scale. So great is the power of this station that tens of thousands of listeners are turning over in their minds the changed conditions of reception that will soon come about. To be tied to the programme of the local station is distressing, yet it is feared that many listeners interested primarily in distant station reception will need to redesign their sets completely. While we have all learned to appreciate the excellent quality obtainable with a local station receiver we are not anxious to give up our interest in tuning to the foreign programmes. Foreseeing these impending difficulties attention has been turned in these pages to the design of long-range selective sets, while readers have been quick to grasp the full significance of the recent articles dealing with H.F. valves and amplifiers. Facts and figures have shown that screen-grid valve performance has passed beyond recognition as compared with previous standards, while new design data, both theoretical and practical, is bringing about a marked improvement in the range of reception. Thus to maintain our contact with the distant transmissions in the face of local interference we shall need sets giving more H.F. amplification than previously and possessing a higher degree of selectivity. New designs will include complete stage screening, coils of good efficiency, and a possible revival of gang control, while there is likely to be a passing out of the use of reaction.

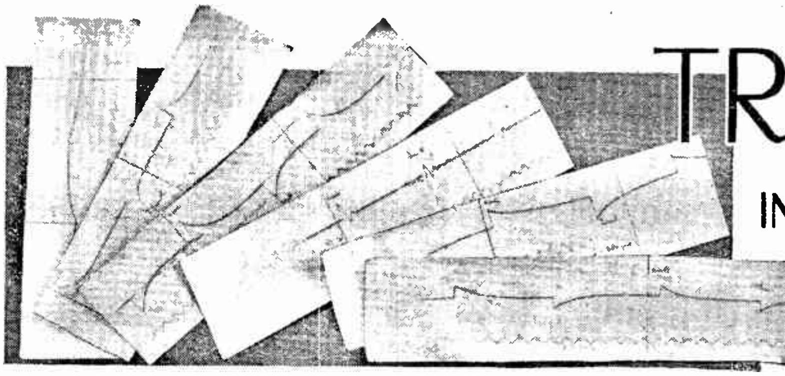
Valve designers and set manufacturers are considering the relative merits of obtaining selectivity simultaneously with amplification by the use of several stable H.F. stages of moderate gain as against the highly efficient stage associated with a tuned filter. Wave-traps and filters supplied as auxiliary units to attach to existing sets are to become popular. Stage gain and selectivity are linked together, the one being modified by the other. When a statement is made as to overall amplification it is important that it should be associated with a figure indicating the degree of selectivity that can be expected. Units of selectivity are yet to be devised as a means of expressing sharpness of tuning. To set up a standard of selectivity is no easy matter, and the problem becomes highly complex when applied to a multi-stage H.F. amplifier or when interelectrode capacity is acting as a stimulant to amplification.

oooo

WIRELESS AND THE MUSIC TRADE.

RUMOURS are current that as a result of the recent linking together of the Marconi and Gramophone Companies the sale of wireless sets may pass into the hands of the music trade, and that after a while we shall go to the music shop to buy our valves. Such a change, however, need not be feared. The working and maintenance of wireless apparatus, combined with the difficulties of servicing, are far too complex to be handled by an inexperienced retailer, and for him to attempt to sell to the equally inexperienced customer is truly a case of the blind leading the blind.

Let us leave wireless to the wireless trade and avoid the mistake of arousing prejudice when presenting new equipments to the wireless-interested public. The voice of the enthusiast is a strong one, and the unsatisfactory results of the handling of radio gear by unskilled salesmen will rouse his resentment.



TRANSIENTS IN LOUD SPEAKERS AND AMPLIFIERS

How Sudden Changes in Sound Intensity Affect the Amplifier.

By N. W. McLACHLAN, D.Sc., M.I.E.E., F.Inst.P.

IN the first article on Transients[1] we were mainly concerned with the influence of a sudden impulse upon a loud speaker. If sudden sounds like those due to gun-fire, the piano, hand-clapping, etc., are accompanied by the natural oscillations of the loud speaker, it is clear that *transients of this nature* must always be reproduced with considerable distortion. The superposition of the natural oscillations of a loud speaker is not the only way in which distortion of a transient can be caused. In order to indicate the nature of the problem it will be well to start from the beginning.

Suppose a sudden sound occurs in room where a microphone is situated. The waveform of the sound will in general be modified by the acoustic properties of the room. If the sound were due to a pistol shot, it is clear that the effect on the microphone would be totally different (a) for a room with bare cement walls, (b) in a room whose walls, etc., were heavily lined with cotton waste. The sound of a pistol shot is obviously a transient, and its waveform as perceived by the microphone will differ according to the type of room in which the pistol is fired. This is due to the effect of reflection from the walls which causes the sound to be prolonged and modified in waveform. With a hard cement wall the sound will persist quite a long time. This case is analogous to the loud speaker transients obtained when the current is suddenly sent through the winding. The diaphragm moves outwards very quickly and afterwards settles down to a series of damped oscillations, as shown in Fig. 1. When a pistol is fired in a room with cement walls there is a sudden rise in air pressure, which travels *direct* from the muzzle. This direct wave affects the microphone and causes a rapid rise in current therein. Thereafter the pressure wave having been reflected from the six sides of the enclosure is modified in shape, and can be considered to be due to the combined effect of the natural oscillations of the room.

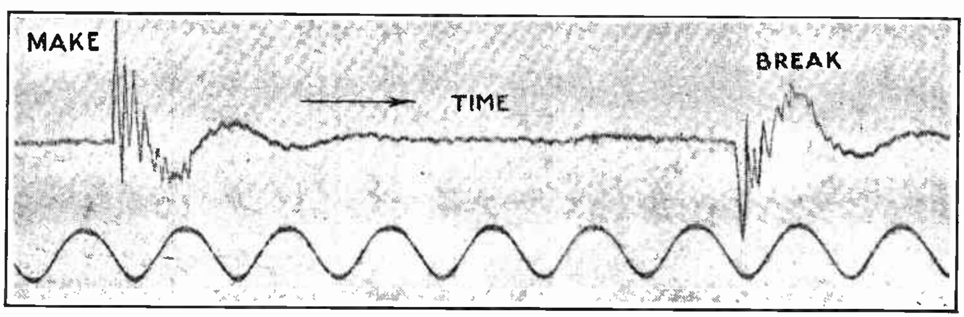


Fig. 1.—Acoustic output from experimental reed-driven loud speaker with large conical diaphragm. The main diaphragm oscillation persists for about two oscillations. Its frequency is about 100 cycles. The higher frequency is about 1,800 cycles.

The Effect of Reverberation.

In free, open space it is clear that only the direct pressure wave would actuate the microphone, since there is no room or enclosure to cause reverberation. When the enclosure is highly damped with cotton waste the sound will decay rapidly and resemble that obtained in free space. Thus the actual shape of an acoustic transient depends upon the external conditions with which its occurrence is associated.

We can, if we choose, regard the true transient as the sound obtained in either the open air or in a very heavily damped room. On the other hand we can simply regard the sound of the pistol shot, however modified by surroundings, to be a form of transient. Taking the latter view we obtain a definite waveform of the sound due to the pistol shot in a certain room. Since the size of the microphone is comparable with the wavelengths of the higher frequency components of the sound, there will be a certain degree of distortion. The result is that we obtain an electric current in the microphone whose waveform is modified by its presence in the sound field. For the time being we shall disregard the variation in waveform caused by the microphone and consider the shape of the desired transient to be

[1] *Wireless World*, April 3rd and 10th, 1929.

Transients in Loud Speakers and Amplifiers.—
that which emanates from the microphone amplifier and is applied as a voltage to the grid of the power valve. The problem which now confronts us is to reproduce a

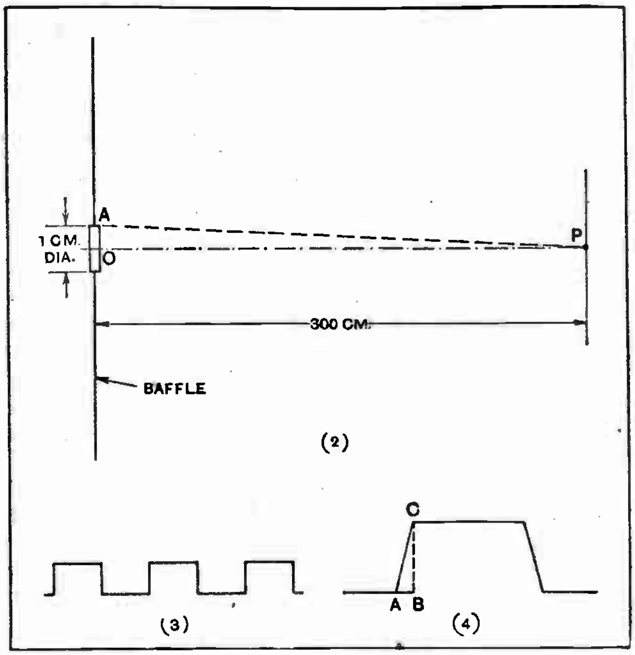
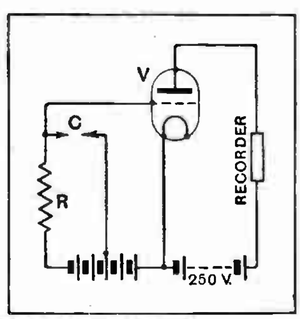


Diagram (2) showing small rigid disc in infinite baffle. The sound waves are propagated equally in all directions at all audible frequencies. In (3) the waveform obtained from relay contacts is shown. Diagram (4) illustrates the finite time (AB) taken for the current to reach the value BC. The smaller the time interval AB, the more rapid the rise in current and the greater the frequency of the component sine waves involved.

sound wave identical in shape with that of the voltage wave applied to the grid of the power valve.

In the article cited above we saw the result of a square-topped waveform as reproduced by various loud speakers. The initial rise in current from zero to a maximum was reproduced — with what degree of precision does not concern us at the moment—but the diaphragm instead of remaining in a definite position due to the steady current in its winding, proceeded to execute a complex damped vibration of the form depicted in Fig. 1. Moreover, instead of a faithful copy of the transient—which might have been due to a pistol shot—we chiefly got the natural oscillations of the diaphragm. This being the case, it is of little use bothering to ascertain whether the initial part of the transient was faithfully reproduced or not.



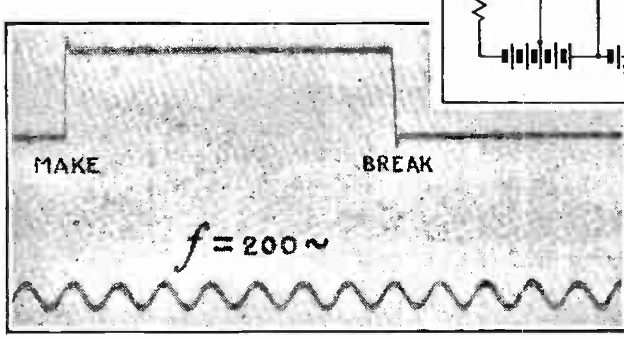


Fig. 5.—Diagram illustrating disposition of apparatus for applying square topped waveform to grid of valve. The grid bias is reduced by closing the relay contacts C through a high resistance R. V is an LS5A valve. The waveform applied to grid of valve containing apparatus under examination is shown in the lower illustration.

If the natural oscillations of the loud speaker had been negligible then we should have been able to probe the problem regarding the degree of agreement between the shape of the original waveform as applied to the grid of the valve, and that propagated from the loud speaker and registered by the microphone at some point on the axis of the speaker. As this phase of the subject is of more than passing interest we can profitably pause to contemplate the fundamental principles of the situation. We shall assume that the loud speaker is represented by a rigid disc one centimetre in diameter situated in a flat baffle of infinite extent as shown in Fig. 2. There is no appreciable constraint at the periphery of the disc, so that the system has no natural frequency within the range of audibility. The disc is to be driven by some hypothetical agent exerting a force thereon, whose waveform is a replica of the voltage applied to the grid of the power valve.

When the Reproduction of Transients would be Perfect.

Under such conditions the sound waves are propagated equally in all directions, and the mass to be added to the disc by virtue of its motion in the air is constant. Thus the total mass of the disc, *i.e.*, its ordinary or gravitational mass plus the accession to inertia,[2] remains unaltered over the range of audible sounds. Over three years ago I investigated the distribution of pressure due to the sound waves caused by a rigid disc vibrating in an infinite baffle.[3] In *The Wireless World*, March 30th, 1927, I gave a formula for the sound pressure on the axis at a distance of eight or more times the diameter of the disc. Suppose in the present case we consider a point on the axis distant three metres from the disc, *i.e.*, 300 diameters. At this point the sound pressure due to the vibrating disc is directly proportional to the axial acceleration of the disc, *i.e.*, at a distance of 600 diameters the sound pressure would be halved. Bearing in mind that we have assumed the force driving the disc to be proportional to the voltage applied to the grid of the power valve—since the electric and mechanical waveforms are identical—what precisely can we deduce concerning the acoustic waveform of a transient at a point 300 diameters from the disc? Since the distances OP and AP (Fig. 2) are almost identical, sound waves of audible frequencies radiated from various parts of the disc arrive in phase at P; this would not be the case with a large disc at, say, 10,000 cycles and three metres distance. Now from the mathematical analysis cited above, the acoustic pressure at all

[2] See *Wireless World*, March 23rd and 30th, 1927.
[3] See also Proc. Roy. Soc. A Vol. 122, 1929.

Transients in Loud Speakers and Amplifiers.—
frequencies is directly proportional to the axial acceleration of the disc. But since the effective mass of the disc is constant the acceleration varies directly as the driving force on the disc. As this force is a copy of the electrical waveform of the transient so also is the acceleration, and therefore the acoustic pressure. Hence, under the conditions postulated in this discussion, the reproduction of a transient whose frequencies

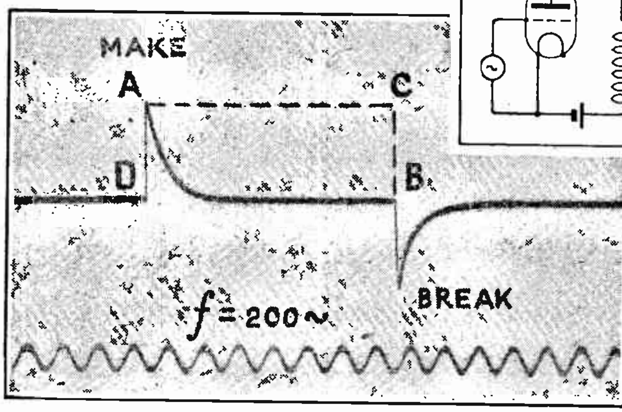


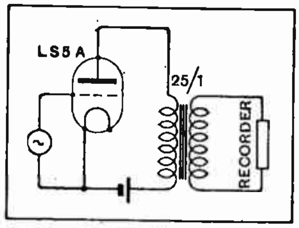
Fig. 6.—Record showing current in secondary of 25 to 1 transformer when rectangular waveform is applied to grid of valve. The primary is shown dotted at DACB.

reside within the audible register would be perfect. In practice an observer situated on the axis of such an arrangement would himself cause distortion of the upper frequencies of the transient due to the presence of his body. The main effects involved would be diffraction and absorption of the sound. This, however, is beyond the purview of our present premises and will not be discussed. Nevertheless, it is well to bear in mind that the body of a listener does modify acoustic waveforms.

Having seen from experimental records that, due to the superposition of their own natural oscillations, loud speakers do not reproduce severe transients with any degree of accuracy, we pass on to investigate the manner in which amplifiers behave in like circumstances.

How the Square-topped Waveform is Produced.

The reader is now familiar with the form of severe transient used for testing the loud speakers, this consisting merely of a series of Morse dots from the contacts of a special relay. The rise or fall of the voltage applied to the valve grid (see Fig. 3) is accomplished in a small fraction of a second, and corresponds acoustically to a sudden rise or fall in air pressure. In conducting experimental work on amplifiers this form of transient was used with results now to be set forth. To understand the effect of such a transient it is advisable to say a few words relating to the inner structure—so to speak—of the Morse dots. These dots occur fifteen times per second, and if we agree to regard them as an alternating current of rectangular waveform, its frequency is 15 cycles. Now this waveform can be considered to consist of a *sine* wave of 15 cycles accompanied by odd harmonics of 45 cycles, 75 cycles, 105 cycles, etc. The main or fundamental wave of 15 cycles determines the basic frequency of the dots, whilst the higher harmonics determine the sharpness with which the current starts and stops, *i.e.*, the squareness of the profile. Referring to Fig. 4, if we regard the time interval AB as one-quarter of a *sine* wave cycle it is clear that the smaller the value of AB the higher the frequency and the sharper the profile of the current wave. More-



over, the sharper the profile the more important are the higher frequency components. Thus, when a rectangular waveform of low basic frequency is applied to an amplifier, the resulting output is a measure of its capabilities of coping with a very wide frequency range, and at the same time of dealing with the impulses corresponding to make and break. A perfect amplifier would, of course, faithfully reproduce the rectangular waveform. A practical amplifier may do two things, (1) distort the waveform due to inadequate amplification of high or of low frequencies or of both; (2) superpose some natural oscillation of its own.[4] The latter phenomenon occurs, of course, in any H.F. low-loss stage and with most tuned anodes. If the natural oscillation has the same frequency as the carrier the latter is temporarily varied. If the frequencies are different a temporary beat will occur. However, there is no need to say anything further on the subject of H.F. amplifiers at the moment, and we will direct our attentions to the L.F. amplifier.

Transients and Various Intervalve Couplings.

In studying the problem of the rectangular waveform as applied to audio frequency amplifiers, it is convenient to treat various forms of intervalve coupling separately. The experimental arrangements will be indicated in each case. Starting off with an LS5A valve, in whose anode circuit the recording apparatus is directly situated, we proceed to key the grid, as shown in Fig. 5. The resulting waveform is illustrated in Fig. 5 and is substantially perfect. The auxiliary *sine* wave of 200 cycles shown on each record is for timing purposes. In the next case illustrated in Fig. 6 a 25/1 output transformer is interposed between the valve and the recorder. The only

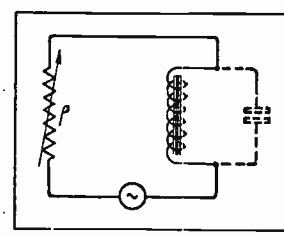


Fig. 7.—Equivalent circuit of valve and transformer. The valve can be regarded as a resistance which varies when the grid bias is altered. The self and mutual capacity effect of the transformer windings is shown dotted.

part recorded with accuracy is the initial rise of the current. At break where the current falls, its phase is altered 180°, *i.e.*, it is reversed. This case is worthy of further consideration. The valve can be represented by a resistance which at make suddenly decreases in value from ρ_1 to ρ_2, and at break increases from ρ_2 to ρ_1. In series with this variable resistance we have the primary of the transformer, as shown in Fig. 7. At make the primary current suddenly increases, thereby causing an increase in the magnetic flux and also a

[4] The amplifier can also introduce harmonics due to non-linear amplification.

Transients in Loud Speakers and Amplifiers.—
voltage rise across the winding. But the secondary winding is on the same core, so that its voltage also rises and causes a current—whose waveform is shown in Fig. 6—to flow through the recorder. The current in the secondary rises rapidly to a maximum, but decays very quickly, so that there is no semblance of the rectangular waveform of the primary current. Now the initial rise is due to the high-frequency components, but the flat top of the wave is determined by the low-frequency components. In Fig. 6 the latter is conspicuous by its absence, and we naturally ask why? Every reader knows that the lower frequencies will only be reproduced if the primary of the transformer has an adequate inductance. In the present case the primary inductance was inadequate not only to reproduce 15 cycles but frequencies of higher value in the audible register. The reversal of current at break is due to the secondary current having fallen from A to B, whereas the primary current was steady from A to C. Thus when the primary is reduced at break the secondary current starts from B instead of from C. The acoustic effect would be identical in either case.

(*To be concluded.*)

AMENDING A RADIO ACT.

America's Reply to the British Radio-Cable Merger.

By A. H. MORSE, A.M.I.E.E.

THE sole remaining obstacle to an alliance between wireless and cable interests in the United States is known as the White Act, a section of which prohibits the operation of radio and line communications under one administration, the object being to maintain competition in the public interest. In this article a New York correspondent shows how the Act may be circumvented, with results which may give America the most powerful communications unit in the world.

IT is perhaps hardly correct to suggest that the huge American communications merger is a reply to the similar merger now being consummated in England; but colour is lent to the idea by the facts that the latter was first announced, and that it has been used as an argument in support of the former.

Begotten of a domestic market of unparalleled dimensions, the American's genius for industrial efficiency is, however, the sole cause and occasion for the extension of the merger idea to communications; and its conception probably long antedates that of the English scheme. It is merely a coincidence that the latter happens to furnish a powerful argument in favour of the removal of the only obstacle to the full consummation of the American proposal.

This obstacle, of course, is that section of the White Act which is intended to preclude the operation of radio and line communications by one administration, so that in the public interest the two means may be kept on a competitive basis. There is, however, a growing feeling that this lofty concept does not, and cannot, serve the desired end. In effect it is like restricting the operation of copper and iron conductors to separate and distinct companies. Only now is it coming to be generally recognised that the most dependable, cheap, and rapid communication service depends upon the availability of every means to each administration. In short, healthful competition must be looked for between systems rather than between means; and the general anti-trust laws must be relied upon to protect the public from unfair exploitation.

One of the parties to the present American merger has apparently met the requirements of the White Act by the simple expedient of forming a separate subsidiary; therefore, to the outsider, it seems that the present hesitancy in absorbing R.C.A. (Communications) is merely a polite gesture; and the exclusion from the merger of the Western Union system appears to be another. The historical, personal, technical, and geographical contracts between the Western Union and the prime movers of the pending merger are such as usually bespeak a community of interest, which is opposed to full competition.

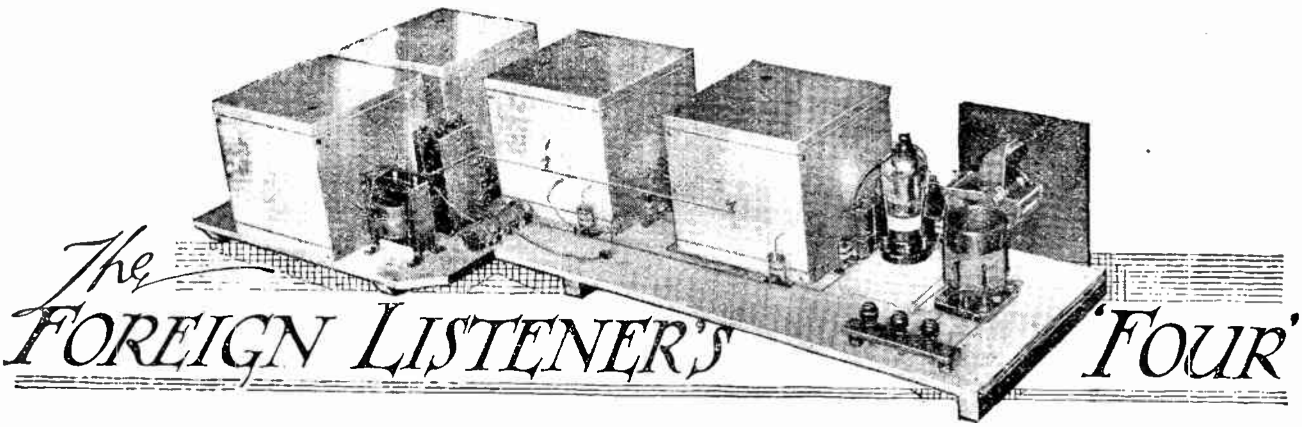
In the circumstances, the present amendment of the White Act might bring about a parity between the communication conditions in England and America—wherein, incidentally, inventors and engineers had but one market for their inventions and brains; and such a prospect, while it lasts, may be taken to preclude any such amendment. But, in a typically American manner, there already looms a vast and entirely new communication organisation, which has given sufficiently satisfactory evidence that it is financially and technically competent to build and operate a nation-wide chain of short-wave, high-speed, public radio-telegraph stations. It is true that their licences do not permit them to engage in international communication, but they are now appealing against this unique disability, and there seems to be good reason why their appeal should succeed.

The Federal Radio Commission, which is charged with the difficult duty of administering radio in America, has very recently handed down a well-considered decision in the matter of an application of an organised and powerful section of the American Press, which has for years been operating a one-way (Westbound) European service via Halifax, N.S. This decision takes cognisance of the fact that applicants, however powerful and organised, represent but a section of the press; and concedes to the applicants some twenty trans-oceanic and twenty trans-continental channels upon—*inter alia*—the following conditions: Applicants must immediately incorporate (form a limited liability company) as a public utility; its stations must be located at points at other than premises controlled by any newspaper or press association; it must provide a bona fide public service open to all agencies of the American Press on a fair and equitable basis; and, in general, it must satisfy the Commission that its utilisation of its channels will serve public interest, convenience and necessity.

The Federal Radio Commission dies a natural death at the end of the current year. By that time its life may be again renewed, or the whole or a part of its functions may be taken over by a Communications Commission, which will administer all communications. In interested circles there is considerable agitation for and against the change; but it seems likely to come about, and there is little doubt that it will be timely.

WIRELESS AND MAGNETIC STORMS.

THE effect of magnetic storms on the strength of radio signals was the subject of an interesting announcement made at a recent meeting of the American Geophysical Union by Miss I. J Wymore, of the U.S. Bureau of Standards, and reported in the *Daily Science News Bulletin*, Washington, D.C. When the radio signals from European stations are weaker than usual and the signals from nearer stations in America are louder, it has been found that magnetic storms may be expected. After a magnetic storm much stronger signals are received from distant stations. The conclusions were deduced from the records obtained by experiments made with the long waves used for high-power transoceanic transmission.



The Foreign Listener's 'Four'

Constructional Details of the Long Range All A.C. Set.

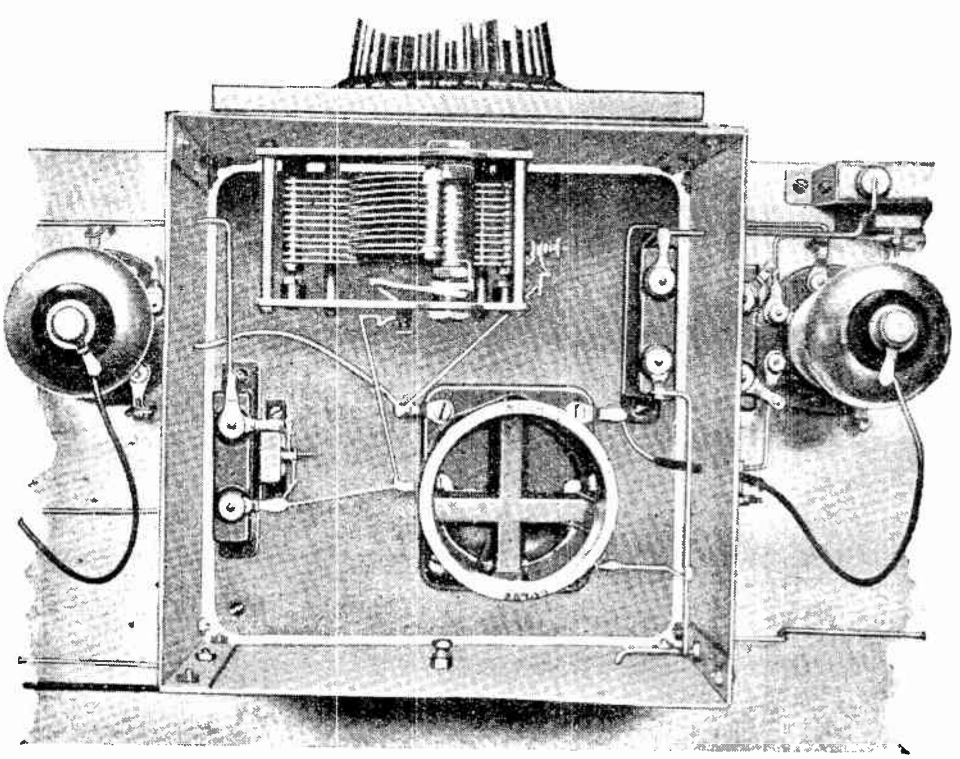
By F. H. HAYNES.

(Concluded from page 96 of previous issue.)

A CONSIDERABLE saving is effected by building the eliminator as part of the receiver. By so doing much complication is avoided as compared with designing an eliminator which will suit all circuit arrangements. Windings on the mains transformer provide 5 volts for heating the filament of a U.5 rectifying valve, about 200 + 200 volts anode current supply, 4 volts for the three indirectly heated valves, and 5.5 volts for the P.625 output valve. All these potentials are obtained on the windings when the transformer is on full working load. Owing to the small load which is always maintained by the potentiometer the peak voltages from the eliminator are considerably reduced and the inexpensive low voltage condensers will not break down. Quite a small choke is used in conjunction with the condensers for smoothing and although, in playing for safety, one might have specified more generous components, the smoothing apparatus does its work effectively.

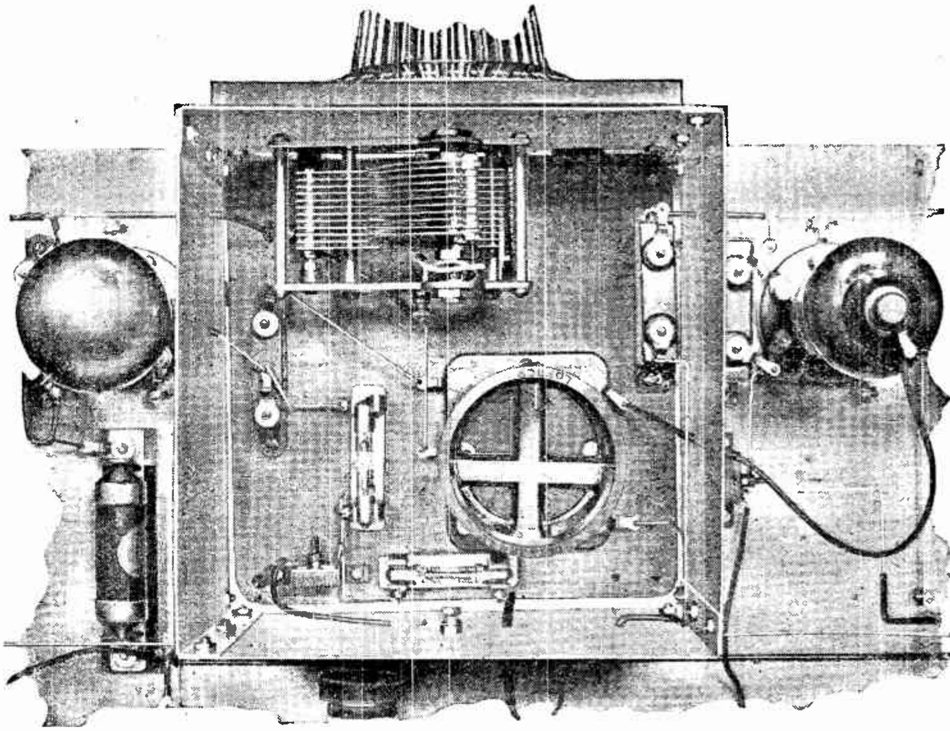
As the current taken in the circuit feeding the screening grids is of varying and uncertain value, the potentiometer method of fixing this voltage is advisable, while H.F. interstage coupling is avoided with quite small resistances (600 ohms), combined with low capacity condensers (0.1 mfd.). To reduce the voltage to the leaky grid detector a series resistance is used which serves, at the same time, as a high impedance path to speech currents, and is thus a deterrent against L.F. oscillation. Little else need be said of this eliminator unit which involves few components, is wired up in a few minutes and cannot fail.

It is believed that the particular form of baseboard construction adopted appeals to those who want results yet often consider it a waste of time to set up the workshop facilities necessary to make a well-finished set in an elaborate cabinet. Any reader desirous of making a cabinet enclosed set will not need



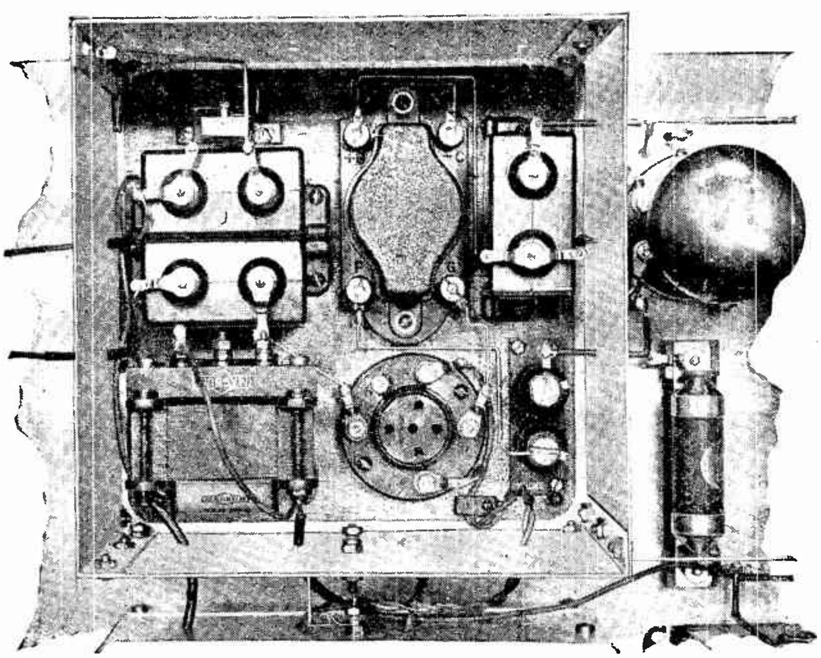
Screened interstage coupling following the first H.F. valve. Assembly and winding details are clearly shown.

The Foreign Listener's 'Four.'—to be told here how to combine the three dials on to a single panel. In this connection two obvious modifications suggest themselves. First, a re-arrangement of the components whereby the detector valve and L.F. unit are placed behind the second H.F. stage, and the eliminator unit behind the first screening box. By this means a clean symmetrical panel layout of modest dimensions is produced. Ganging is the other modification, and although the writer prefers the unganged set, the linking of the two H.F. stages is permissible, as already mentioned. To do this use the appropriate condensers with extended spindles and arrange the H.F. stages one behind the other. Brackets will be needed to support the rear condenser panel while, as well as slightly modifying the wiring layout, it will be necessary to elevate one of the coil platforms so as to clear the spindle linking the two condensers. It is better, perhaps, to undertake this modification only after having followed out the working of the set with three dials.



The second screened unit. The condensers and resistances can be identified by reference to the practical wiring diagram.

Complete screening by means of spaced boxes ensures freedom from oscillation. Thus eddy currents set up in the screens are not common to the successive circuits. These separate boxes provide a double barrier against weak stray fields while, moreover, the electrodes of the valves themselves are protected from coupling with their associated circuits. Practice has shown this separation of the valves to be desirable.



Detector valve and the output unit. Note the closely twisted pair of leads carrying A.C. to the filament.

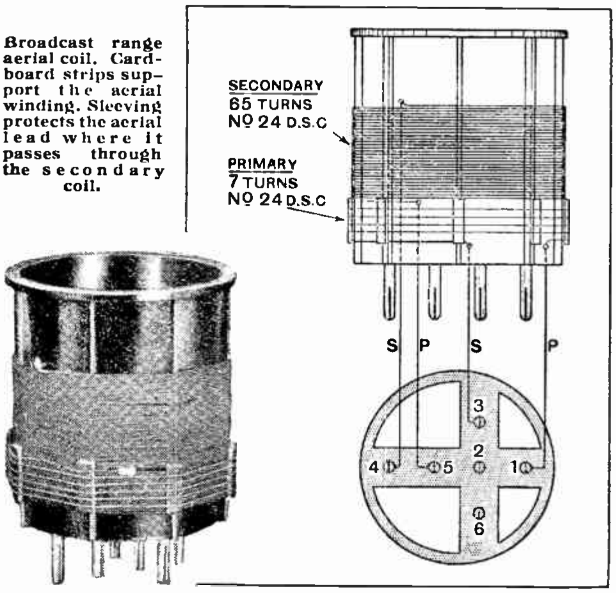
Practical Hints.

To give instructions as to the building of a set which merely comprises a baseboard assembly is, perhaps, scarcely worth while, but details of the procedure adopted by the writer may be helpful to follow. Clean down with fine glasspaper a good piece of planed board or plywood to serve as the base. If it is inclined to bend stiffen it with suitable battens. Taking dimensions from the plan view, the three A.C. valve holders may be located on the base and straightaway wired for A.C. supply, using twisted twin flex so as to minimise the A.C. field. Although it is better to use soldering tags the leads may, as an alternative, be well held down under screws, bearing in mind that a heavy current is to be passed and the fault caused by a high resistance contact will take a lot of finding. This pair of A.C. feed wires can be identified where they pass through the screen in

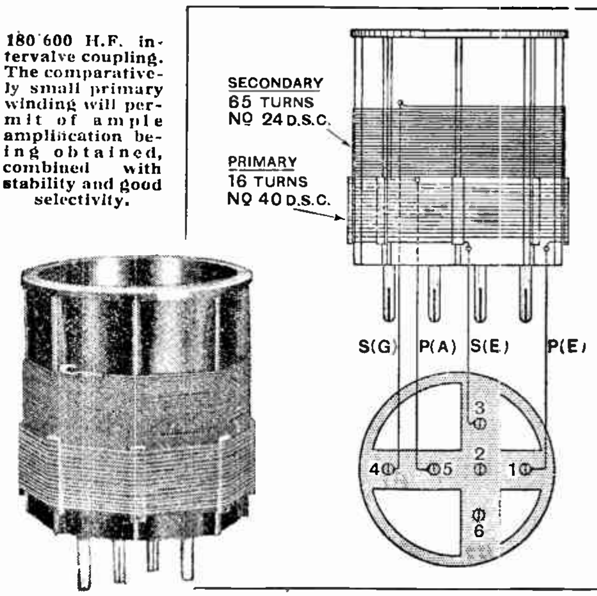
The Foreign Listener's 'Four.'—
the illustration showing the eliminator unit. Next in assembly, one should put down all other baseboard apparatus including the aerial tuning condenser.

Quite a lot of the wiring can now be carried out before driven through into the edge of the baseboard. Between the panel and the box a thin piece of cardboard is clamped so that the box will pull up securely to the panel in spite of the turnover of the aluminium at the bottom of the box and at the lid.

Broadcast range aerial coil. Cardboard strips support the aerial winding. Sleeving protects the aerial lead where it passes through the secondary coil.



180/600 H.F. intervalve coupling. The comparatively small primary winding will permit of ample amplification being obtained, combined with stability and good selectivity.

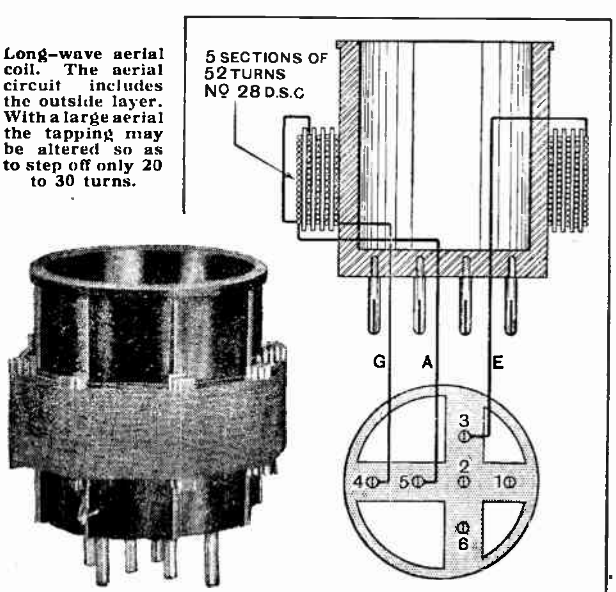


any of the boxes are brought into position. Condensers and dials are fitted up in accordance with manufacturers' instructions and, if difficulties are to be avoided, one is cautioned when using the particular components specified to procure dials that will suit the condensers as mentioned in the list of parts. These particular dials are chosen for their convenience of operation. Note that the insulating panels overhang the lower edge of the screening box so that two or three screws can be

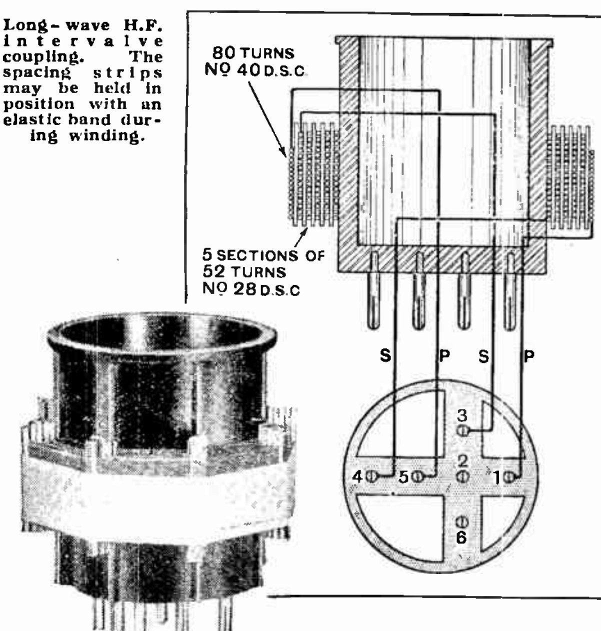
It is the work of only a few minutes to attach the H.F. components to their respective baseboards procuring various round-headed brass screws for the purpose. A few leads can be run before dropping in the baseboards, but it is equally easy to solder them in position after screws have been passed through the bases and the boxes secured.

It will be appreciated that components have been

Long-wave aerial coil. The aerial circuit includes the outside layer. With a large aerial the tapping may be altered so as to step off only 20 to 30 turns.



Long-wave H.F. intervalve coupling. The spacing strips may be held in position with an elastic band during winding.



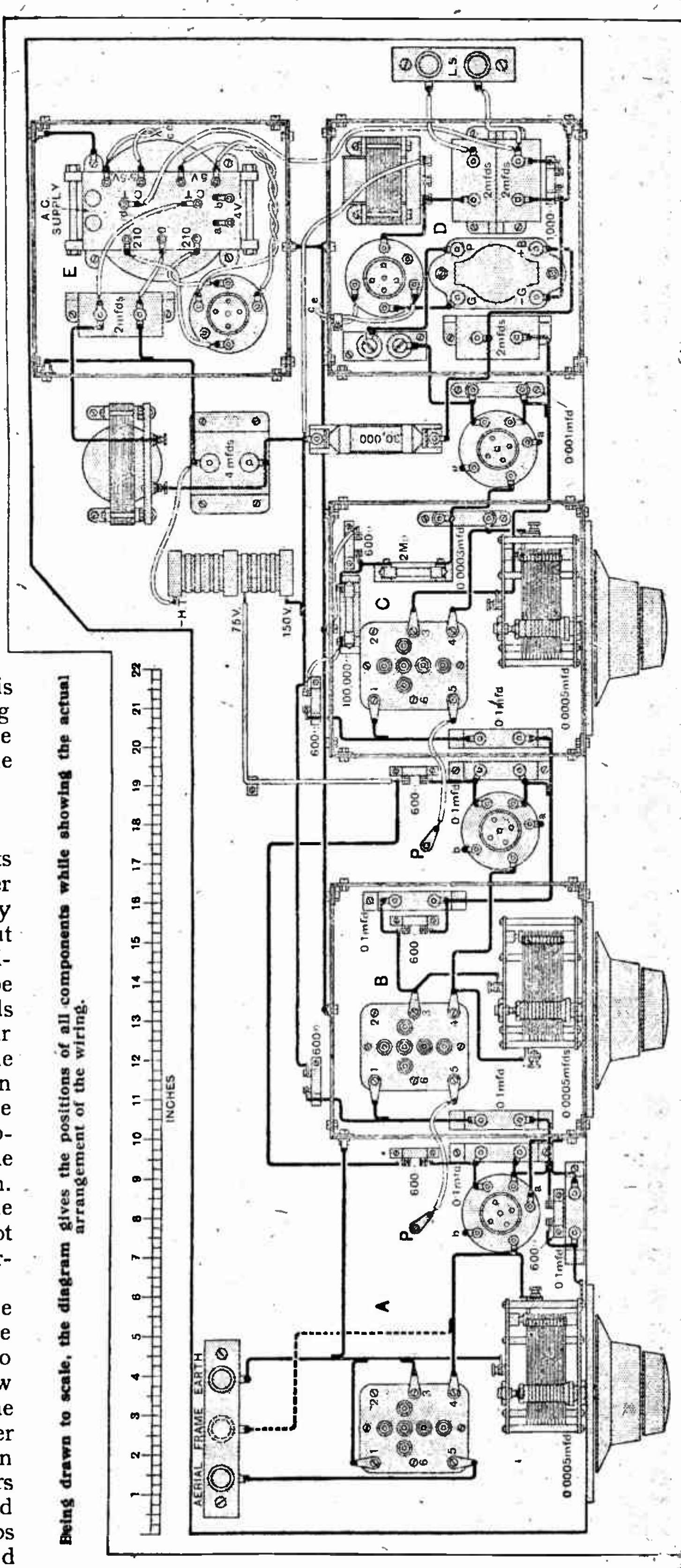
The Foreign Listener's 'Four.'—

selected which are all fitted with screw terminals so that, should one wish it, soldering can be almost entirely avoided. Short wires may be run anyhow between the points to be connected, and providing they do not stray too much the performance of this H.F. amplifier will remain unimpaired. Soldered stiff wiring and connecting tags, together with the use of sleeving wherever wires are near together or are required to pass through the screens, make an instrument in which the finding of faults is an easy matter. A flexible lead is brought out from each anode winding for the plate connection of the screened valves. It is advisable to additionally protect these leads with sleeving where they pass out through the screens. Much of the wiring in the L.F. stage can be completed before placing the baseboard into the box. Terminals are available on all components so that here, again, soldering can, if desired, be avoided. Use a twisted flex pair to carry the A.C. filament current of the output valve. Unlike the H.F. stages which pick up H.T.— through the condenser fixings a wire must be run in the case of the L.F. stage from the 1,000 ohm biasing resistance to the box, as can be seen in the illustration of this unit. No observations are necessary concerning the termination of the various wires on to the transformer in the eliminator unit other than the advisability of twisting all A.C. carrying pairs.

Heater Circuits Earthed.

It will be noted that an earthing wire connects the A.C. heater circuit on the first valve holder to the nearest point on the screening box. By so doing the last traces of hum are removed, but in carrying this out it is desirable that the particular "side" of the A.C. shown should be earthed, while the corresponding heater terminals of the other two A.C. holders should be of similar polarity. A lead is shown earth-connecting the frame of the transformer, an optional precaution that, fortunately, makes no difference. In the practical wiring diagram the actual point of tapping the potentiometer is shown, although one might test for the position of best signal strength. Check and recheck the wiring before testing the set. It is so easy to omit a lead which, while not preventing the set from functioning, may considerably affect its behaviour.

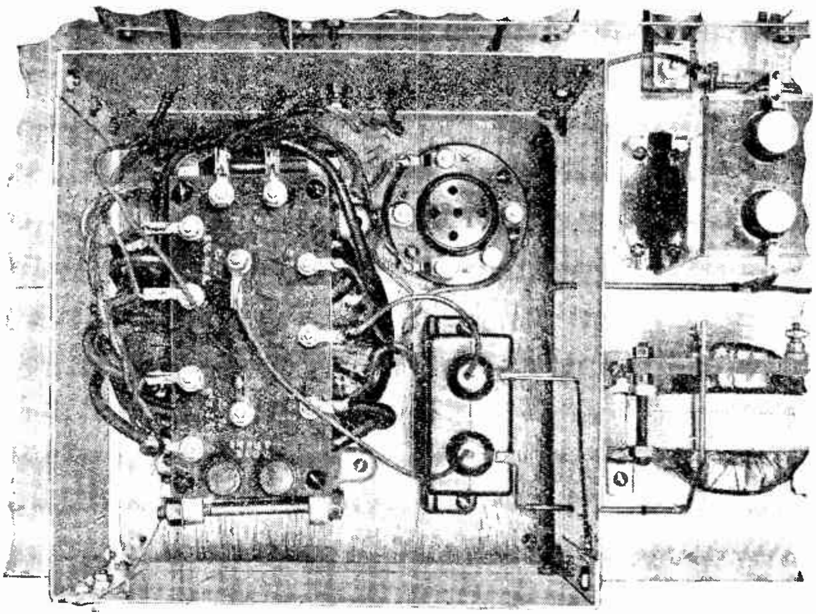
Drawings and illustrations are given showing the construction of the coils. In every case the outside primary windings are in the opposite direction to the secondaries. By this it is meant that the low potential ends, which are, in every case, at the base, spiral off in opposite directions or, in other words, if the low potential ends were joined an inductive two-layer winding would result. Spacers are made from cardboard which has been soaked in shellac varnish and, when dry, cut into strips with a sharp knife. Coils for the broadcast band



Being drawn to scale, the diagram gives the positions of all components while showing the actual arrangement of the wiring.

The Foreign Listener's 'Four.'—

are easy to wind, and for a single wave range set there is no objection to the use of shellacked cardboard formers $2\frac{1}{4}$in. in diameter and 2in. in length. Secondary windings should be elevated just clear of the surface of the former by a circle of cardboard strips. Where the top end of a primary passes through a gap forced in the secondary a piece of sleeving should be used to provide separation. When winding the long wave coils start each layer from the lower end by passing the wire across the turns.



The rectifier unit. Flexible leads are brought through the screen, adjusted to length and terminated on the transformer.

Although the windings given are intended to be definite, it is quite a simple matter to exceed the number of turns stated in respect of the primaries, taking off only just sufficient to give the desired selectivity. This is mentioned as it is obvious that conditions will vary with aerial dimensions and proximity to an interfering station. One cannot expect to adopt anything like the calculated number of primary turns for maximum amplification. A primary winding which will give stability with a single stage, neglecting for the moment aerial and detector damping, will need to be appreciably reduced when applied to a two-stage amplifier. Incidentally, it is the need for selectivity which brings down the primary windings far below the limits fixed for avoiding oscillation.

Use an elevated aerial with the set. It is better to adopt an efficient aerial with a small aerial winding than an improvised indoor one, although the latter will give good results. Tuning on the dials is not critical in that any one dial may be detuned by, perhaps, ten degrees without cutting out the station. If, however, two dials are turned one degree a loud distant station will disappear. Should either oscillation or loud A.C. hum be encountered, look for a wiring fault. When A.C. ripple becomes apparent on tuning in a station, and has the effect rather of modulating the carrier, it is safe to assume a faulty H.F. valve. Do not remove valves while the current is on as those valves remaining on the circuit may be injured by a rise in voltage. Although quite normal potentials exist in the set, one is recommended to always turn off the current before examining the circuit or, better still, before removing the lids. Volume control may be added if required by introducing a variable 30,000 ohm shunt across the primary of the L.F. transformer. Detuning is, however, satisfactory as a means of controlling strong signals. It is well worth recording for future reference station settings as they are obtained, many of the transmissions being easily identified by reference to wavelength programme data.

TRANSMITTERS' NOTES.

The Short-Wave Era.

Our readers may remember that in our issue of February 8th, 1928, we published a fairly comprehensive list of stations regularly transmitting on wavelengths below 100 metres. This list, compiled from information laboriously collected from several different sources, was copied in a number of foreign journals (sometimes with and sometimes without acknowledgment to *The Wireless World*), a fact that certainly gratified us as proving that our efforts were appreciated. Among the good resolutions made with the New Year one of the first was to revise and bring this list up to date, anticipating that it could probably be condensed within three or four pages of our journal. We deemed it advisable, however, to wait until call-signs and wavelengths had been adjusted to conform with the Washington Convention, and, if possible, until the new "Berne List" had been issued, in order that the list might be as accurate as we could make it under the circumstances. The publication of the first part of the new "Berne List" and its supplements has, however, upset our estimate of the number of short-wave stations, for we find that out of over 2,800 commercial and Government land stations of which particulars are given, no fewer than 900 have short-wave transmitters, and many of these work on a number of different wavelengths—in some cases twenty or more. These do not include the stations performing special services, such as time-signals, weather reports and press messages, or broadcasting stations, of which the lists have not yet been issued by the International Telegraphic Bureau. It is obvious, therefore, that it is impracticable to publish a list that will be in any way comprehensive, within the limitations of our available space, and a selection is, as we know from experience, always unsatisfactory. We can, therefore, only advise those who wish for a complete list to follow our own example, procure copies of the "Berne Lists" and a copious supply of red ink with which to underline all the short-wave stations.

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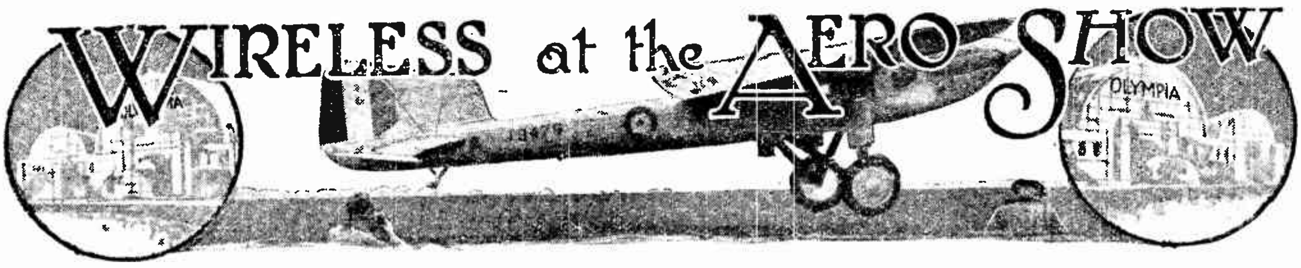
A Correction.

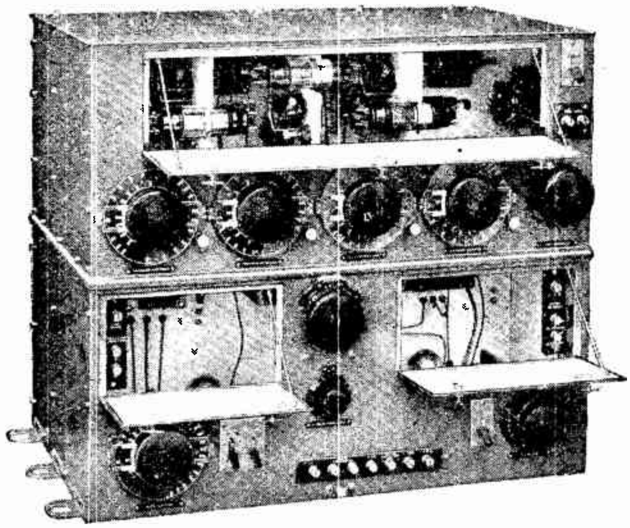
Mr. H. A. Bartlett (G5QA) asks us to say that the address of his station is "The Laurels," 95, Old Tiverton Road, Exeter, and not that given, in error, in our issue of July 24th.

WIRELESS at the AERO SHOW



Descriptions of New Radio Apparatus for Aircraft.

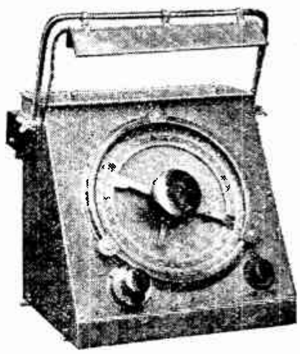
IT is just conceivable that broadcasting, more or less as we know it to-day, might be carried out through a wire network; the Electrophone provided an illustration of possibilities in this direction. Similarly, our needs in the matter of rapid international communication are fairly well served by landlines and submarine cables without any supplementary radio channels. But those who travel by sea or air can exchange information between themselves or with those on land in no other manner than by the wireless link; consequently, we find that the first important field of usefulness for radio telegraphy was in the navies and mercantile marines of the world. As soon as flying reached a state of development where it became possible to do something more than merely get into the air, experiments were made in transmission and reception; now an installation either for telephony or telegraphy is regarded as desirable—in many cases essential—for the majority of Service and civil aircraft.



Three tuned H.F. stages with "10 per cent. ganging"; a Marconi direction-finder for ground stations.

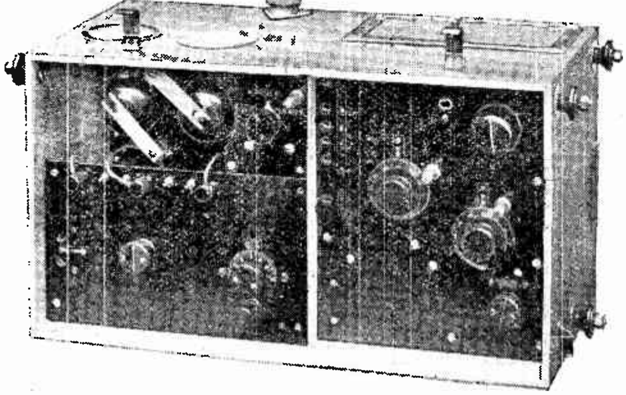
Any possible reduction in weight and bulk is still of vital importance, and so we find that great ingenuity has been shown in the design of sets of almost incredible lightness and compactness. Stern economic pressure is partly responsible for this; the saving of each pound weight may well increase the earning capacity of a commercial aeroplane by a matter of shillings per trip. In this respect, designers of portable broadcast receivers might well have learnt some valuable lessons from an examination of some of the wireless apparatus shown at the recent Aero Exhibition at Olympia.

One of the most interesting and novel exhibits was the Marconi Type AD.22 telephony set for light aeroplanes. It is primarily intended for operation by the (wirelessly) unskilled owner-pilot, and is rated at 75 watts. It operates normally on wavelengths between 850 and 950 metres; in emergencies communication can be effected with shipping on 600 metres by throwing over a switch. The receiver is a fairly conventional arrangement of H.F. amplifier, reacting detector and one L.F. magnifier. Current is supplied by a combined H.T. and L.T. wind-driven generator, of which the output is sensibly unaffected by the air speed of the aeroplane; this is attained by an automatic governor controlling the windmill blade pitch. The set has a range of between 50 and 100 miles when working with a typical ground station, and weighs no more than some 60 lb. complete.



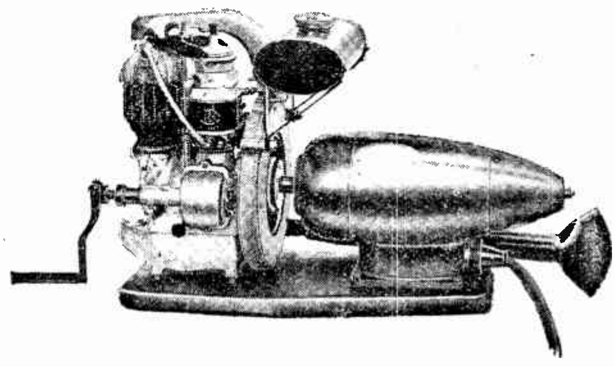
Marconi D.F. goniometer.

Short waves were used in early transmissions from aircraft, and it seems likely that increasing congestion on the 900-metre wavelength normally used for commer-



This Marconi "Light Aeroplane" transmitter and receiver weighs, with its generator, little more than the average transportable broadcast receiver.

Wireless at the Aero Show.—
cial communication will be responsible for greater use of these high frequencies. They already have to carry a certain amount of naval and military aircraft traffic, and it is primarily for Service use that the Marconi

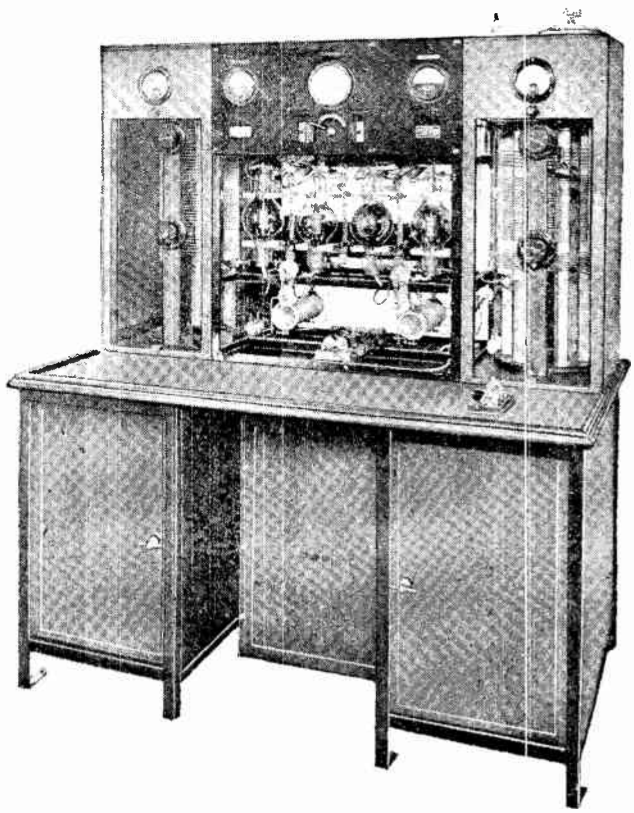


A lightweight petrol engine generating set for emergency use.

Type A.D.19 transmitter has been designed. This set operates on wavelengths between 40 and 60 metres, and functions either with a trailing or fixed aerial. Incidentally, one notices that the former kind of aerial is still widely used, although some of the large flying boats are fitted with a ship-type aerial stretched between a short mast above the leading edges of the main planes and the tail fin, so that communication may be maintained while on the water. For short-wave work the fixed aerial is to be preferred, although the transmitter in question is fitted with a drive oscillator for maintaining constant frequency. The power rating is 150 watts, and transmissions can be effected on telephony or C.W. telegraphy. In addition, a disc is fitted to the armature shaft so that interrupted continuous wave signals may be emitted. As in the case of the "light plane" set, anode and filament-heating current is supplied by a wind-driven generator.

The companion receiver (Type A.D.20) is an H.F. det. – L.F. three-valve combination. There is but one tuning control—that of the coupling circuit, the input from the aerial being aperiodic.

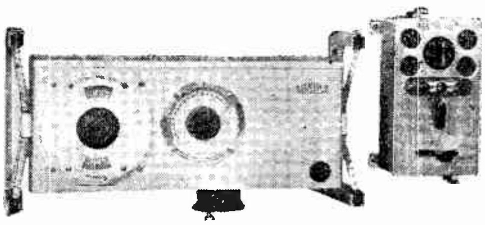
Space does not permit of a description of the many other Marconi aircraft sets, which are produced in types designed for almost all possible requirements. A ground station direction finder (Type D.F.M.4) was interesting, if only for the neat layout of its three tuned H.F. stages. Each grid and plate circuit is completely screened in separate compartments of the heavy metal case, while the feature of "ten per cent. ganging" is included. As most readers are aware, this arrangement has been included in several of the firm's receivers that have been described in these pages; individual tuning condensers are first set to a marked calibration nearest

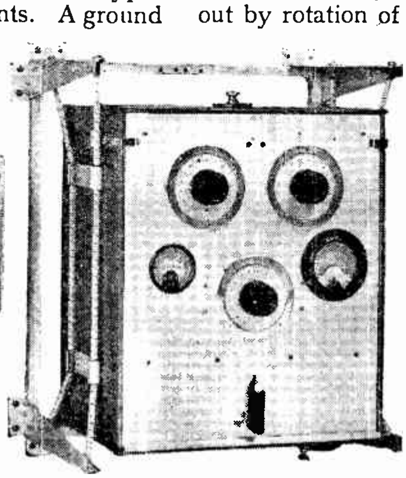


A Marconi Radio Beacon for automatically transmitting signals enabling aircraft or ships fitted with D.F. apparatus to find their bearings.

to the wavelength of the station whose signals it is desired to receive, after which searching may be carried out by rotation of a single knob which tunes all circuits simultaneously. The screen-grid high-frequency valves (Marconi S.625) are mounted horizontally, and project through the vertical partitions.

Another product likely to interest the organisers of long flights over water is the emergency power plant. While all goes well, the ordinary windmill generator is perfectly adequate, but in the event of a forced descent it becomes useless—at a time when the ability to use the wireless installation is particularly vital. For emergencies of this kind, a small 1 h.p. two-stroke petrol motor has been de-





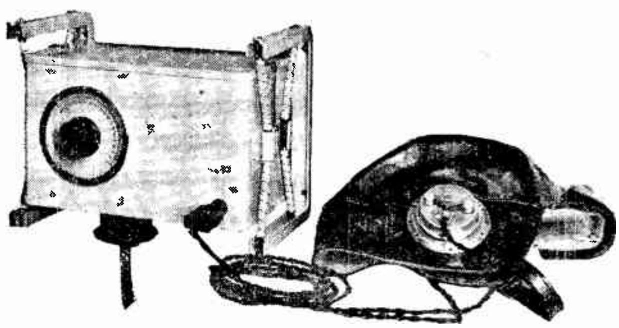
Graham - Amplion aircraft equipment—receiver and direction-finder, control box and transmitter.

Wireless at the Aero Show.—
signed; it is air-cooled, and, with a bed-plate to accommodate it and a generator, weighs about 30 lb.

It was noticed with interest that the well-known firm of Graham-Amplion, Ltd., in conjunction with its parent company, have entered the aircraft wireless field, and have produced a range of apparatus of unusual design. The most ambitious outfit shown is an air port equipment of which the nucleus is a ½ k.W. transmitter for telephony, telegraphy, and I.C.W. Receivers for normal or medium wavelengths are supplied, together with direction-finding equipment and extra amplifiers. A unit system is employed, and so any desired combination can readily be assembled.

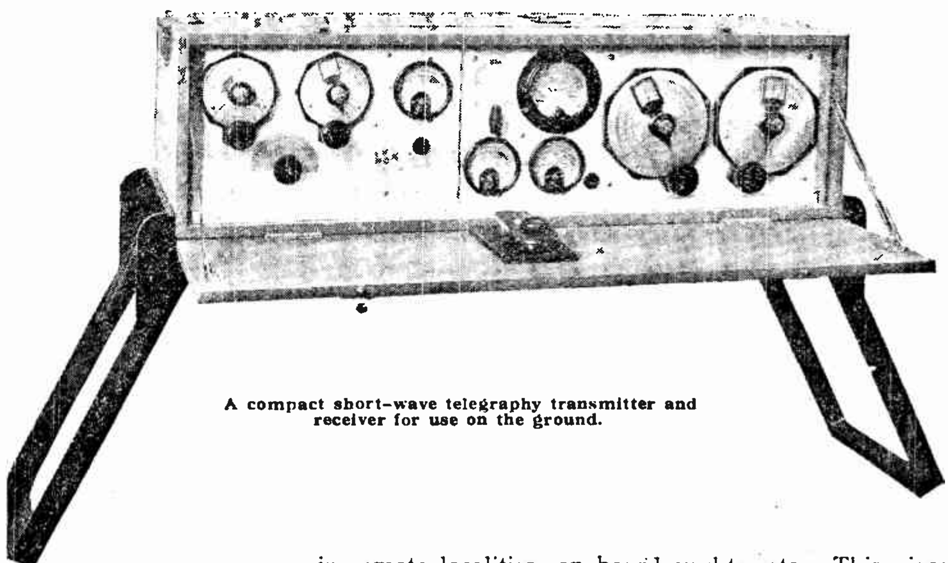
The Amplion aircraft set, type G.A.1, comprises a transmitter, control box, and receiver with direction finder. There are, of course, the usual accessories, such as generator and aerial reel, etc. The main units are suspended in a skeleton frame by means of heavy rubber cords which act as shock absorbers. A similar outfit, Type G.A.2, is of the same appearance, but does not include direction-finding apparatus, the space in the left-hand side of the receiver case being used to house an oscillator (for C.W. reception).

Most of the Amplion receivers are of similar design, and comprise two aperiodic H.F. stages, the transformers of which are designed to peak at 900 metres. Screen-grid valves are used, and space is saved by mounting the coupling device directly on the anode terminals in the manner shown in an accompanying illustration. Spring clips mounted inside screening tubes, which are secured to the underside of the lid, are arranged to grip the bulb of the valve, and thus to avoid risk of damage. At the same time adequate interstage screening is provided by this method of construction.



An Amplion four-valve receiver for the owner-pilot, weighing only 3½ lbs.

Although not intended for use in aircraft or, indeed, for communication with them, the Amplion "short-wave intercommunication" set is worthy of mention. It was designed originally for ground work by aerial survey expeditions, but is equally applicable for use in remote localities, on board yachts, etc. This piece of apparatus comprises a short wave telegraphy transmitter and receiver mounted in a compact case with folding metal legs. It derives all its energy from a generator run from a 12-volt alkali accumulator battery, which, in cases where no other source of electrical power is available, may be charged by means of a dynamo operated by man-power through pedals and gearing.



A compact short-wave telegraphy transmitter and receiver for use on the ground.

Announcements to the public in the hall at Olympia were made through a battery of Amplion loud speakers—including two of a new pattern. This instrument embodies a long coiled logarithmic horn, housed in a wooden box, and actuated by a moving coil drive unit. The combined effect of these loud speakers, in conjunction with two of the "Lion" type, struck the writer as being exceptionally good.

Economical of weight and space: Amplion method of mounting "aperiodic" H.F. transformer on the anode terminal of an S.G. valve.

A full range of electrical measuring instruments was shown by Ernest Turner, of High Wycombe. Practically all the requirements of the wireless user are catered for by the products of this firm. In particular it was noted that small panel-mounting milliameters with several ranges intermediate between 0-0.5 milliamp and 0-2.5 milliamps are standard productions. These should be of interest to those who are adopting the practice of inserting a meter in the anode circuit of a bottom bend detector.

Events of the Week in Brief Review.

THE COMPLEAT CADET.

Instruction in Morse signalling and wireless forms part of the programme which is being carried out by the Public Secondary Schools Cadets now encamped on Marlborough Common.

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ANOTHER PARIS WIRELESS SHOW.

A wireless section is to be included in the *Concours Lépine*, or Small Inventors' and Manufacturers' Show, to be held in Paris at the Parc des Expositions, Porte de Versailles, from August 22nd to September 30th.

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GERMAN LICENCE DECLINE.

At the end of June the number of receiving licences current in Germany amounted to 2,826,628, showing a decrease of 11,266, as compared with the figure at the end of March.

The British licence "curve" has shown a temporary drop on three occasions, viz., October, 1924; July, 1925, and October, 1926.

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SPANIARDS MUST PAY.

Under a new decree, Spanish listeners must now pay a quarterly tax on their receivers. The crystal user is treated very generously, his quarterly fee amounting to only one peseta (8d.), whereas valve owners must pay five pesetas.

Transmitters pay an *ad valorem* tax of five per cent.

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WIRELESS FOR ANTARCTIC EXPLORERS.

The barque *Discovery*, which left the Thames on August 1st for a new voyage of Antarctic exploration, is equipped with Marconi wireless apparatus that should enable it to maintain constant communication with the outside world. The expedition, which is under the leadership of Sir Douglas Mawson, the famous Australian explorer, has been specially equipped for scientific and survey work in the Antarctic to the south of Australia.

In addition to a Marconi 1½ kilowatt quenched spark transmitter and a ship's receiver, a Marconi short-wave telegraph transmitter is to be used for communication with Australia and Great Britain from the heart of the Antarctic. In conjunction with this transmitter a new Marconi short-wave receiver is fitted.

A wireless direction finder also forms part of the navigational equipment, while the Moth aeroplane to be carried by the expedition is also being equipped with Marconi apparatus. The aeroplane is to be used for scouting purposes within a range of 100 miles of the *Discovery*, and it is being fitted with the new Marconi transmitting and receiving set for light aeroplanes, recently described in these columns.

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HOLLAND'S OUTPUT OF RADIO GEAR.

According to the *Algemeen Handelsblad* the total export from Holland of wireless goods during 1928 has been exceeded by about nine million florins during the first five months of 1929.

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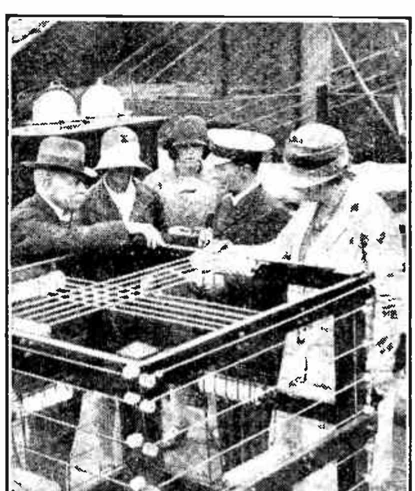
TONIC TALKS FOR THE TRADE.

If Dr. Julius Klein, U.S. Assistant Secretary of Commerce, is correct in his estimate, the wireless business has a glorious future. On the basis of five listeners to every set, Dr. Klein sees a potential world market for 200,000,000 radio receivers. A recent survey by the Department of Commerce showed that there are about twenty million sets already in use, two-thirds of this number being in the United States.

Lest the radio trade should grow despondent at the prospect of reaching saturation point, it should be noted that Dr. Klein has not allowed for wear and tear of existing sets.



D.F. ON "DISCOVERY." The wireless operator on Sir Douglas Mawson's Antarctic exploration ship in the East India Dock explains the functions of the frame aerial.

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JAMAICA TO BROADCAST.

Proposals for the establishment of a broadcasting station are announced by the Government of Jamaica. It is prescribed that the company to which the concession will be given must be incorporated in the colony.

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I.B.C. ATTACKS INDIAN PRESS.

The Indian Broadcasting Company celebrated its second birthday on July 23rd. In a leading article in the *Indian Radio Times*, the company deplores the indifference to broadcasting shown by the Indian newspapers, which are stated to have ignored the "pirate" problem—the main obstacle to the success of Indian broadcasting—by withholding reports of questions in the Legislative Assembly and Government replies thereto on the subject of illicit listening and the steps to be taken to enforce the law. The company calls for "a real live increase in the number of licences."

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ONE OF THE FLOURISHING TRADES.

In his report for 1928, just published, Sir Gerald Bellhouse, Chief Inspector of Factories, states that whereas business was bad in such industries as cotton, iron and steel, and shipbuilding, there was a decided briskness in electrical equipment, wireless, and gramophones. The flourishing trades were well represented in the south.

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PROGRAMMES FROM CHINA SOON?

By January, 1930, China is expected to enter the field of international wireless with the opening of two short-wave stations for communication with the United States. During a recent visit to the headquarters of the American National Broadcasting Co., Dr. Cha Tsao, a member of the radio mission of the Chinese Reconstruction Council, stated that a national system of broadcasting was also being contemplated and that it would probably follow the American system, revenue being obtained from advertisements.

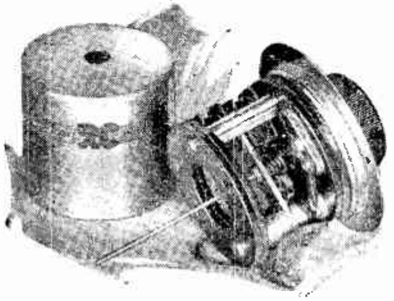
Nearly one hundred young men in China are studying to become radio engineers, and on them will fall the responsibility of establishing China's broadcasting chain.

NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

"R.C." CONE LOUD SPEAKER UNIT.

This unit consists of two permanent magnets and two laminated pole pieces carrying the coils. The vibrating reed is mounted centrally between the pole pieces and is fixed rigidly at one end. Attached to the mid-point of the reed is a strong helical spring, the tension of which is controlled by a large adjusting screw. This enables the air-gap between the reed and the pole pieces to be fixed to suit conditions. The spindle carrying the cone is mounted at right angles to the reed and protrudes approximately 2in. beyond the metal case which encloses the unit.



"R.C." cone loud speaker unit with cover removed.

These movements are supplied by the Ridged Cone Co., Ltd., York House, Theobalds Road, London, W.C., and the price is 13s. 6d.

oooo

WATMEL FIXED CONDENSERS.

Tin foil is used for the plates and mica forms the dielectric in the Watmel fixed condensers. These are enclosed in a neat moulding with the terminals on top. In certain cases clips are provided for a grid leak, but, since separate terminals are fitted, the connections necessary for the particular requirements of the circuit, in which they are used, can be made externally. The combined leak and condenser is compact and takes up very little baseboard space.

Some samples sent in for test were measured and the capacities were found to be within 10 per cent. of the marked values.

Rated Capacity.	Measured Capacity.	Percentage Error.
0.0001 mfd.	0.00009 mfd.	−10%
0.002 „	0.0022 „	+10%

Watmel fixed condensers. Capacities up to 0.0009 mfd. are fitted with grid leak clips.

The makers are the Watmel Wireless Co., Ltd., Imperial Works, High Street, Edgware, Middlesex, and the prices have been fixed as follows: 0.00004 mfd. to 0.0009 mfd., fitted with grid leak clips, 1s. 6d. each; 0.001 mfd. to 0.004 mfd., without clips, 1s. 9d. each; and other values up to 0.01 mfd., 2s. 6d. each. Grid leaks cost 1s. each for values from 0.25 to 5 megohms.

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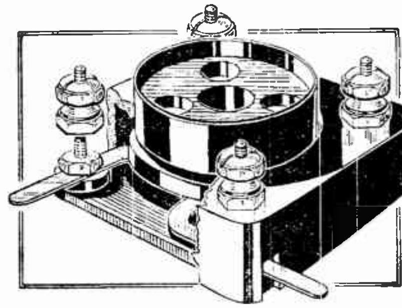
"FORMO" VALVE HOLDER.

The "Formo" anti-microphonic valve holder is compact, neat, and inexpensive; it costs 1s. 3d. only. Soldering tags as well as terminals are provided, but its main feature of interest is, perhaps, the sunk metal sockets. These are ⅛in. below the top of the bakelite centre, and it is impossible to make contact with the pins on the valve unless they are correctly aligned with the sockets. Danger of burning out the valve due to mal-alignment is non-existent.



Formo valve holder. The spring and soldering lug are in one piece.

Stout phosphor-bronze springs are riveted to the brass insets, and these form also the soldering tags. The terminals pass through holes in these lugs, and are held in contact by means of small nuts inside the shell. When connecting wires to the terminals, care should be taken in tightening the hexagonal terminals, since excessive force may loosen the screw and lead to the inside nut becoming loose and thereby leading to an intermittent contact. Apart from this small matter, the general design is sound, and the valve holder can be confidently recommended.

The makers are the Formo Co. (Arthur Preen and Co., Ltd.), Crown Works, Cricklewood Lane, London, N.W.2.

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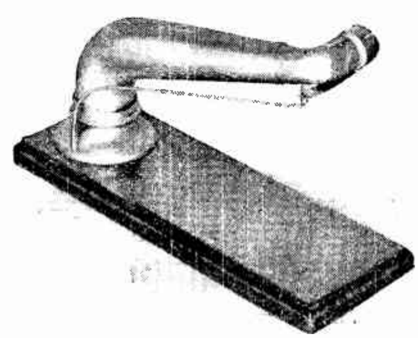
"D.X." AUTO-TRACK TONE ARM.

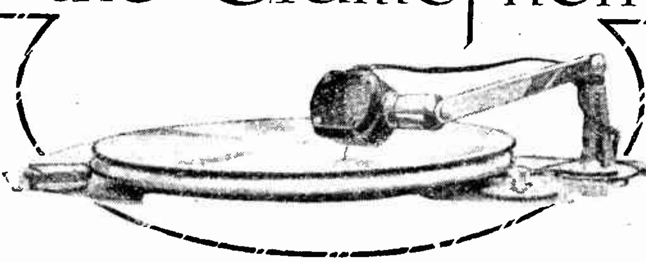
The new "D.X." tone arm, which is particularly suitable also as a pick-up carrier, has been designed to ensure that the needle maintains correct alignment with the grooves in the record during the whole of its travel. The pick-up holder is pivoted to the arm and its angle, with relation to the arm, controlled by a lever attached to a radial spring, which can be seen in the illustration.



New "D.X." tone arm showing self-aligning device to reduce wear on the record.

The movement of the needle is thus more in the nature of a radius than an arc, and it is claimed that this feature reduces record wear and prolongs the life of the discs. This useful accessory is supplied by Messrs. D.X. Coils, Ltd., 542, Kingsland Road, London, E.8, and the price has been fixed at 10s. 6d.

Mounting the Gramophone Pickup



Simple Instructions for Obtaining Correct Alignment.

NOW that a large number of sets are adapted for the electrical reproduction of gramophone records in addition to their regular duties, there is a growing interest in the design of pick-ups and their mountings. In particular, attention has recently been drawn to the question of accurate tracking of the needle with respect to the record and to the fallacy that the ideal position of the tone arm is such that the needle passes over a point at the centre of the turntable. The writer recently tackled the problem from a mathematical point of view, and the following results were arrived at:—

1. If an ordinary tone arm is correctly placed and the pick-up is properly adjusted thereon, the tracking can be made to approach very nearly to the ideal without the inclusion of special devices for ensuring a straight-line motion or its equivalent.

2. The track of the needle should not pass through the centre of the turntable.

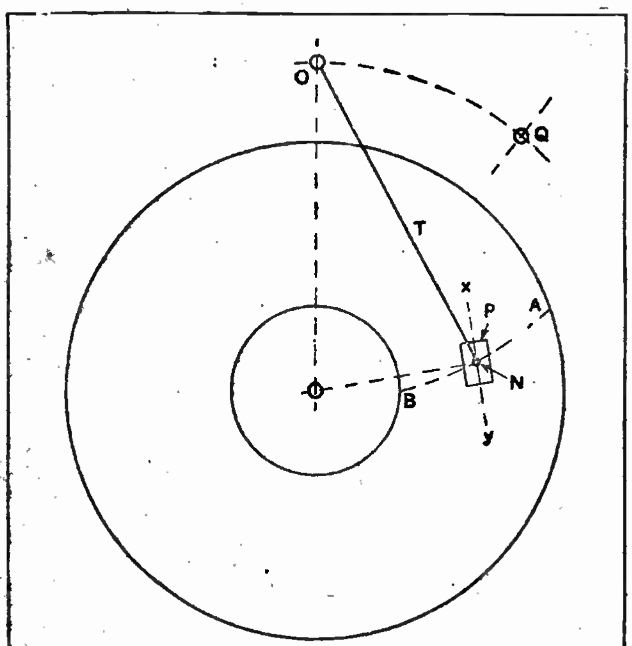


Fig. 1.—The relative disposition of the tone arm T, the pick-up P, and the needle N, can be easily seen in this diagram.

3. A simple formula for calculating the best position for a tone arm of any length may be evolved.

It is well known that to obtain the best reproduction, coupled with minimum wear on the record, the needle should lie in a plane tangential to the record groove at the point of contact and should be free to move at right angles to the groove. Thus, in Fig. 1, if N is the needle of a pick-up P resting in the position shown, and the needle is free to move across the record, the movement is at right angles to the tangent *xy* at the point of contact.

The Variables Concerned.

Clearly, if the needle is mounted on an ordinary tone arm T, moving, say, about a centre O, the needle must move along a curve AB, and cannot be correctly placed with regard to the record at all points in its travel. With an incorrectly placed tone arm the error may be considerable. Our problem, then, is to find the position of the tone arm which gives the minimum error.

The variables concerned are:—

(*a*) The length of the tone arm.

(*b*) The distance of the pivot from the centre of the turntable.

(*c*) The angle which the pick-up makes with the tone arm.

(*d*) The dimensions of the record itself.

It should be noted that the disposition of the tone arm in relation to the gramophone itself is immaterial. Thus, in Fig. 1, it does not matter whether the arm is pivoted at the point O at the centre back of the cabinet, or at a point Q at the back right-hand corner, so long as the distance from the pivot to the centre of the turntable remains the same. It is sufficient, therefore, to arrive at the ideal value for this distance, and then to fix the tone arm accordingly in any part of the cabinet that is convenient.

Fig. 2 illustrates the method of arriving at the correct position for the tone arm pivot. The arm *c*, of length BA, is pivoted at B, and in playing the record the needle moves from a point A at the outside of the playing area to a point A_1 at the inside. The actual shape of the arm does not concern us and for our present purpose the most elaborately shaped arm could be replaced by a straight rigid rod extending from the pivot to the needle.

For perfect tracking, the line of the pick-up (that is,

Mounting the Gramophone Pick-up.—
the plane of the needle) must always be tangential to the groove, or, what is the same thing, at right angles to the radius b drawn from the centre C of the turntable to the point of contact A. Since the angle between the arm and the pick-up is fixed, this condition can be maintained only if the angle between the arm and the radius is constant. Unfortunately, this angle must vary as the needle passes from position A to position A_1. It is possible, however, to arrange that the angle, and therefore the tracking error, is equal at the inside and outside of the playing area. The error can then be spread over the entire path of the needle so that it is never more than a small amount.

Calculating Tone Arm Length.

The formula by which we may readily determine the correct distance from the tone arm pivot to the turntable centre is $a = \sqrt{c^2 - 12}$*, where a is the distance from the pivot B to the centre C, and c is length of the tone arm. To find the required distance, therefore, we must square the length of the tone arm from pivot to needle, subtract 12, and find the square root of the result.

This distance having been found, it still remains to fix the pick-up at the correct angle to the tone arm. If we decided to fix the angle so that there was no error at the inside and outside, we could calculate the value of cos A from the triangle formula. Reference to trigonometrical tables would then give the value of the angle A, and it is obvious from the diagram that the angle between the pick-up and tone arm is equal to $90^\circ - A$. But if this were done, the error at a point midway between the inside and outside would be greater than it need be. A better method is to fix the angle so that there is no error at a point, say, one inch from the outside, that is, at a distance of 5in. from the centre. There will then be an error in one direction at the outside, falling to zero when the needle has moved an inch towards the centre, then rising to an approximately similar error in the opposite direction, falling to zero again and finally rising to an error equal to that at starting as the needle reaches the end of the track.

The value of cos A for a radius of 5in. can be found at once by substituting that value for b in the triangle formula, all the other values now being known. The angle can then be found from the tables and subtracted from 90° to find the angle at which to place the pick-up.

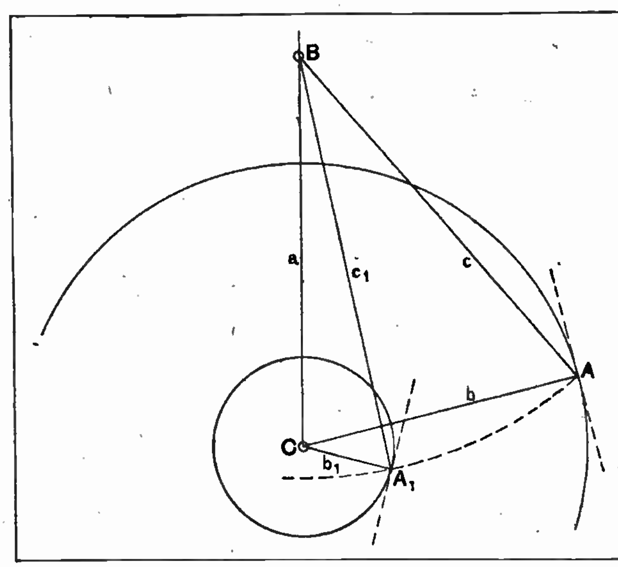


Fig. 2.—Method of finding correct position for tone arm pivot.

As a matter of fact, it is an easy matter in practice to adjust the pick-up by eye so that the plane of the needle is tangential to the track at a radius of 5in. In all cases the angle is appreciable, and it is absolutely essential that the arm should be provided with means for its adjustment.

If the above principles are followed, it will be found that for a tone arm of ordinary length the maximum departure from tangential tracking can be kept below 2°. This is much less than can be attained by rule-of-thumb methods, and is quite low enough to ensure good reproduction and long record life.

In brief, and by way of summary, one should first determine the distance BC, Fig. 2. To do this, square the length of the tone arm as measured between pivot and needle, subtract 12, and take the square root of the result. Making use of the distance thus found move the position of B until the needle points in the direction of a tangent to the groove when at a point about 5in. from the centre spindle. Should the pick-up possess the desirable feature of permitting of adjustment on the end of the arm, then the precise location of B is immaterial so long as the distance BC is maintained, and in these circumstances the pick-up will need to be swivelled to the tangential position when the needle is 5in. from the centre.

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* If, in addition to the lettering already adopted, we denote the angle between the arm and the radius by A, and the distance from the pivot B to the centre C of the turntable by a, then, according to the usual formula for the solution of triangles,

$$a^2 = b^2 + c^2 - 2bc \cdot \cos A$$

$$\therefore \quad \cos A = \frac{b^2 + c^2 - a^2}{2bc}$$

The inside radius of a twelve-inch record may be taken as 2 inches and the outside radius as 6 inches. Therefore, for the outside,

$$\cos A = \frac{6^2 + c^2 - a^2}{2 \times 6c} = \frac{36 + c^2 - a^2}{12c}$$

and for the inside,

$$\cos A = \frac{2^2 + c^2 - a^2}{2 \times 2c} = \frac{4 + c^2 - a^2}{4c}$$

But if the angle A is equal at the inside and outside, the above expressions must be equal:

$$\frac{36 + c^2 - a^2}{12c} = \frac{4 + c^2 - a^2}{4c}$$

Therefore
$$36 + c^2 - a^2 = 12 + 3c^2 - 3a^2$$
$$2a^2 = 2c^2 - 24$$
$$a = \sqrt{c^2 - 12}$$

If the formula is worked out in full, without assuming any particular size of record, it becomes

$$a = \sqrt{c^2 - r_1 r_2}$$

where r_1 and r_2 are the inside and outside radii respectively.

THERE ARE MORE THINGS IN AERIALS AND EARTHS

O Radio, Than are Dreamed Of in *Your* Philosophy.

By D'ORSAY BELL, M.A.

THE kind reception given to my first article, on various parts of the frequency spectrum, shows that the readers of *The Wireless World* are ready to take a keen interest in new work on lines akin to "Radio" proper, but not directly connected with it. Now, of the vast amount of research and invention going on these days over all the world quite an important fraction is of this kind, and the Editor has given me the pleasant job of keeping his large circle of readers informed, from time to time, of recent results in these fields.

Anything will be grist for my mill so long as it concerns wave-motion of some kind. It may be something of immediate, practical importance, or it may be—at first sight, anyhow—a purely high-brow contribution to the sum-total of our knowledge. I say "at first sight" because sometimes, before it knows where it is, one of these high-brow items of knowledge is seized upon and dragged protestingly into the most commercial developments—look at the Dewar cup and its metamorphosis into the "Thermos." But enough of introductions—there is so much to write about and time is so short. . . .

In my first article I mentioned that Lakhovsky had cured his begonias of an (ordinarily) fatal disease by surrounding them with an open spiral of wire, insulated from everything and—as he thought—picking up the cosmic rays and thus surrounding the sick plant with weak oscillations of a frequency of about 10^{22}. The curative effect of these open spirals has since then been tried on human beings: several doctors who have tested this treatment have reported good results. I think a sweet picture could be made of one of Tom Webster's bookmakers being cured of cigar-shaped fungoid growths, with his head peeping like a wistful flower above spiral-formed foliage. But I am afraid we cannot attribute the healing effect of these spirals to cosmic rays as was first thought; the idea now is that the spirals pick up all kinds of impulses from the air—broadcast messages, spark disturbances from motor-cars, and so on—and convert them into weak oscillations of the natural wavelength of the spirals themselves: varying from a third of a metre to two metres. This region of the frequency spectrum is quite fascinating.

"At first sight a purely high-brow contribution to the sum-total of knowledge."

The "Ultra-shorts."

Anything under 10 metres, among wireless waves, comes into this category. From a medical point of view the most interesting are the waves below 5 metres. Long before Lakhovsky and his spirals D'Arsonval had used these radiations for their medical effects, and recently a new development in "D'Arsonvalisation" (as it is called) has enabled certain drugs to be carried through the skin and body-wall to the particular organs which need them. Then we have Seidl, who has shown that milk can be sterilised by waves of length between 1.5 and 3 metres; and now comes the news that the distinguished German professor, Esau, has cured mice of tuberculosis by the application of 2-metre waves. On the other hand, an overdose will kill a mouse in a few seconds (and from America, by the way, come reports of severe headaches and feverishness produced in engineers by exposure to 5½-metre waves).

The "Ultra-violets."

Rays in the ultra-violet region are just as attractive—there seems to be some mysterious spell in the title "ultra . . ." These rays are turning out to be of enormous use in detecting counterfeit banknotes, forged documents, and false jewellery. There seems also to be scope for their use on a large scale for purifying the water of public baths. There are so many remarkable uses for them that it is hardly necessary to mention their employment for invigorating human beings, racehorses and racing greyhounds. Listen to this: For years the ardent silkworm breeder (on whom depends the whole of the real silk industry) has flinched at the word "grasserie," rather —I think—as the devout bee-keeper winces at the mention of the Isle of Wight. For it is the name of a fell disease which attacks his pets: it is so

There Are More Things . . .—
deadly that immediate diagnosis is tremendously important in order that the invalid may be removed before it can spread the infection. Until recently it was almost hopeless to try to detect it in time: it is practically impossible to feel a silkworm's pulse, and there are no other symptoms to go by. But now it has been found that a particular ray in the ultra-violet region (3650 Angstroms) reveals small yellow spots, faintly fluorescent, on the second day after infection. One cannot help wondering whether some such method of diagnosis might not be possible for human ailments. Is there not a chance that long before the rash appears in—say—measles some change has taken place beneath the skin which could be revealed by ultra-violet or some other radiation? How about it, O Medical Researchers?

The "Ultra-microscope."

Writing the words "medical researchers" in connection with "ultra" makes it almost inevitable for me to speak about the ultra-microscope, although this is just old enough to make me apologise to those of my readers who already know all about it. Its development was such a neat bit of work, and its utility is so great, that it would be a shame not to mention it. Improvement after improvement was made in microscope methods and apparatus till at last such enormous magnifications were reached that the workers found themselves up against a brick wall: all apparently rational steps to increase the magnification still further met with failure. Then it was realised that with the magnification aimed at the small details were so small that they were comparable in size with the waves of light by which they had to be viewed. Imagine yourself in a nightmare trying to rule a straight line with a pencil so huge that its point was nearly as large as your ruler—and you will appreciate the difficulty. So it seemed for a time as if the limit of magnification had been reached till an ingenious researcher thought of replacing the light rays by ultra-violet—so that the reasonable proportion of wavelength to size of detail was restored, and new possibilities in the way of magnification were opened up. A very pretty bit of work, I think.

The "Ultra-micrometer."

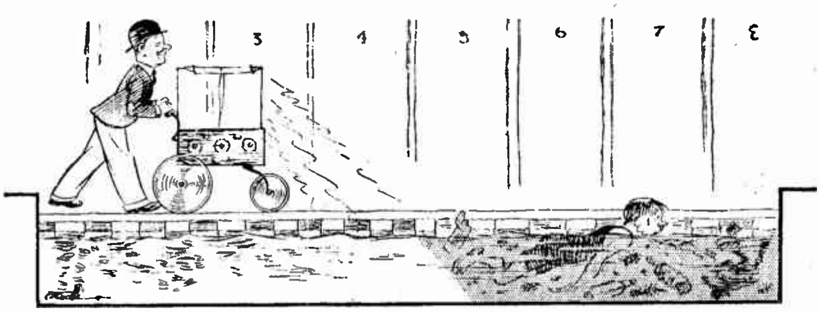
In this device, which measures infinitesimal changes in size, we get back to triodes and grid leaks—fauna and flora more familiar to the inhabitants of the wireless world. It is an amazingly sensitive measuring instrument: if you put in it a piece of fairly stoical impervious material—such as a piece of very hard flint —and turn on the loud speaker while one of our average summer weather forecasts happens to be on, at the words "a deep depression is approaching . . ." a distinct shrinking on the part of the flint will be indicated on the instrument. But this device is only an isolated example of the wonderful technique of vast magnification and astounding accuracy in measurement recently presented to us by wireless research; a technique which is a happy combination of the principle of heterodyne tuning, piezo-electric or tuning-fork frequency stabilisation, and amplification by valves. I do not know what the limit of this latter process is, but I know that a friend of mine works consistently with overall amplifications between 5 and 10 millions. As for accuracy in measurement, let me give you an example.

Speaking Disrespectfully of the Equator.

This used to be one of the things that were not "done"; being myself one of the older generation I do not much like mentioning the following result of the new technique: but it is a vivid example, and, after all, one must move with the times. . . . "Engineering physicists are beginning to question whether the accuracy of the rate of the earth's rotation round its axis is sufficient for their measurements. If the length of the day alters by about one second in ten years this would soon cause an appreciable discrepancy between reference standards. . . ." So writes a distinguished engineer, and, however much one may disapprove of it, the fact is so: one second in ten years works out at about 1 in 300 million, and already our new methods allow us to measure things to within about 1 in 100 millions. The present standard unit of time is the mean solar second, and if this is varying—as seems quite likely—by 1 in 300 millions, a standard based on it to-day (say a standard microfarad condenser) might be appreciably different from a similar standard built thirty years hence: which would be very disconcerting.

. . . . . .

In fact, it is *all* very disconcerting: I don't know what the Government is coming to. . . .



Purifying the water of public baths.

THE NEW KILO-MAG FOUR.

In next week's issue is to be described a revised version of the popular "Kilo-Mag Four"; (two H.F. stages with S.G. valves, followed by anode bend detector and one L.F. magnifier). All the features of the original set are retained; in addition, constructional work is greatly simplified by the adoption of a new form of screening.
The design is simple and straightforward, and includes only such additions as are strictly necessary to allow full amplification to be obtained with complete stability.
Selectivity can be readily adjusted to suit varying receiving conditions—even the most difficult.

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.

AMATEUR STATUS.

Sir,—I, personally, have found the R.S.G.B. of great help to me on all matters when I have asked for help and, to my certain knowledge, no stone is left unturned in doing anything which may further the cause of amateur radio. One of your correspondents thought fit to sneer at conventionettes and ham jests. Doesn't it occur to him that these are functions which serve a very useful purpose in enabling members to get together and, if necessary, air any grievance they may have. The statement made by "The C.G." that the Radio Society only helps their own members (in matters pertaining to licences), to the exclusion of any others, is scarcely correct, as anyone who will take the trouble to enquire will find for himself.

In conclusion, I would suggest that before writing to *The Wireless World* with a wholesale denunciation of the R.S.G.B. and its alleged incapability to help the amateur the people concerned should approach that Society with a view to ensuring that their views are justified. C. S. BRADLEY, G.2AX.

London, N.8.

Sir,—The R.S.G.B. developed from the Wireless Society of London, which was primarily used as a medium for spreading technical knowledge of radio among its members. In the early days such a society was the only medium in this country for the interchange of views, with the exception of *The Wireless World* and *The Radio Review*. On the advent of broadcasting the further interest aroused was met by the issue of many more publications, and the development of your own good paper, together with its sister, *Experimental Wireless*, has removed the need for a society for technical knowledge.

The transmitting amateur was still left uncatered for as regards political and legal questions. The R.S.G.B. tried to make itself the medium by which this could be done, but owing to its lack of general interest and unsatisfactory administration the average transmitter was not willing to join it. This lack of support has been the chief reason why the outside transmitter has been ignored, and has resulted in the lack of power of the R.S.G.B. The R.S.G.B. appears to assist only its active members and those who can make enough noise at H.Q. to be heard. It has neglected its rank and file, who have consequently allowed membership to lapse. The ever-present vicious circle appears here.

The R.S.G.B. cannot by any stretch of imagination claim to represent the amateurs of this country. If it desires to do so it must change its outlook. Let it develop some of the A.R.R.L. spirit, let it be interested in all transmitters, be they brass-pounders or serious workers; let it make a public statement as to its policy and actions; let it look after every single transmitter in this country; then, and only then, will it be supported by the transmitters.

Transmitters, it is up to you to show a united front against the onslaughts of such persons as B. Gladstone, and to have your views expressed to the authorities by a body which you support.

Croydon, Surrey. "AMATRAN."

Sir,—Congratulations on your Editorial *re* "Amateur Status." It is time something was done to give the amateur movement fair play and a sound foundation. There is one point I should like to stress, which is as follows: There are many who have taken up wireless as a hobby, first in connection with broadcast reception. After a time fancy has turned to ultra-short wave reception. The next step is a desire to enter the field of amateur transmission, but two points have to be taken into consideration. The first point is that of cost. A transmitter using one of the many good makes of valve, with its attendant power supply and meters, is so expensive that many amateurs (including myself) have to rule out transmission on such a scale. The way out is that of using a low-power transmitter which uses an ordinary type receiving valve adapted for transmission. With this valve, a few home-made coils, condensers, and other small parts, a cheap transmitter can be built which can send out signals receivable as far away as Morocco.

This all sounds very nice, but then the G.P.O. regulations step in—a Morse test by a P.O. official, a wavemeter costing pounds, while one is not allowed on the ultra-short wave without proof of experience. Now why should a man have to pass a Morse test if he only wants to transmit on telephony, and why should anyone desiring to use a low-power transmitter of the type mentioned have to conform to the letter with regulations which govern the working and plant of the commercial equipments? It is quite time that the under dog had a chance. Could not the regulations be made easier and some small concession granted the users of fly power transmitters so that they might obtain practical experience under working conditions? I feel sure that transmission on these lines could be allowed without so much red tape, and a waveband could be granted where no harm would be done. A. W. M.

Middlesbrough.

Sir,—In a letter by a rival association it is said that the R.S.G.B. is only a glorified London society. How this impression has come about is hard to imagine; any amateur in the world can become a member. It is affiliated to the I.A.R.U., and holds meetings in all the big provincial centres to discuss amateur radio, and any suggestions made at these meetings are made use of at headquarters.

The position of the radio amateur in Great Britain is, one must admit, not a very happy one, but other countries are far worse off, and the only way to obtain further concessions is to get the P.M.G. to see the true requirements of the radio amateur. This cannot be done in a few weeks, but if a united front is put forward in time I believe we shall be in the same position as the United States amateurs, except, perhaps, in the handling of messages. A. S. WILLIAMSON, BRS.26.

Sheffield.

THE "NON-TRANSMITTING" TRANSMITTING PERMIT.

Sir,—In congratulating you on having once more stepped in at a critical time with a warning to the amateur organisations of this country, I would like to draw your attention to what I consider to be a somewhat strange action on the part of the Post Office.

Recently I applied for a transmitting permit, and after furnishing the customary particulars I was informed that I might be allowed to use an artificial aerial. Such a proposal is, of course, a good one, as much real experimental work can be carried out with a non-radiating tuned circuit. I cannot understand, however, what the P.M.G. has to do with non-radiating laboratory equipment, and why I should be asked to pay a fee of 10s. to carry out my electrical experiments. Surely his powers are limited only to the use of apparatus for communication purposes? This question must have arisen before, and perhaps some of your readers can enlighten me.

London, N.W.3. "STUDENT, I.E.E."

ELECTRONIC OR ELECTROLYTIC?

Sir,—In a current advertisement it is stated that the excellent Westinghouse rectifier is purely electronic in its action. Can any reader please explain what is the precise meaning of this statement?

An electrolytic action is surely the evidence of an electron flow. By using the expression electronic in order to signify "non-consumable" confusion is certain to arise between the action of the metal rectifier and the thermionic valve. In the latter case the use of the term electronic is no doubt permissible, meaning, as it does, the passage of an electron stream through a rarefied gas. L. CLARKE.

London, S.W 7.

BROADCAST BREVITIES

By Our Special Correspondent.

Testing at Brookman's Park.—Exit a Spark Station.—The "Proms."

London Regional Testing.

Tests have already begun on a closed circuit at the London Regional station, Brookman's Park, and it is probable that the station may begin radiating, out of broadcast hours, within the next week or two. But it is stoutly asserted at Savoy Hill that "service" transmissions must not be expected before the end of the present month. However, it looks as if people who go away on holiday and forget all about the Regional Scheme will have a breathless moment or two when they switch on again in September.

oooo

Overcoming Obstacles.

Meanwhile, a faint shadow of doubt still lingers over Pole Moor, Slaithwaite (*Slewitt*, if you please), where the B.B.C. engineers believe they have found the ideal site for the Northern Regional station. The B.B.C., it seems, is finding once more that the course of true broadcasting never runs smooth, especially when there are tenant farmers to be reckoned with. However, present obstacles are not regarded in a very serious light, and I think it would be safe to wager that Pole Moor will indeed be the site of the Northern Regional.

oooo

Stamping out the Sparks.

Here is good news for London and the south coast. That tireless provider of mush, viz., FFB, Boulogne, is to change to I.C.W. before the end of the year. FFB is one of those offenders whose signals seem to spread all over the dial of the ordinary unselective receiver, their only useful purpose being to indicate that it is 5GB and not the listener's set that has broken down.

In the past the British and Belgian Governments have both made representations to France to curb the activities of FFB, without any pronounced effect. The promised reformation is in compliance with the terms of the Washington Convention, under which all spark stations are to be abolished by the year 1935.

oooo

A Scottish Tattoo.

Probably the last tattoo of the season to be broadcast will be that relayed to 2LO and 5XX on September 4th. This is the Scottish Command Tattoo, which will come from Dreghorn Castle, Edinburgh.

More "Proms" to be Broadcast.

It is generally recognised that the Queen's Hall Promenade Concerts were saved from extinction by the B.B.C., or, in other words, by the money contributed by broadcast listeners in the form of licence fees. No one will assert, therefore, that listeners will be taking more than their due during the coming season because the concerts are to be broadcast on five nights instead of three, as in previous years.

FUTURE FEATURES.

London and Daventry.

AUGUST 14TH.—"King Henry VIII" (Shakespeare), arranged for broadcasting by Dulcima Glasby.

AUGUST 15TH.—Cabaret from the Riviera Club.

AUGUST 17TH.—A Vaudeville Programme.

Daventry Experimental (5GB).

AUGUST 11TH.—Selections from the Oratorios.

AUGUST 13TH.—"King Henry VIII."

AUGUST 16TH.—Selections from the Musical Comedies.

Cardiff.

AUGUST 13TH.—"The Prince who was a Piper," a play by Harold Brighouse.

AUGUST 15TH.—"King Lear's Wife," a play in verse by Gordon Bottomly.

Manchester.

AUGUST 11TH.—Special Scouts' Service in connection with the Boy Scouts' Association World Jamboree, 1929, relayed from Liverpool Cathedral.

AUGUST 12TH.—"Captain Cook and the Widow," a comedy by Stuart Ready.

Newcastle.

AUGUST 12TH.—"Shoot and Run," a revue by E. A. Bryan.

Glasgow.

AUGUST 12TH.—A Maritime Programme.

Aberdeen.

AUGUST 15TH.—A Border Programme.

Belfast.

AUGUST 17TH.—Running Commentary on Royal Automobile Club Tourist Trophy Motor Race from Ards Circuit, near Belfast.

The August Programme.

The portions to be broadcast will be the first part of each concert, usually ending at about 9.40, and as the "plums" of the programme generally occur before the interval, listeners stand to gain rather than lose by the new arrangement, which will ensure a "Prom" from 2LO, 5XX, or 5GB nearly every night of the week. The broadcast will usually be from 2LO and 5XX on two nights a week and from 5GB for the remainder.

The "Prom" dates for August are: From 2LO, 5XX, and other stations except 5GB on 10th, 13th, 15th, 16th, 19th, 22nd, 23rd, 28th, and 31st. From 5GB on the 12th, 14th, 17th, 20th, 21st, 24th, 26th, 27th, and 30th.

During the Promenade season (August 10th to October 5th) the London news bulletin will be given at 9.45 instead of 9 o'clock.

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Relays from Belgium.

Last year's experiment of relaying a concert from the Kursaal, Ostend, will be repeated this month. On Sunday next, August 11th, and again on August 25th, listeners to 2LO, 5XX and other stations will hear the programme from the famous Continental resort from 9.5 to 10.30 p.m.

oooo

The B.B.C. at Play.

The tyranny of the microphone was forgotten a fortnight ago when as many of the B.B.C. staff who could tear themselves from work proceeded to the corporation's new playing fields at Motspur Park, Wimbledon, for the inaugural sports. I am told that certain high officials performed the most astonishing feats and that an extraordinarily high official rose to greater heights in his socks.

With so many young men and maidens in the B.B.C., the sports club has a potential membership of 500. The ground covers fifteen acres and contains a splendid pavilion.

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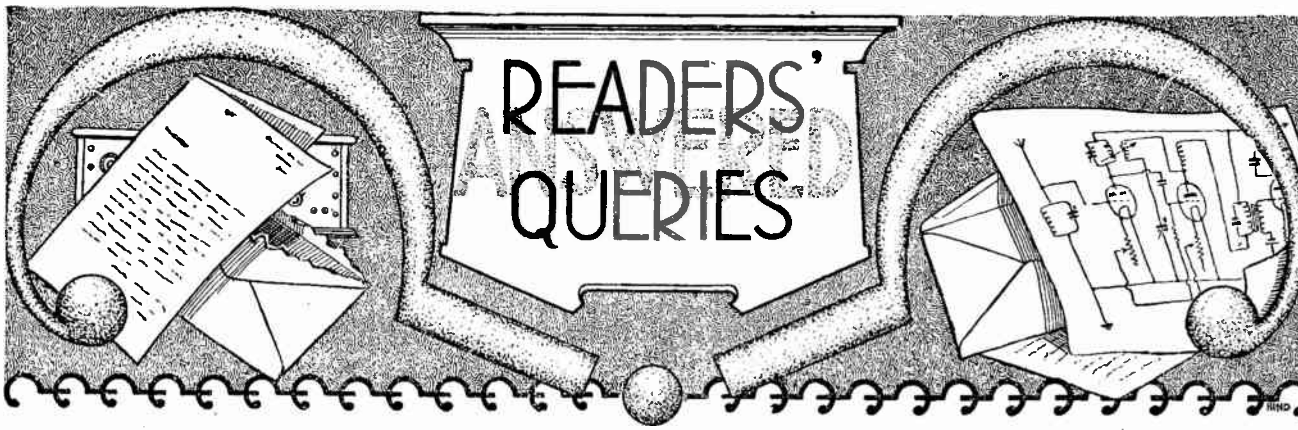
Listeners on Strike.

There are two kinds of listeners' strike, one of which consists in the refusal to pay licence fees. I hear that an affair of this kind has broken out at Innsbrück, Austria, where listeners have decided to sit on their cheque books until the local station puts out a bigger and better wattage. (I really think the B.B.C. should take a note of this.)

The other kind of listeners' strike originated in America about two years ago, when a whole street in one of the "hick" towns of the West objected to certain broadcast items and refused to listen. This may sound rather baboonlike, but as there are no licence fees, how otherwise can they protest in America?



"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.

Making Decoupling Resistances.

I wish to make some de-coupling resistances of about 2,000 ohms; will you suggest a suitable gauge of wire for this purpose? A. P. P.

A good deal depends on the current to be carried by the resistance, but for ordinary use in receivers we suggest either No. 45 or No. 47 S.W.G. Eureka wire. These gauges have resistances, respectively, of approximately 100 and 200 ohms per yard. The first-mentioned is naturally rather easier to work and carries a heavier current without overheating.

○ ○ ○ ○

Twin Transmitters.

If and when the proposed Regional scheme of broadcasting comes into being, I take it that those of us who live in the immediate vicinity of the twin stations will be forced to use H.F. amplification in the interests of selectivity—and will then have to throw away this amplification to avoid overloading by local signals. Indeed, judging by experience, some precaution must be taken to obviate overloading, even of the first valve, when the set is accurately tuned—and it will be impossible to operate it in any other condition, or the other "twin" station will interfere. I propose, therefore, to try a simple "pre-H.F." volume control as shown in the attached diagram; my idea is that, for local reception, the H.F. valve grid circuit shall be joined across two or three turns of the aerial input coil, while for long-distance work the grid connection will be restored to its original position at the electrical top of the coil. Will you please comment on my line of reasoning and say if you consider this method of volume control to be sound? Of course, final and critical regulation of signal strength will be effected by a conventional post-detection device. M. T. C.

Your arguments are sound enough, but it is not quite correct to assume that H.F. amplification will be essential to those living near the proposed twin stations.

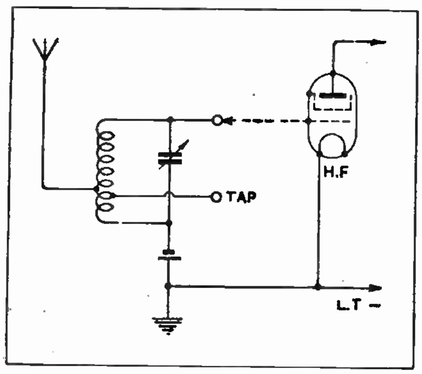


Fig. 1.—Method whereby a small part of the total signal voltage developed across an input coil may be applied to the H.F. valve grid.

Unless distant reception is desired, it will not be necessary to provide the means of H.F. amplification and then to make no use of it; where there is an ample reserve of incoming signal strength, the necessary selectivity is attainable by the use of tuned filters.

We think your plan has its advantages; these would probably be most marked in cases where a two-circuit aerial tuner is used, and where it is often impossible to arrange for an extremely weak aerial coupling—which would act as a volume control in much the same way as the H.F. potentiometer shown in your diagram (reproduced in Fig. 1).

○ ○ ○ ○

Cost of Upkeep.

In the published description of the "Flat-Dwellers' A.C. Three" set it is suggested that a fuse carrying approximately one ampere should be inserted in the mains feed lead. Is the total current consumption of that order? If so, I fear the set may be rather expensive to run. G. L. R.

An improvised fuse that breaks down when the current passed exceeds approximately one ampere was suggested solely because it is not an easy matter to find a protective cut-out to operate at an appreciably lower current. Actually, the set consumes no more energy than the average electric lamp, and is, indeed, extremely economical in this respect.

○ ○ ○ ○

A Source of H.F. Loss.

The performance of my receiver (two H.F. stages, anode bend detector, and one resistance-coupled L.F. stage) has fallen off considerably, and I am wondering whether this might be due to the fact that the bias cells have been in use for well over a year, and have probably a high internal resistance, as their voltage has dropped considerably. E. W.

Under certain conditions, the use of high-resistance bias cells for H.F. amplifying valves, and more particularly for a succeeding anode bend detector, has been proved to be responsible for a considerable falling-off in efficiency. It is wise to make a practice of changing the cells when their voltage begins to drop rapidly, and it would perhaps be well if we always made a practice of shunting them with a large condenser, preferably with mica dielectric.

RULES.

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

(2.) *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.*

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

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

(5.) *Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.*

(6.) *Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.*

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

"AS BRITISH AS BRITANNIA"

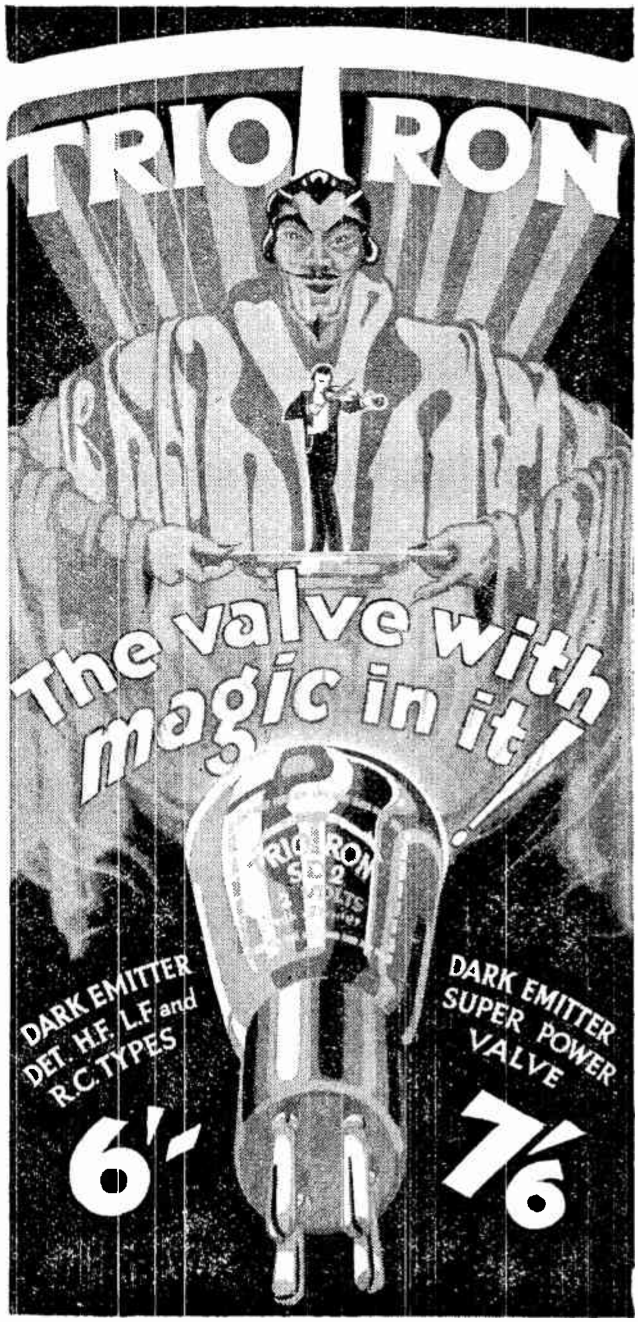
THE wonderful new Brown "Vee" Unit has created the biggest Radio sensation of recent years. Nothing like it has been known before. For the first time has been produced a unit which cannot chatter or distort. Never before has such pure, mellow tone been heard—or such full, rich volume Remember that *anyone* can assemble the "Vee" Unit and the Brown Chassis (with Cone) and have a complete and better loud speaker in 2 minutes. See and hear it at your Wireless Dealer's.

Unit 25/-

Chassis & Cone 15/-

The Wonderful NEW Brown "VEE" UNIT

Advt. S. G. Brown, Ltd., Western Ave., N. Acton, W.3.



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MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is:

12 words or less, 1/- and 1d. 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.

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.

THE SALE OF HOME-CONSTRUCTED UNLICENSED APPARATUS.

A Service to our Readers.

We have made an arrangement with the Patentees whereby readers who wish to dispose of a home-constructed receiver not licensed under the patents made use of, can license the set by means of the Deposit System referred to above.

The person desiring to sell, in sending us particulars for his advertisement, will in every case make use of a Box No., and should add to the price which he requires the amount of royalty customarily paid by manufacturers.

If the purchaser is satisfied with his purchase, the sum realised will be forwarded to the seller, less the amount due in respect of royalties, which amount will be paid by "The Wireless World" to the owners of the patents concerned, and a certificate will be handed on to the purchaser of the set.

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.

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WAVE TRAP
for the new Regional Scheme.

A highly efficient instrument. **10/6 each**

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PICK-UP ARMS.

KUSHA 12/6 and 14/6.

ADOPTED AS STANDARD BY THE G.E.C.

Weight-relieving (adjustable). Adaptable in angle and length to ensure perfect alignment.

Excellent workmanship.—"*Wireless World.*"
A very satisfactory proposition.—"*Broadcaster.*"
Excel the rest.—"*Music Dealer.*"

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THE ORIGINATORS OF RADIO PART EXCHANGE

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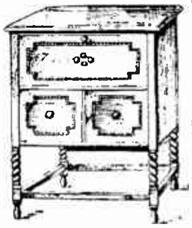

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Home Constructor Parts £4-7-6.
BRITANNIA REPRODUCERS Ltd. Furnival Road, SHEFFIELD.

RECEIVERS FOR SALE.

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

3-VALVE All-wave Receiver, latest type, powerful, perfect; £4.—V. Taylor, 57, Studley Rd., Stockwell, London. [0274

WIRELESS is a Fascinating Subject, but makes heavy demands upon the purses of its devotees. For one who is determined to keep abreast of the times, there are always new components to be bought, and sets and loud-speakers to be superseded.

AT the Same Time, the would-be buyer is often deterred from buying because he knows that there will be still one more piece of apparatus left on his hands, to add to those already in the junk box.

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ALL We Ask is that You should Send Along a List of Your Old Apparatus, together with your new requirements, or, better still, send the apparatus to us to inspect, when we will make you a fair offer.

IF You Approve of this You can Send your Remittance for the Balance, and we will forward the apparatus required; if you have sent your old apparatus and you do not approve of our offer, we will return, carriage paid.

THE Principal of this Firm, who has been a professional wireless engineer since 1910, and has been manager for the Sterling Telephone Co., radio expert to the General Electric Co., and Chairman of the Technical Committee of the National Association of Radio Manufacturers, will willingly give advice to those who are desirous of purchasing apparatus; we are entirely unbiased and will recommend the best apparatus for your particular purpose; you save money by having genuine expert advice.

DON'T Forget We Will Take Your Old Receiver or Components in Part Exchange.

WE Will Also Build Any Sets to Specification (Marconi royalties payable), and install anywhere in the British Isles; sets modernised; send for estimate.—Scientific Development Co., 51, Fishergate, Preston. Tel.: 1364. [0226

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A LONG List of Receivers does not convey much, and probably would not include the exact instrument you are looking for, therefore, I give a few specimen sets only, and ask you to let me know your needs; my unbiased advice is at your service.

SCREENED Grid Five.—A receiver to be proud of, since there is nothing to compare with it at even double the price, built to an ideal, absolutely irrespective of cost, with the finest components obtainable; comprises 2 S.G. H.F. stages covering long and short waves without coil changing, completely screened in beautifully made aluminium screening box, anode rectifier, and an L.F. amplifier specially designed to give the best possible quality on an M.C. speaker, jack for pick-up, and volume control fitted, gives enormous range and selectivity without detriment to quality; prices from £25.

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Receivers for Sale.—Contd.

5-VALVE Portable, complete, new, perfect order; £9/10.—Brucey, Factory Sq., Streatham. [5682

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SIMMONDS BROS. for the Pentode Two; £7/2/6.

SIMMONDS BROS. for Quotations Without Obligations.

SIMMONDS BROS.—All above prices are for the set as specified, in oak cabinet, exclusive of valves, batteries, and royalties; prices with pleasure for sets to your own or any design.

SIMMONDS BROS., Shireland Rd., Smethwick. [4841

ROADSIDE Four Portable, complete; £12, or near offer.—C. Mason, 23, Conderton Rd., Camberwell, S.E.5. [5748

SUPERHET Gecophone Portable, just returned from makers, in perfect condition; £25.—Bridger, 151, High St., Slough. [5742

FOR Sale, 5-valve transportable Gecophone, practically new, cost, with turntable, extra batteries and headphones, £33, owner sailing for America; will sacrifice and accept best offer; demonstration by telephone appointment only.—Tel.: Shadbolt Museum 8340. [5755

IGRANIC Baby Portable Amplifying Equipment, complete with microphone, batteries, loud-speaker and valves, only used one week during General Election; cost £58, quick sale £25.—Thomas, Brooklands, Pontyclun, Glam. [5754

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THE Mains Pioneers, who in 1925, equipped the hospitals with mains sets.

STILL Supreme in all Mains Work.

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ALL Mains Power Units.

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WET H.T. Replacements.—Sacs (capped or uncapped), highest grade, No. 1, 10d. per doz.; No. 2, 1/9 per doz.—See below.

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C.D.E.S. Accumulator Hire and Maintenance Service (5 mile radius).—98, Cherry Orchard Rd., Croydon. [4062

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TANTALUM Electrode Strips for H.T. Rectifiers, suitable for A.C. mains eliminators; 2d. each, or set of 8, 1/-.—1-7, Dalton St., West Norwood, S.E.27. [0308

Chargers and Eliminators.—Contd.

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TRANSFORMERS and Chokes for Battery Eliminators, and for all wireless purposes, receiving or transmitting; enquiries invited.—Chester Bros., 244, Dalston Lane, London, E.8. [4993

JUST Out!—The new improved model Uniflex H.T. A.C. eliminator kit; 30/-; giving full output of 120 volts, 15 milliamps, free from hum results.

THE New Kit Includes Shielded Mains Transformer with Terminals, heavy choke, 3 Hydra type condenser, tested 500 volts, D.C. Loewe vacuum resistance and clip, valve holder, panel ready drilled, and 3 sockets fitted, all the components mounted on a polished base board, and neatly boxed with full instructions and picture diagram, ready for assembling in a few minutes; sent anywhere in the British Isles, per parcel post, c.o.d., 30/-, on the receipt of a postcard stating mains voltage, and cycle.

MULLARD D.U.10 Valve, recommended, 15/- extra (please state when ordering if valve to be sent); every part guaranteed; satisfaction or money refunded.

THE New Model is the Finest Value in England, thousands now in use; hundreds of testimonials.

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SPECIAL Bargains, cannot repeat, all new.—Ecko D.C., 60 and 120 tappings, 25/-; Climax D.C., 10 tappings up to 200 volts, 30/-; Atlas A.C. model, 80 milliamps at 200 volts, 2 variable tappings, 0-150, list price £12/10, my price £8; all above carriage paid and guaranteed.—Douglas Briggs, A.M.I.R.E., Austin Friars, Newport, Mon. [5721

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NUMBER Four Size, 8/3 per gross, full length bobbins (core 1in.×1½in.) 1/3 each.

NUMBER Fifteen Size, 5/9 per gross, bobbins (core ⅝in.×1¼in.) 11d. each.

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WE Manufacture Also Complete Mains Transformers and Power Chokes for Every Wireless Purpose.

RELIABLE Apparatus at Reasonable Prices; consult us first, we specialise in wireless power from the mains, and can save you money.—Savage, 146, Bishopsgate, London, E.C.2. 'Phone: Bishopsgate 6998. [5342

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PHILIPSON'S Safety Eliminators Give Consistent Results.

PHILIPSON'S Safety Eliminators are Guaranteed for 12 Months.

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PHILIPSON'S Safety Eliminators are Described and Illustrated in our Booklet "Radio Power." Have you had your copy?—Write to-day to

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Cabinets.—Contd.

KAY'S Cabinets, the greatest range of pedestal cabinets in the kingdom; original creative designs at prices 50% lower than elsewhere; quotations for specials by return; delivery at short notice guaranteed; moving coil, portable, baffle, vignette, radio-gramo, electric pick-ups, television, etc.; illustrated lists free.—H. Kay, Wireless Cabinet Manufacturer, Mount Pleasant Rd., London, N.17. 'Phone: Walthamstow 1626. [5362

FINEST American Types, astonishing value, special offer oak cabinets, hinged lid, baseboard, highly polished, take 12in.×6in. panel; sample, carriage paid, 6/6; trade discounts for quantities.—Mag-Radio, 112, Warstone Lane, Birmingham. [2656

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FOREIGN Listeners 4, set of three low wave coils, 32/6; highwave, 32/6; bases, 1/6 each.—Radiograph.

S.G. Multi Valve Portable Coil, 21/6; Europa portable coils, 21/- pair.—Radiograph.

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REDFERN'S Deep Ribbed or Becol Tube, 5d. per inch; slotted for winding, 1/6 extra.—Radiograph, Station Rd. corner, New Inns, Handsworth, Birmingham. [5769

S. PULSFORD.—Coils, transformers, multiple valve portable, 21/6; Europa portable, 21/- pair; S.G. regional, 37/6 pair; Selective Two, 15/-; flat dwellers A.C.3, 16/6; Kilomag 4, 60/- set; modulated wavemeter coils, 21/- pair.

S. PULSFORD.—Coils for the foreign listeners; 4 will be available shortly at 31/6 set medium wave; 31/6 set long wave; bases 1/6 each.—S. Pulsford, 135, Hockley Hill, Birmingham. [5770

600-OHM Decoupling Resistances for "Wireless World" Circuits, hand made and tested in our own workshops; 1/- each, post free.—Groves Bros., St. Mary's Place, Shrewsbury. [5394

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ALL "Wireless World" Coils Supplied, mostly from stock, every coil guaranteed by the original specialists and leaders: Everyman Four coils, 33/- pair; Europa Three, 33/-; New Empire set of 3, 21/-; Broadcast coil, 8/6; Titan unit, 15/-; 600 ohm resistances, 2/-.

BERCLIF Standard Coils for New All-Wave Four, Standard Four, A.C. Three, Regional, Everyman Four, etc.; 77/9 set of 4, with bases.

BERCLIF Catalogue and Latest Coil List Post Free; trade supplied all quantities.

SIMMONDS BROS., Shireland Rd., Smethwick. [4842

1,000 ohm. Decoupling Resistances for "Wireless World" Circuits; 1/3 each, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [5753

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CROSLEY Merola Pick-up, complete with arm and volume-control, used on demonstration set, perfect and approved make; cost 87/6, sell 60/-.—Rushton, 50, Humber Rd., Wolverhampton. [5761

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COIL Drive Speakers, Goodmans; call any date between 12.30 p.m. and 1.30 p.m. during the City luncheon hour, and hear any of our products demonstrated.—Goodmans, 27, Farringdon St., E.C.4. [0091

IF You are in London Call and See Goodmans' Coil Drive and Reed Units before purchasing elsewhere.—Goodmans, 27, Farringdon St., E.C.4. [0090

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DRY BATTERIES

MILES PER GALLON!

In these days of groaning taxation, one of the first questions you ask about a car is "How much per mile is it going to cost me?" And you find that it is not necessarily the cheapest car that costs least to run.

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It pays you every time to get a Hellesen, particularly if you get a Treble Capacity, which costs less than twice the price of a Standard Capacity.

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"Wiray" 9 volt Grid Bias Type	2/-
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"Kolin" 60 volt H.T. Type	19/-
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SUPREME for 27 years.

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A. H. HUNT, LTD., CROYDON, SURREY.

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EPOCH, the greatest scientific achievement of the year

EPOCH.

EPOCH.—Marvellous new model moving coil speaker.

EPOCH.—Requires no accumulator! No mains! No complications!

EPOCH.

EPOCH.—Does not require umpteen valves; a crystal and one valve or a portable will work it.

EPOCH.—The only straight line speaker.

EPOCH.—Straight line reproduction from 50 to 8,000 cycles.

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EPOCH.—Sharp, crisp attack. No drumming! No hissing!

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EPOCH.—A good soprano does not sound like a contralto, nor as if she had a cold.

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EPOCH.—A flute sounds like a flute but a violin doesn't.

EPOCH.

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EPOCH.—The only range of speakers that reproduces speech as well as music with absolute accuracy.

EPOCH.—The speakers that have eliminated the defects of ordinary moving coil speakers

EPOCH.—Greatest variety on the market to suit all requirements and pockets.

EPOCH.—20 models; price from 50/-.

EPOCH.—See the new 9in. public address model.

EPOCH.—A happy model 66P.M. user asks us to state that an Epoch does not make a bad set good, but it makes a good set perfect.

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EPOCHS are in use in many Talkies, have been adopted by scientific institutions, and are the preferred choice everywhere after comparative tests.

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EPOCH Speakers are very Massive, sturdy, foolproof, and made for everlasting wear.

EPOCH.—But should a speaker meet with an accident you can insert your spare diaphragm in 3 minutes (no tools whatever required), and the speaker is perfect again.

EPOCH.—With other moving coil speakers it is a complicated factory job—perhaps to be sent abroad.

EPOCH.—Dealers often push substitutes because of bigger profits; insist upon getting Epoch.

EPOCH.

EPOCH.—If your dealer will not take your order, the manufacturers will supply you direct.

EPOCH.—The only proper way to compare speakers is on your own set with a quick switch over; Epoch 66 welcomes such a comparison.

EPOCH.—You can have any type Epoch, subject to 7 days' approval.

EPOCH Speakers are Fully Guaranteed.

EPOCH.—British throughout.

EPOCH.

EPOCH.—Send for Booklet.

EPOCH.

EPOCH RADIO MANUFACTURING Co., Ltd., are the manufacturers. City Office and Service Station, 25, Laurence Pountney Lane, E.C.4 (off Cannon St.). 'Phone: Mansion House 4683. [5667

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SECOND ANNOUNCEMENT SEASON 1929/30

"W.W.S." TRANSFORMER. Price 39/6.
Wound, to "Wireless World" specification, with Secondary voltages adjusted as follows:—

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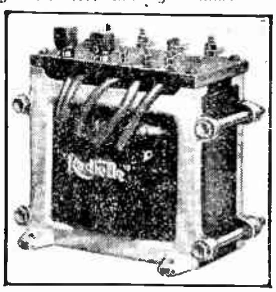

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37/6

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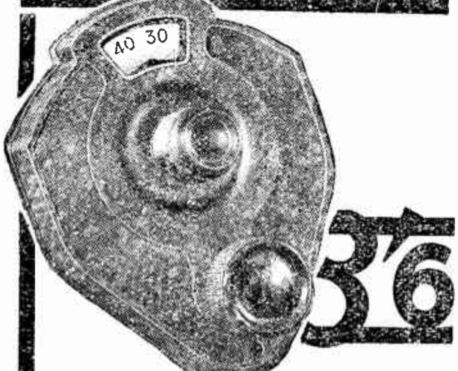
DOMINION VERNIER DIALS



DOMINION SLOW MOTION DIAL.

Brownie are now producing 2,000 Dominion Vernier Dials a day. That is why it is possible to offer this high-grade dial at the wonderful price of 3/6.

The mechanism is a special non back lash design with a reduction ratio which makes fine tuning easy without becoming tedious. Finished in plain black or beautifully grained mahogany Bakelite.

BROWNIE WIRELESS

Loud speakers.—Contd.

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SELHURST RADIO Moving Coil Speakers are of Proved efficiency and recognised as the best obtainable. Sold direct from address below, or from dealers in 10 countries. 14 days' approval.

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R A D I

OUR Moving Coil Speakers are of the Highest Grade, and appreciated everywhere. Radio enthusiasts from all parts have sent their unsolicited and written testimony of the high efficiency and magnificent performance achieved.

MOVING Coil Speakers, manufactured by Baker's Selhurst Radio, are of proved efficiency.

ON Receipt of a Postcard, our new 36 page booklet will be sent at once.

VOLUME, with natural reproduction of both speech and music, obtained from Baker's speakers.

IN all Cases we are Happy to Advise You on any point concerning loud speaker reproduction.

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GIVES Pleasure to all Music Lovers. Baker's moving coil speakers are being used for "Talkies," in leading restaurants and hotels, by manufacturers of radio-gramophone receivers, and for all purposes where volume and clarity of reproduction is essential.

CALL at our Works at Croydon and Examine all Models; you will be convinced of their superiority.

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EVERY Model can be Supplied as a Complete Speaker, ready to connect to receiver if desired.

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WHY is the Webson B.S.7 Moving Coil Loud-speaker used by manufacturers of high grade radio-gramophone sets?

BECAUSE the Webson B.S.7 is designed and made for the use of musical critics to whom only the finest possible reproduction is good enough.

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SEND for Particulars to Star Engineering, Didsbury, Manchester. 'Phone: Didsbury 1785, or, if in London, ask Alexander Black, the Wireless Doctor, 2a, Woodville Grove, London, N.16 to give you a demonstration. [5631

SPECIAL Bargains in Well Known Balanced Armature Units, shop soiled only, Ormond, 11/6; Triotron, 14/-; Blue Spot, 21/-; Whitley Boneham, 11/6.—Douglas Briggs, A.M.I.R.E., Austin Friars, Newport, Mon. [5722

AMPLION A.R.19, recently overhauled; £1/10.—Martin, Woodroffe, Westington, Chipping Campden, Glos. [5757

OFFERS Wanted for New Zampa Moving Coil L.S. Unit, 200-250 volts, D.C., list price £7.—A. Lindsay, 105 Byres Rd., Partick, Glasgow. [5765

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EPOCH by Deferred Payments.

EPOCH.

EPOCH.—Any responsible householder can obtain any type Epoch moving coil speaker by easy terms: no references, no interest.—Particulars from Mr. Laserson, 110, Cannon St., E.C.4. [5518

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FINEST Suspension Leather, for fixing cones to moving coil or reed units, as supplied to principal makers; 2/- sq. ft., 1/6 10in. square; segments up to 12in. cone 9d. for 4; all post free, cash with order.—Dilley, 8, Ashby Rd., Essex Rd., N.1. Clissold 0736. [5662

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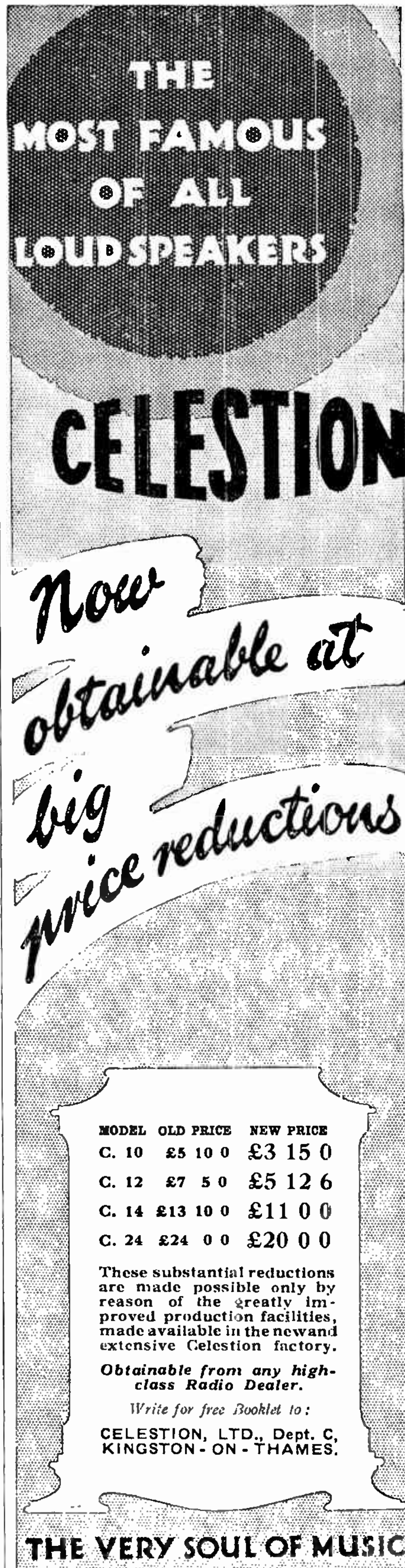
SILK Gauze, finest quality, gold or silver; 1/3 sq. ft., post free.—Douglas Briggs, A.M.I.R.E., Austin Friars, Newport, Mon. [5723

MARCONIPHONE Moving Coil, in mahogany cabinet, new, cost £11/11; Ferranti ½ amp. trickle charger, 200-250 mains, for above; R.I. straight line transformer; £10 lot; would sell separately.—Crawley, 41, Hatfield Rd., Watford. [5751



Loud-speakers.—Contd.

B.S.A. Kone, £6 model, perfect order, unsoiled; £4, or near, demonstrated evenings.—U., 9, Cromartie Rd., N.19. [5750

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THERE are those whose æsthetic tastes revolt when confronted by cheap production, whose mentality allows of no pretence, to whom rash promises are a vulgarity and colourful offers a bore; who require £1 worth of value for every £1 expenditure, and know full well that no living being can give them more.

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600 Ohms Decoupling Resistances; see advert. under Coils. — Groves Brothers (Manufacturers). [5719

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A.W. Linnen Speaker, Precision job, 15/-; S.M. dials, 2 Brownie, 5/-; 2 Lotus, 7/-; 3 Brownie valve holders, 2/6, all new; 2 Ormond condensers, 0.0003, brass vanes, 12/6 pair, cost 25/-; Climax H.F. choke, 4/-; 2 Lotus coil holders, 3/6 each; 2 others, 2-way, 2/6, 3-way, 3/6; Decca portable gramophone, 10 records, 35/-; exchange for H.T. accumulator, 120 volts.—Box 2477, c/o *The Wireless World.* [5737

FOR Sale, L.T. and H.T. charger, 120 volt and 6 volt accumulators, in excellent condition, cost £9, sell £3/10; valves, S625, P.M.256, D.R.5A, each 7/6; P.M.6D, P.M.5X, D.E.H.610, each 4/-; 2 Utility slow and quick motion dials, 0.0005 and 0.00035, variable condensers, Climax trioccular and Lewcos H.F. chokes; all 3/6 each.—Box 2528, c/o *The Wireless World.* [5743

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FULL Directions for Using Above Instruments for many purposes, and diagrams of connections free; all goods guaranteed, and despatched by return post; free expert advice on all matters microphonic.—Fredk. Adolph, Microphone Manufacturer, 27, Fitzroy St., London, W.1. 'Phone: Museum 8329. [5767

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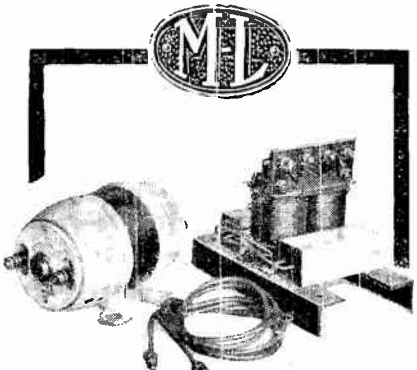

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'Phone: 5001.

Wanted.—Contd.

ANODE Converter, 12 volt input, 300 volt 50 milliamp output.—Littledown, Chiddingford, Surrey. [5739

FERRANTI 25-1 Output Transformer, heavy duty choke, high resistance potentiometer.—Wallace, 119, Chorlton Rd., Manchester. [5762

GECOPHONE Slow Motion 0.0005, Igranic micro 0.00005.—Kilburn, 30, Newton St., Bensham, Gateshead. [5760

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TWO D.E.P.215 and R.I. Varley Push-Pull Output for pentode and transformer; cash adjustment or sell.—Offers to G. A. Thearle, Freshwater, Isle of Wight. [5752

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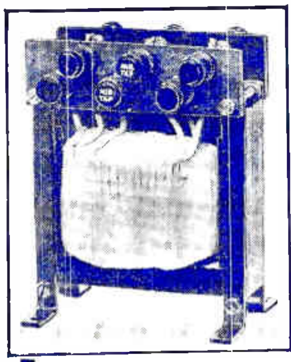

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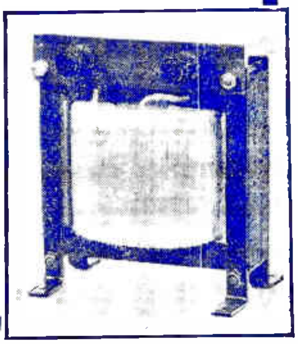

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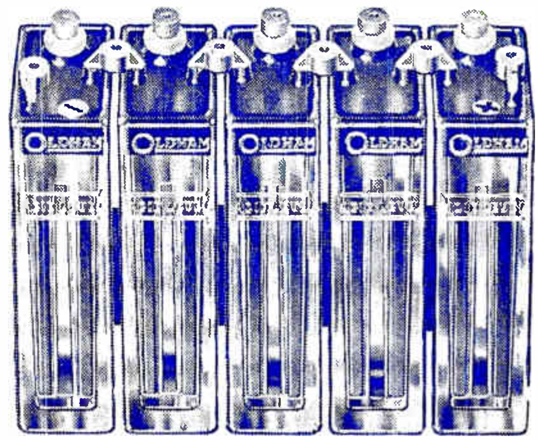

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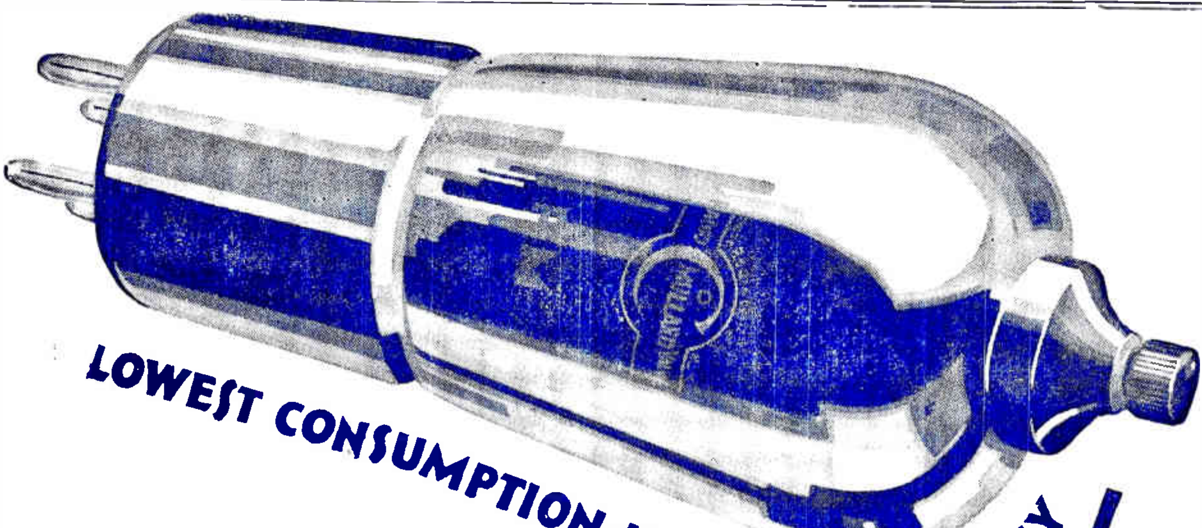

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NEW KILO-MAG FOUR

The Wireless World

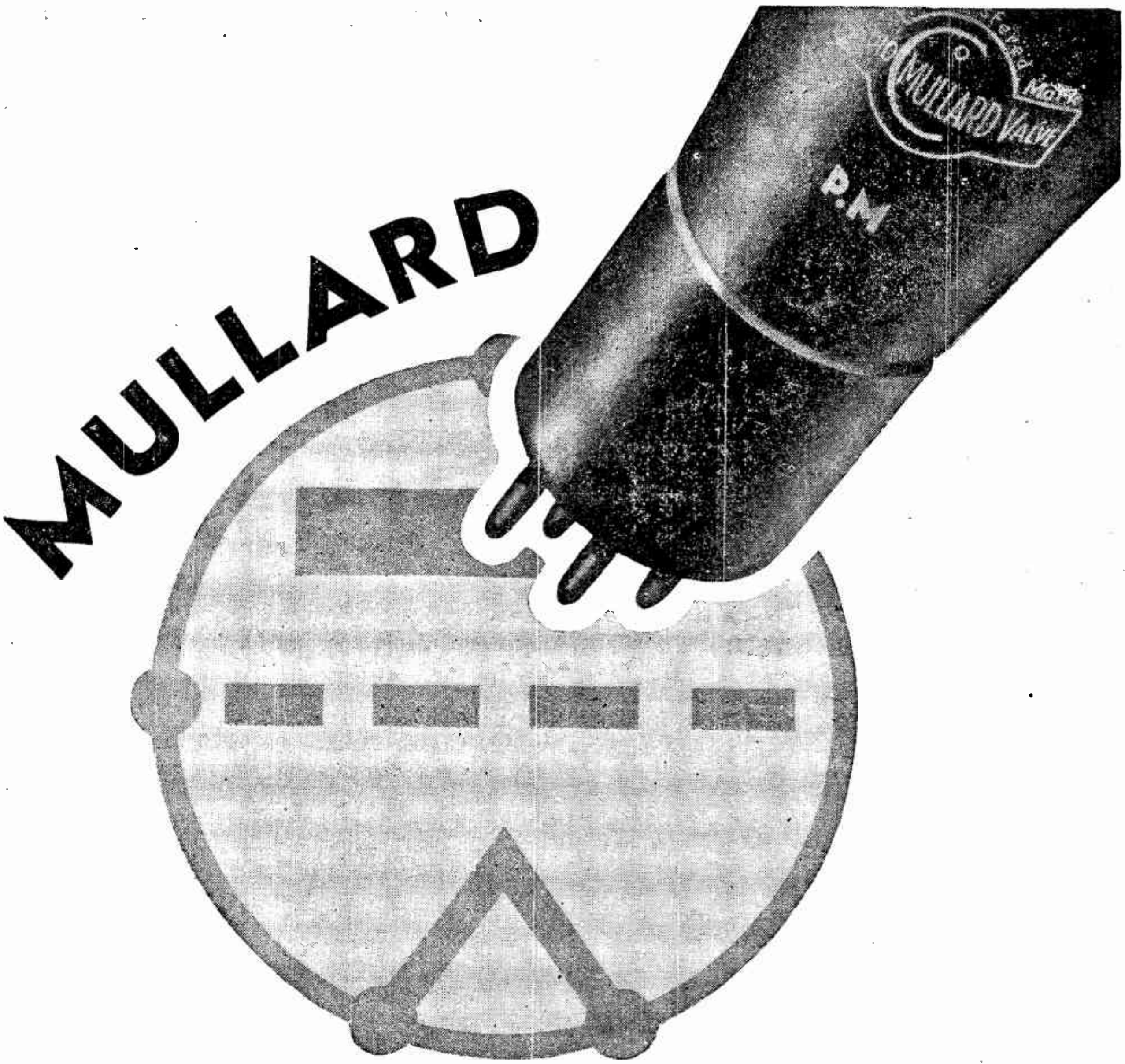
3D

AND RADIO REVIEW

The Paper for Every Wireless Amateur

Wednesday, August 14th, 1929.

No. 520. Vol. XXV. No. 7.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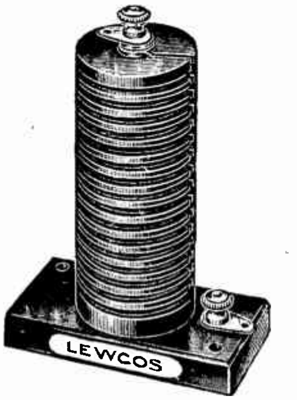

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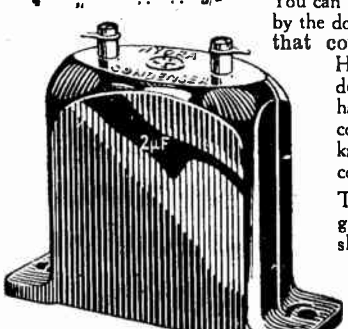

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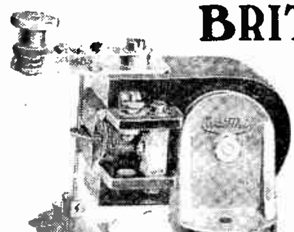

18/6

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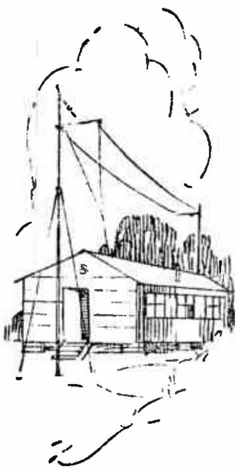

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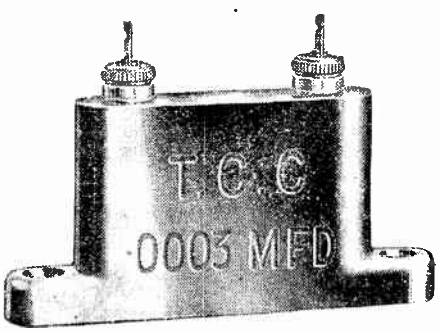

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The Wireless World AND RADIO REVIEW

(17th 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.

THE SCOUT MOVEMENT AND WIRELESS.

THE celebration of the coming-of-age of the Scout Movement has focused all eyes on the magnificent achievement of this organisation amongst all nationalities throughout the world.

The main purpose of the Jamboree was to bring together units from all over the world so that they might meet one another with common interests and so help to confirm that comradeship which hitherto had been established but with barriers of distance to surmount.

Need for a Means of Communication.

At a time when wireless amateurs throughout the world are showing that distance can so easily be annihilated and that communication from one end of the world to the other is now possible even with very simple wireless apparatus, it would seem to us that the importance of wireless to the Scout Movement cannot be overstated.

We are of the opinion that the Scout Movement would be enormously strengthened if a knowledge of wireless and of how to construct and operate transmitting and receiving apparatus were included as an essential part of the Scouts' training. Every Scout headquarters could have its short-wave station capable of communicating with other headquarters in almost any part of the world, and the interchange of messages through their own short-wave network would maintain as a permanency that personal contact which it has been the aim of the Jamboree to bring about.

Need for Official Encouragement.

We know that wireless is recognised amongst some Scout units and that in individual instances great proficiency has been attained, but we think there is opportunity for wireless to become of far greater importance to the movement than ever it has been in the past if once it is adopted officially at the Headquarters.

There should be very little difficulty experienced in obtaining the necessary sources of instruction for the Scouts. Wireless to-day has become a subject of almost "general knowledge," and every local Scout group could readily obtain the services of a competent wireless amateur, or the aid of the local radio society, to give instruction and train the group in the theory and operation of a wireless set.

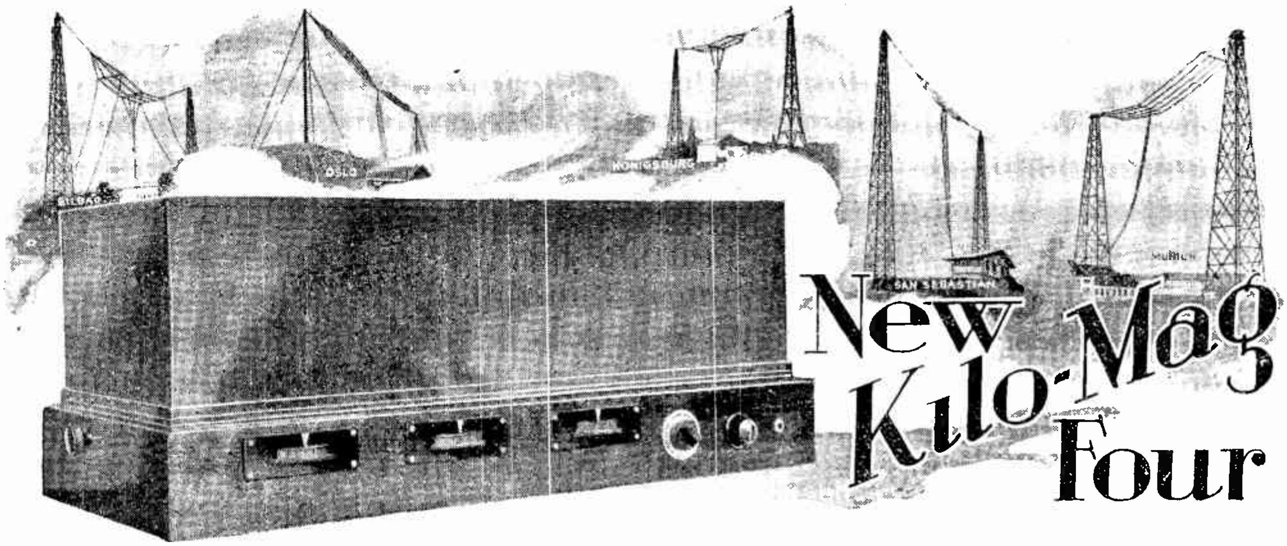
The direction in which we foresee the greatest stimulus to the development of wireless in the Scout Movement would be in the provision of facilities which would enable the units to converse with other units abroad, and exchange greetings and compare notes on their activities.

oooo

THE NEW KILO-MAG FOUR.

UNDER this title in the present issue a constructional design is given for an up-to-date revised edition of this receiver which, on its merits, has already proved so extremely popular. The original "Kilo-Mag Four" was described in *The Wireless World* of October 24th and 31st last year, and the receiver has been so successful that it was felt that the time had come to provide a new design having as its particular object the simplifying of the construction, since experience has shown that the previous design was apt to give some trouble to the constructor, particularly in the matter of assembling the components in the screening compartments.

On the question of performance of this receiver there is no need for us to make any comment here, as the design has already earned such a reputation for range, selectivity, and quality.



New Kilo-Mag Four

A Re-designed Model of a Popular Receiver.

By H. F. SMITH

ALMOST since the inception of broadcasting in this country, a four-valve receiver has been the favourite choice of the amateur in need of long range and reasonable selectivity—this in spite of the introduction of valves with vastly improved characteristics. The average three-valve set, even with the best modern valves, is still hardly adequate for consistent long-distance reception, although the better designs can admittedly make a good showing when conditions are reasonably good.

Our four-valve sets, in the great majority of cases, include a single H.F. amplifier, detector, and two L.F. amplifiers; the writer would venture the opinion that there will be a distinct tendency in the near future for this valve combination to give way to the alternative arrangement of two high-frequency stages followed by a detector and a single L.F. valve. A receiver on these lines is much more selective, and its capabilities in the matter of volume are ample for all except the comparatively few wireless users who must have an exceptional power output.

New Constructional Methods.

The original "Kilo-Mag Four"[1] was a straightforward receiver to this specification, and represented an attempt to obtain something approaching the theoretical maximum H.F. amplification. To this end, all circuits were completely isolated, but no "frills" or complications were introduced, barring those deemed to be necessary in order to achieve stability. A conventional method of construction was adopted, and here we come to an admitted weakness, although, judged by the ordinary standards applicable to a receiver of its type, it was not difficult to build—indeed, successful examples have been made by the unskilled. But it must be conceded that modern cascade H.F. amplifiers call for radical changes in the methods that have served well enough in the past for sets without metallic shielding, or with only a simple vertical screen; fortunately, the task of devising a scheme of construction

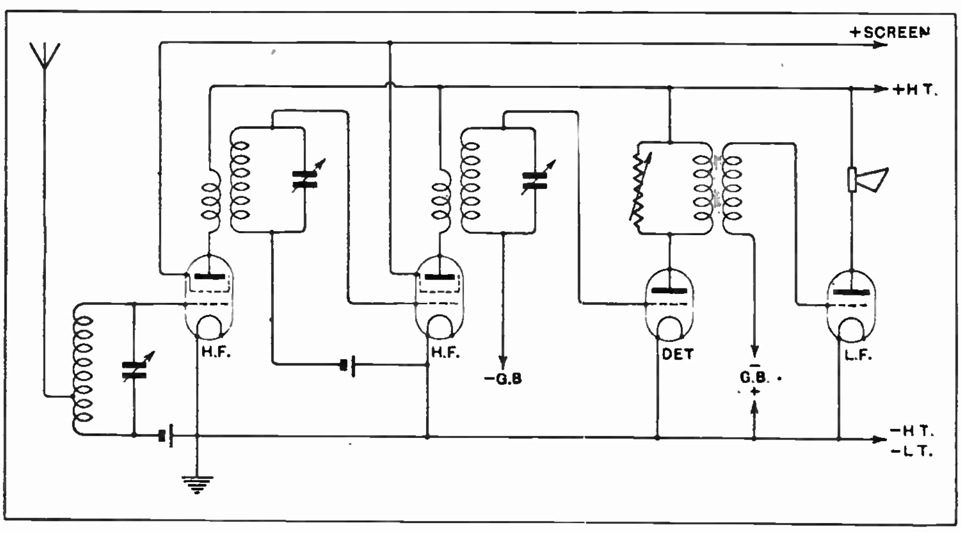


Fig. 1.—Simplified diagram, showing the basic circuit arrangement, without decoupling devices, waveband switching, filament heating connections, etc.

[1] *The Wireless World*, Oct. 24th and 31st, 1928.

New Kilo-Mag Four.—
for a modernised version of the original "Kilo-Mag Four" has been removed from the writer's shoulders, as *The Wireless World* technical staff has evolved a type of container (described in the issues dated July 10th and July 24th) which at once removes all our difficulties.

The circuit of the new set, of which the essentials are shown in Fig. 1, differs from that of the original only in details: such modifications as have been introduced tend slightly to increase the total H.F. amplification obtainable. With the better valves of the ordinary type, the title of the set may still fairly be considered as being descriptive; a high-frequency magnification of about 1,000 times is readily obtainable, but this figure may be greatly exceeded with the new battery valves shortly to be available.

reception, the long-wave windings of both primaries and secondaries (which are connected in series) are short-circuited by the switches S_2 and S_3.

The detector valve operates on the anode bend principle, and derives its negative bias from a battery common to the next stage; a decoupling resistance and condenser (R_5 and C_8) are included in this circuit in order to prevent interaction. It will be observed that an L.F. transformer is used to pass on the detector output to the L.F. amplifier, and that an H.F. stopping choke, with its by-pass condenser C_9, is interposed between the valve anode and this component. In addition, a variable resistance, for volume control purposes, is connected across its primary winding.

Nothing need be said of the connections of the output valve, V_4, beyond mentioning the fact that, as an addi-

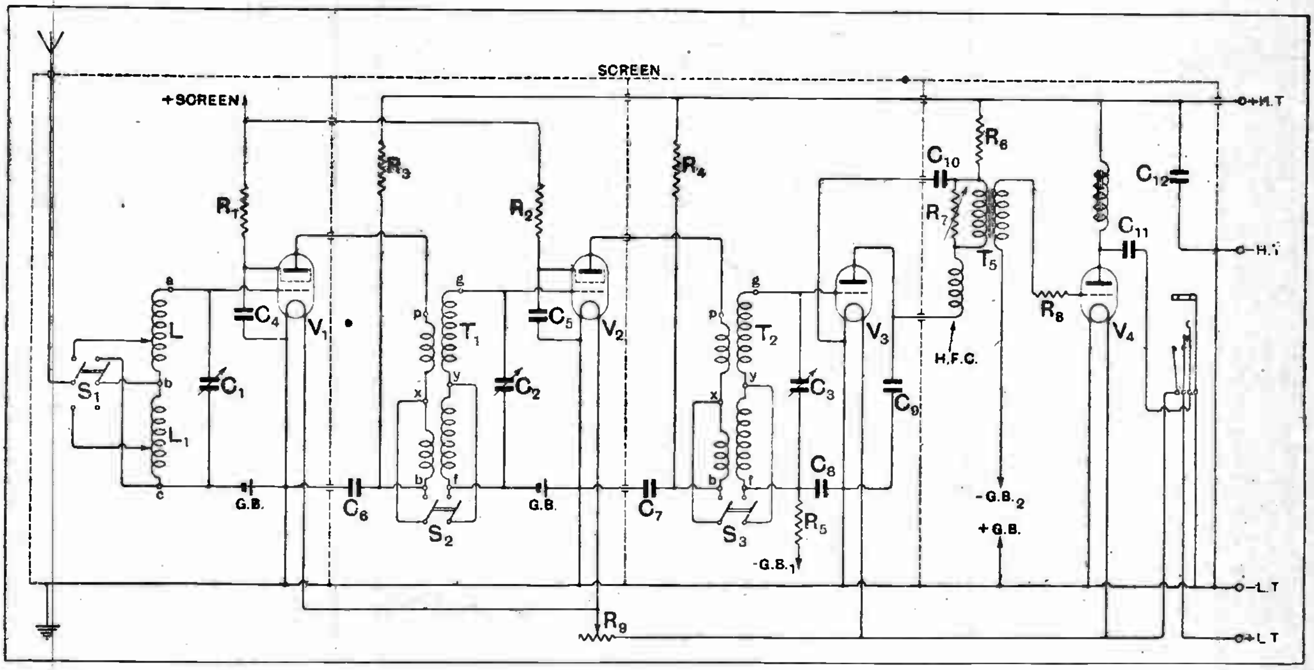


Fig. 2.—Complete circuit diagram. C_1, C_2, C_3, 0.0003 mfd.; C_4, C_5, C_6, C_7, C_8, 0.1 mfd.; C_9, 0.0005 mfd.; C_{10}, C_{11}, C_{12}, 2 mfds.; R_1 R_2, R_3, R_4, 600 ohms; R_5, 10,000 ohms; R_6, 20,000 ohms; R_7, variable resistance, 0–200,000 ohms; R_8, 250,000 ohms; R_9, filament rheostat, 30 ohms. Lettering on coil terminals corresponds with that in other diagrams.

As is now well known, the stage gain of an H.F. amplifier is determined not only by the "goodness" of the valve characteristics and on the thoroughness of the precautions taken to minimise unwanted inter-circuit couplings, but also by the effectiveness of the internal valve screening; considerable advances have been made in reducing residual inter-electrode capacity to an extraordinarily low figure.

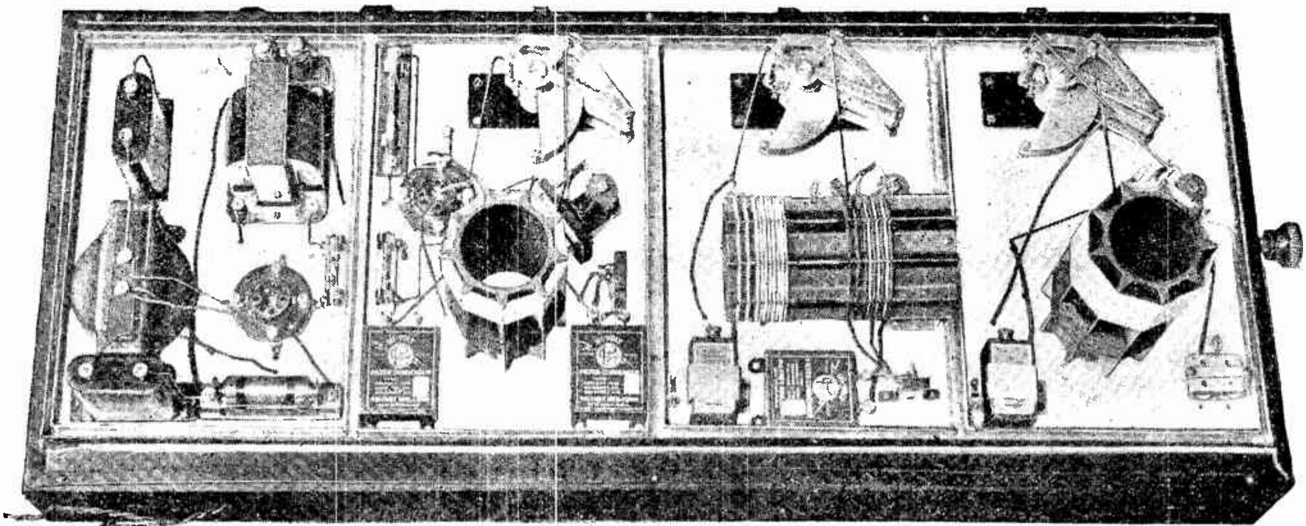
It is easiest to trace out the features of the complete circuit (Fig. 2) by comparing it with the simplified diagram already mentioned. Aerial coupling is through an "aperiodic" auto-transformer arrangement in which medium- and long-wave grid coils L and L_1 are connected in series, the unwanted winding being short-circuited by the switch S_1, of which one blade makes the appropriate change of aerial connection. Both H.F. valves (V_1 and V_2) are coupled by means of similar tuned high-frequency transformers, T_1 and T_2. For medium-wave

tional precaution, an H.F. stopper is connected in series with its grid, while a choke filter is interposed in its anode circuit. Loud-speaker connections are picked up through a jack; insertion of the plug automatically closes the filament circuit. This is a convenient arrangement, but is only incidental to the design.

It is not proposed to give a detailed description of the metal container, of which the leading dimensions are given in Fig. 3. This type of cabinet has been described at length in the articles to which reference has been made, and there are indications that manufacturers have not been slow to turn their energies towards the production of commercial designs embodying the basic idea suggested. By the time this article is in print, cabinets with a considerably more pleasing appearance than that of the experimental model illustrated, should be available on the market. It is permissible to stress the need for a perfect electrical seal at the junctions between cover

New Kilo-Mag Four.—
and metal base; in the case of the container actually used, this was obtained by placing rolled strips of flexible brass gauze in each of the channels between the base receivers, and it would be a mistake to impair its general usefulness in order to save an inch or two.

Before dealing with assembly and wiring it will be well to describe the construction of the special coils. Both



Plan view, showing mounting of tuning condensers and lay-out of components on each section of the baseboard. Note the knob (on right) for operating the three ganged waveband switches. H.F. valves are mounted horizontally in the base, and thus are not affected by the fields of the coils.

trays, and also round all the four outer edges. The dimensions as given in Fig. 3 show that the container is on the large side. These measurements could be reduced slightly, but the cabinet was designed for more or less universal use in the construction of sensitive aerial-grid inductances and intervalve transformers are made as units, comprising a set of medium- and long-wave windings. This plan is convenient, and tends to simplify both the mounting and wiring of the components, although it is generally possible to effect some economy of space by making up separate coil units for each wave band.

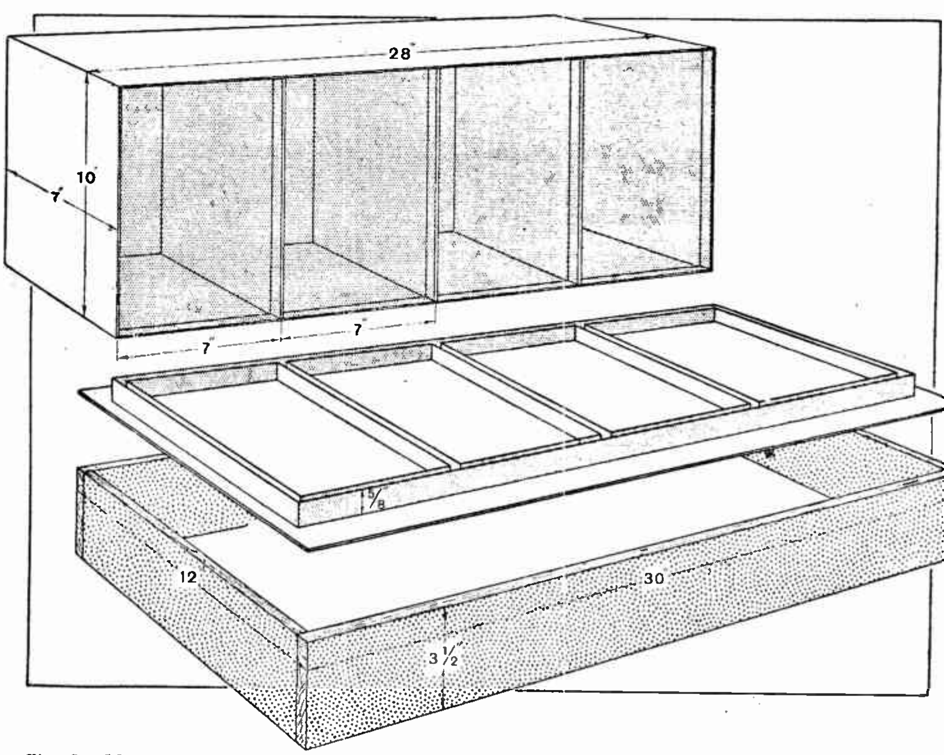


Fig. 3.—Measurements of the screened container. A sheet of plywood, ¼ in. thick, is fitted inside the base tray, with its upper surface flush with the edges.

The aerial-grid coils L, L_1, of which a sectional sketch is given in Fig. 4 (A), are wound on a 6in. length of "Becol" 9-ribbed ebonite former. The short-wave section is a simple solenoid winding consisting of 65 turns of No. 26 D.C.C. wire tapped at several points round about the 8th turn from the earthed end (*b*) for connection of the aerial lead. The long-wave coil is wound in slots, of which the dimensions and positions are given in the diagram, and consists of 210 turns—six sections of 35 turns—of No. 32 D.C.C. wire. Taps at the 15th, 20th, and 30th turns from the earthed end (in connection with the soldering tag marked *c*) are provided; these tappings, together

LIST OF PARTS.

3 Variable condensers, 0.0003 mfd. (J.B. Log).
5 Fixed condensers, 0.1 mfd. non-inductive (Polymet).
1 Fixed condenser, 0.0005 mfd. (McMichael; clip-in type, with base).
3 Fixed condensers, 2 mfds. (Ferranti).
2 Valve holders, horizontal type (Aermonic).
2 Valve holders (Godwinex).
4 Decoupling resistances, 600 ohms (Groves Bros.).
1 Wire-wound resistance, with base, 20,000 ohms (Ferranti).
1 Grid leak type resistance, 10,000 ohms (Loewe).
1 Grid leak type resistance, 250,000 ohms (Loewe).
2 Resistance holders, porcelain (Bulgin).
1 Variable resistance, 20,000 ohms (Rotor Ohm).
1 Filament rheostat, 30 ohms (Igranic; porcelain).
1 L.F. transformer (Brown).
1 L.F. choke, 32 henrys (Pye).
1 H.F. choke (McMichael; "Junior").
1 2-way connector (Athol).
3 Switches, D.P.D.T. (Utility; knob pattern).
3 9-rib ebonite formers, 6-in. long (Becol).
2 Single dry cells (Ever Ready; "0" size).
1 Grid bias battery, 16½ volts (Siemens).
1 Jack, single circuit open, filament control (Edison Bell).
1 Metal container with wooden base.
3 Special edgewise dials.
Brass strip, wire, screws, ebonite, etc.

Approximate cost, excluding cabinet and dials, £7 10s.

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.

with those on the coil L, need only be of a temporary nature, as it is intended that the aerial connection will be permanently made to the point found by trial to give the best compromise between the requirements of sensitivity and selectivity. Care should be taken to see that both windings are in the same direction; that is to say, either one should be a continuation of the other.

A simple mounting is provided in the shape of a wooden plug fitting into one end of the coil former, through which a screw is passed into the baseboard.

The medium-wave H.F. transformer secondaries differ from the corresponding aerial-grid coil in that they are wound in slots, a series of primary coils being sandwiched between the secondary sections. A transformer of this kind is quite effective, as the requirements of close magnetic coupling and low inter-winding capacity are fulfilled, while the work of construction is much easier than if the primary windings were carried on spacing strips in

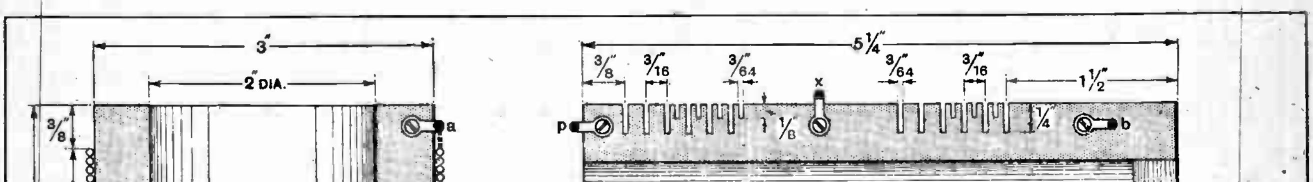
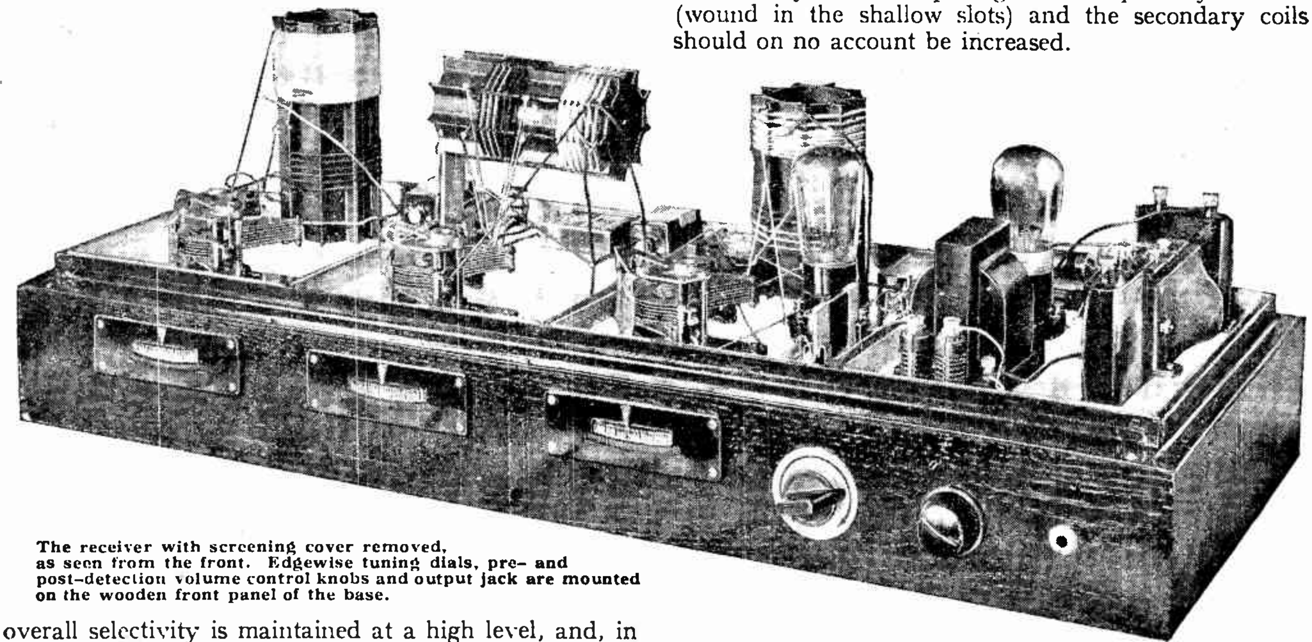


Fig. 4.—Details of coil formers and windings. Diagram A (on left) shows the aerial-grid coil assembly: diagrams B and C show, respectively, dimensions of slots and method of winding and connecting the H.F. transformers. One of these is mounted horizontally on a light metal bracket as shown, while the other (T_2) is mounted vertically by means of a wooden disc.

New Kilo-Mag Four.—
the more conventional manner. Admittedly, these section-wound coils have a higher H.F. resistance than single-layer solenoids of the optimum gauge of wire, but their "goodness" is quite adequate for the present purpose; by using a still better coil for the input circuit, overall selectivity is maintained at a high level, and, in particular, the "spreading" of strong local signals is restricted.

Preparation of the formers for the H.F. couplings is illustrated in Fig. 4 (B), although it should be pointed out that the marked dimensions of the slots must be taken as approximate, as a good deal depends on the thickness of the wire covering, and on the amount of tension applied in winding. The slots may be deepened slightly if necessary, but the spacing between primary sections (wound in the shallow slots) and the secondary coils should on no account be increased.



The receiver with screening cover removed, as seen from the front. Edgewise tuning dials, pre- and post-detection volume control knobs and output jack are mounted on the wooden front panel of the base.

(To be concluded.)

IMPROVISING A SMALL CONDENSER.

How Twisted Flex may be Used in an Emergency.

In testing a newly built receiver containing a stage of high-frequency amplification, it is often necessary to connect the aerial temporarily to a tuned circuit that was designed to tune over the desired range without any such addition. If, for example, a 1-v-2 set fails to give the signals expected of it, the first test would probably consist in attaching the aerial to the secondary of the H.F. transformer, coupling the first valve to the detector, and connecting telephones in the plate circuit of this valve to find out whether the local station can be heard at the expected strength for a one-valve receiver. If all seems well at this point, the aerial and the telephones are moved, valve by valve, out from the detector, so checking the performance of each valve separately.

If such a scheme of test is proposed—and it is a very informative one—it is annoying, to say the least of it, to find that the addition of the aerial capacity to the grid circuit of the detector has altered the tuning range of that circuit to such an extent that the stations to which it is desired to tune for test purposes cannot be tuned in.

If this discovery is made it is not necessary, as at first sight might appear, to abandon the test, for a condenser of small capacity in series with the aerial will speedily circumvent the difficulty. Probably the test is being made in the evening, no condenser of suitable capacity is to hand, and the shops are shut. But there is still no need for despair, for any two conductors placed near to one another, but not in electrical contact, form a condenser of sorts. A foot of twin flex, for example, may be commandeered, one wire being connected to the set and the other to the aerial, both connections being made at the same end of the flex. The capacity between the two wires, though not as free from losses as the purist might desire, will at least serve to pass the high-frequency currents through from aerial to set. Although there is no slow-motion dial on this improvised condenser, it is variable. If less capacity is required, one can always cut the flex, or, if in an economical mood, it need only be untwisted.

Familiar to the "Old Hands"?

The suggestion here made is familiar enough to "old hands," but there must be many experimenters to whom the idea of using a pair of insulated wires twisted together to play the part of an emergency small condenser will come as a novelty.

A. L. M. S.

CLOCK SETTING by WIRELESS

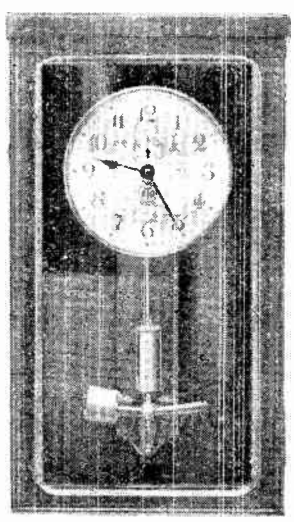
Automatic Synchronisation from Time Signals.

LISTENERS who have tuned in *Radio - Paris* shortly before 10.40 a.m. or 6.25 p.m. will have heard the announcement of the special time-signals for automatic clock-setting by wireless, followed by a series of from six to ten rhythmic dots, ending at the exact times mentioned.

To take advantage of these time-signals two special devices are required (in addition to the ordinary receiver), viz., a relay and an electrically driven clock.[1]

The photograph shows the construction of the relay equipment, and Fig. 1 gives the connections. It will be seen that the audio-frequency currents pass through the primary of a transformer permanently connected in series with the loud speaker, and that the valve amplifies and rectifies these audio-frequency currents, thus producing a series of short direct-current impulses through the coil. In the field of this coil is an armature to which the pendulum is attached. The period of this pendulum being adjusted to be the same as that of the rhythmic dots, the movement of the pendulum builds up until, after three or four impulses, it becomes large enough for the hook C to pick up the contact A and pull it into contact with B on each swing to the left. It should be noted that A is very flexible and thus escapes from C after the contact has been made.

Thus, after the first three or four dots of the time signal, the relay sends out a series of direct-current impulses from the four-volt battery to the clock—one for each dot. The damping of the pendulum is such that it ceases to swing almost at once after the termination of the series of dots, and therefore no further direct-current impulses are transmitted to the clock. It will be obvious that this principle of employing a pendulum prevents the relay from being actuated by signals other than those having the correct periodicity; indeed, it is stated that the time signals can be used even when sent out simultaneously with music.



The wireless synchronised clock.

The batteries indicated on Fig. 1 are those of the receiver (4 volts is the standard voltage of the French receiving valves), no separate batteries being needed.

A point of interest is that *any* rhythmical time-signals can be used (as, for example, the "vernier" dots from the Eiffel Tower, or the Daventry dots), provided that the period of the pendulum is adjusted accordingly.

Fig. 2 shows a simpler type of relay, in which the signals actuate a telephone receiver permanently connected in parallel with the loud speaker. On the diaphragm of this telephone receiver a contact is fitted, the movement of the diaphragm thus rhythmically *breaking* the circuit through the coil of the pendulum. To avoid waste of current, a switch must therefore be fitted in this circuit, and it would appear desirable that the switch should also disconnect the relay itself, though this refinement is not included in the makers' specification.

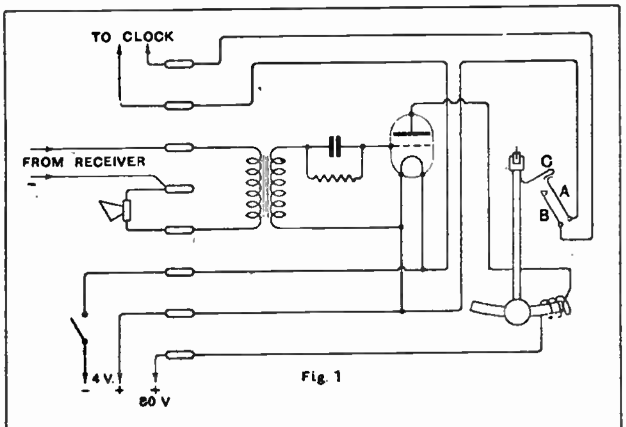
Human Element Avoided.

The simpler type of relay can be used only with stronger signals and where little parasitic noise exists. It is stated that with the average receiver (which in France means a superheterodyne) this type of relay is generally satisfactory up to 150 miles from Paris. By the use of the relays the introduction of the human element is reduced to the operation of one switch (to light the valve in one case or to connect the relay in the other) shortly before the time fixed for the signals; while even this task can be avoided by the fitting of special contacts to the clock itself.

The mechanism of the clock is far more complicated, and unfortunately does not lend itself to photographing, but our illustration gives an idea of the general appearance, and incidentally shows that the pendulum used in the relay is very similar to that of the clock itself.

It should be observed, in Fig. 3, that the cross-shaped cam is mounted integrally with the minute hand, on a tube driven *frictionally* by the main driving spindle shown, so that the minute hand

* The French electrically-driven clock here referred to is the "Ato."



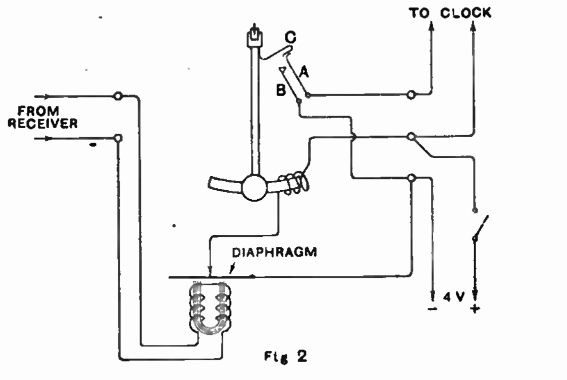


Fig. 1.—(Top) The audio-frequency dot signals cause the anode current to energise the magnet associated with the pendulum. Eventually the pendulum gathers sufficient swing to actuate the contacts A and B. These contacts send out current pulses to the clock. **Fig. 2.**—Modified form of control pendulum. Here a telephone relay replaces the valve rectifier.

can be moved (with its tube and cam) independently of the driving mechanism of the clock, and, what is equally important, can be *held* in any given position without stopping the clock. The hour hand is driven through a twelve-to-one gearing from the tube of the

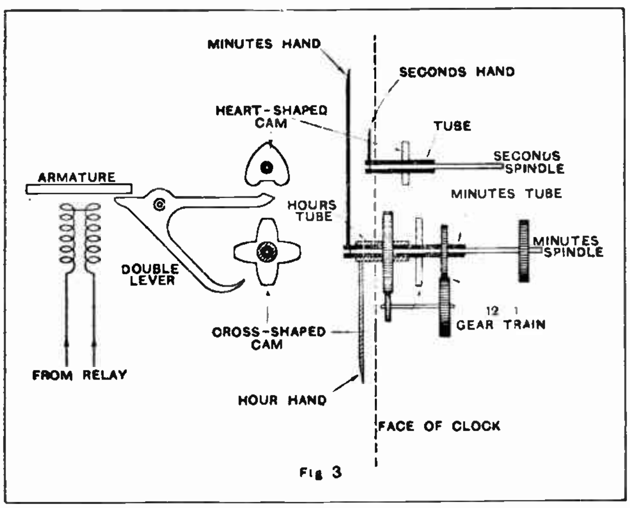
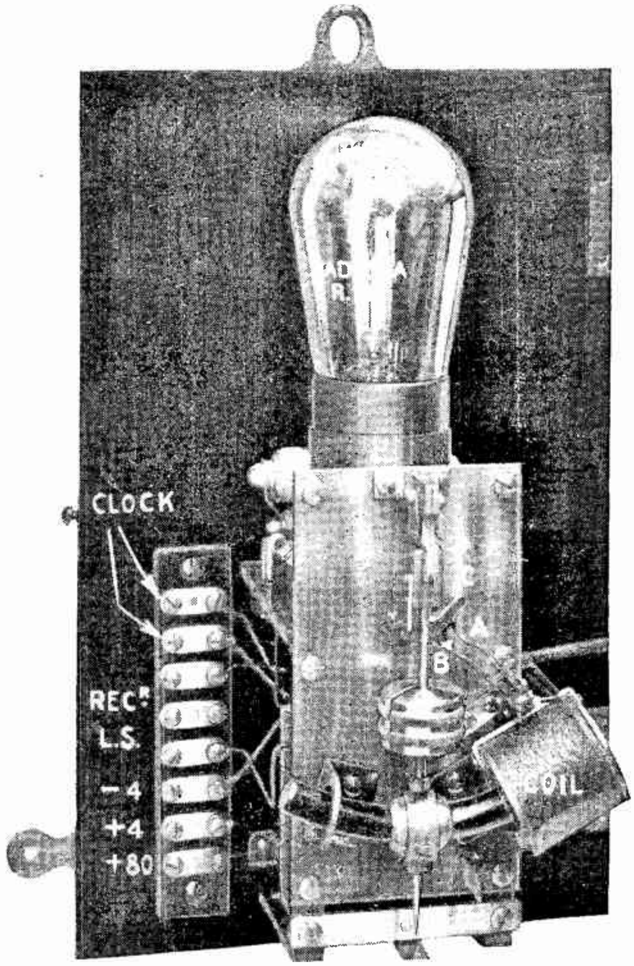


Fig. 3.—Each pulse of current controls the clock mechanism by bringing the minute and second hands to zero. It is not until the dot signals cease that the clock hands are set free to take up the friction drive from the clockwork.

minute hand and not from the spindle, so that any change made in the position of the minute hand also moves the hour hand to its corresponding new position. Finally, the second hand is also mounted, together with its heart-shaped cam, on a tube driven by friction from the "seconds" spindle.

The direct-current impulses arriving from the relay pass through the coil of the electro-magnet shown, and the double lever is thus actuated by the armature. One arm of this lever enters whichever section of the cross-shaped cam may be opposite it, and thus sets the minute

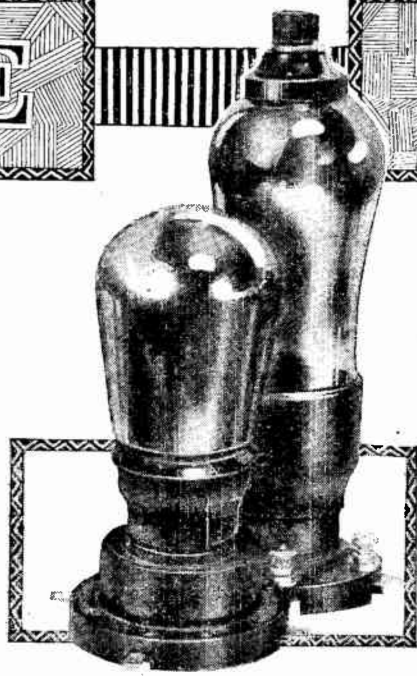


The relay equipment, consisting of valve rectifier and impulse pendulum.

hand to the position corresponding to this section. At the same moment the other arm of this lever actuates the heart-shaped cam, thus setting the second hand to zero.

On the termination of the impulse, the three hands are released, but each subsequent impulse brings them back to the same positions, and it is not until the final impulse has arrived that the clock mechanism is left free to take charge of the hands again. The limit of correction is about five minutes fast or slow, this being conditioned by the width of the openings of the cross-shaped cam. However, even if such a clock is set only once a week, nothing like this error should occur.

VALVE TESTS



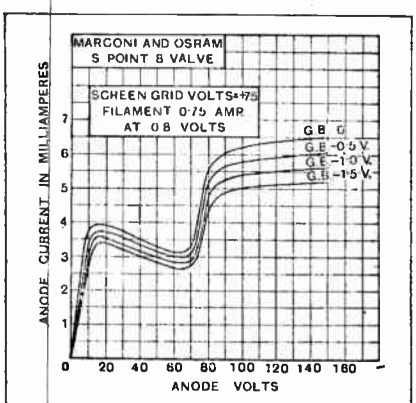
Two New A.C. Valves.

Additions to the Marconi and Osram "Point 8" Group.

THE group of valves which figure in the Marconi and Osram lists as the "point 8" class has hitherto appeared incomplete, since it did not include one of the screen-grid type or a valve which could be used, under all conditions, as a detector. Happily this omission has now been corrected, and two new recruits, the S point 8, and the D point 8, have been added to the list already containing the HL point 8, H point 8 and P point 8. These were tested and reviewed in our issue of April 17th.

S Point 8 Valve.

The S point 8 is a screen-grid valve, the filament being heated direct from the secondary winding of a suitable transformer. It should not be confused with the indirectly heated type. The filament requires 0.8 of an ampere at 0.8 volt. Its working characteristics are comparable with those of the S215, the 2-volt battery-fed screen-grid valve.



Average values under working conditions: A.C. resistance 265,000 ohms, amplification factor 200, and mutual conductance 0.75 mA per volt.

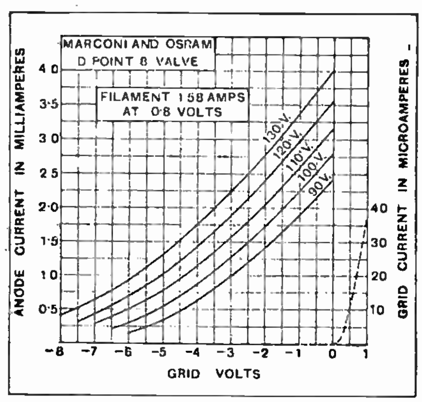
According to the maker's rating, the A.C. resistance—measured at anode volts 120, and plus 80 volts on the screen-grid—is 200,000 ohms, and the amplification factor 160. These constants, however, will alter under different working conditions. As an example, we measured the impedance and amplification factor with plus 75 volts on the screen-grid, and found the average A.C. resistance between 100 and 150 anode volts to be 265,000 ohms; the amplification factor was approximately 200. The mutual conductance, or "slope," came out very much the same as stated by the makers, namely, 0.75 mA. per volt, as compared with 0.8 mA. per volt with 80 volts on the screen. The A.C. resistance will increase with reduction in screen potential, and decrease when the screen volts are raised. Within certain limits the conductance remains the same. In view of the relatively high A.C. resistance under working conditions, the most suitable intervalve coupling would appear to be a 1 : 1 ratio transformer, but this may not be possible in practice without neutralising the small residual valve capacity in the approved manner. The ratio should be, therefore, as near unity as the conditions of stability will allow.

D Point 8 Valve.

Hitherto the stumbling-block with regard to the detector stage has been the difficulty of producing a filament which is hum-free where lit by A.C. direct. This valve is far more susceptible to hum than any other valve in the set, especially when leaky-grid rectification is used. In the D point 8 valve this difficulty is overcome in a satisfactory manner by increasing the thickness of the filament, while still retaining the "point 8" characteristic as regards voltage; the current passed, however, is comparatively large. This valve consumes 1.6 amperes at 0.8 volt. In spite of the nature of the supply, the temperature of the filament remains practically constant. The current consumed is of little importance, even though it is double that taken by the other "point 8" valves, since it is drawn from the mains and the extra 0.64 of a watt will add very little to the operating costs.

Characteristics measured at 100 volts H.T. and Zero Grid Bias.

D Point 8.	A.C. Resistance Ohms.	Amplification Factor.	Mutual Conductance.
Maker's rating	21,000	14.0	0.52 mA./volt
Specimen sample	26,650	15.4	0.58 mA./volt



Average values under working conditions: A.C. resistance 33,000 ohms, amplification factor 16.5, and mutual conductance 0.5 mA per volt.

Valve Tests.—

The conductance remains fairly constant over a wide range, and measurements made under normal working conditions as an amplifier with 120 anode volts and minus $4\frac{1}{2}$ grid volts, gave the A.C. resistance as 33,000 ohms; the amplification factor 16.5 and mutual conductance 0.5 mA. per volt.

The D point 8 detector, in common with other leaky-grid detectors, functions best with a small positive grid potential; about $1\frac{1}{2}$ volts is required in this case. Since the filament is lit by A.C., this positive bias cannot be derived from a potentiometer across the filament, and it will be necessary to provide either a small grid cell, or tap into the grid battery from which the L.F. amplifiers derive their bias.

It is well to remember that when using the directly heated class of valves that all grid return leads must be connected to the centre point of a potentiometer, which should be connected across the filament of each valve. As the potential difference between the ends of the filament is only 0.8 of a volt, a resistance of a few ohms each will suffice. These can be made up quite easily by winding a short length of resistance wire on a fibre or paxolin strip and tapping it at the electrical centre.

USEFUL DATA CHARTS. (No. 26.)

The Design of H.F. Transformers.

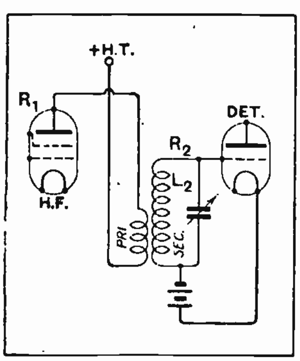
IN designing a H.F. transformer we begin with the secondary circuit which consists of a coil and a variable condenser arranged to tune over the range of frequency required. This secondary circuit is designed exactly as for a tuned anode circuit, and the coil is wound with wire of suitable gauge to make the H.F. resistance as small as possible.

The next step is to design the primary winding, which is in series with the plate of the H.F. valve. The presence of the secondary circuit results in an extra load being thrown into the primary circuit, and it is well known that the stage gain will be greatest when this extra load is equal to the differential resistance of the H.F. valve.

If the transformer were iron-cored the proper turns ratio to obtain this result would be given by the formula, square of ratio of primary turns to secondary turns = differential resistance of valve × H.F. resistance of secondary coil ÷ square of reactance of secondary coil, or

$$n^2 = R_1 R_2/[2\pi f. L_2]^2.$$

Thus, if the H.F. valve has a resistance of 100,000 ohms, and if the secondary coil has a reactance of 2,000 ohms and a H.F. resistance of 20 ohms, then $n^2 = 10^5 \times 20/4 \times 10^6 = 0.5$, and $n = \sqrt{0.5} = 0.71$, so that the number of turns in the primary can be obtained at once, being 0.71 times the number in the secondary.



The conventional connections for a transformer-coupled screen-grid valve.

Actually we do not use iron in H.F. transformers on account of the heavy losses which would be incurred, leading to flat tuning and diminished amplification; instead we use coils in air, and then the formula given above is no longer quite correct; it underestimates the primary turns required for two reasons, the first being that the coupling between the coils is now less than unity, and the second that the inductance of the primary is no longer proportional to the square of the primary turns, since a shape factor comes in depending on the ratio of the length of the coil to its diameter.

The correction required cannot be specified accurately, since it depends so much on the manner in which the coils are wound. When, as is usually the case, the primary is made of fine wire and wound closely over (or under) the secondary, sufficient accuracy is obtained by increasing the turns ratio obtained from the formula by 10 per cent.

Example.

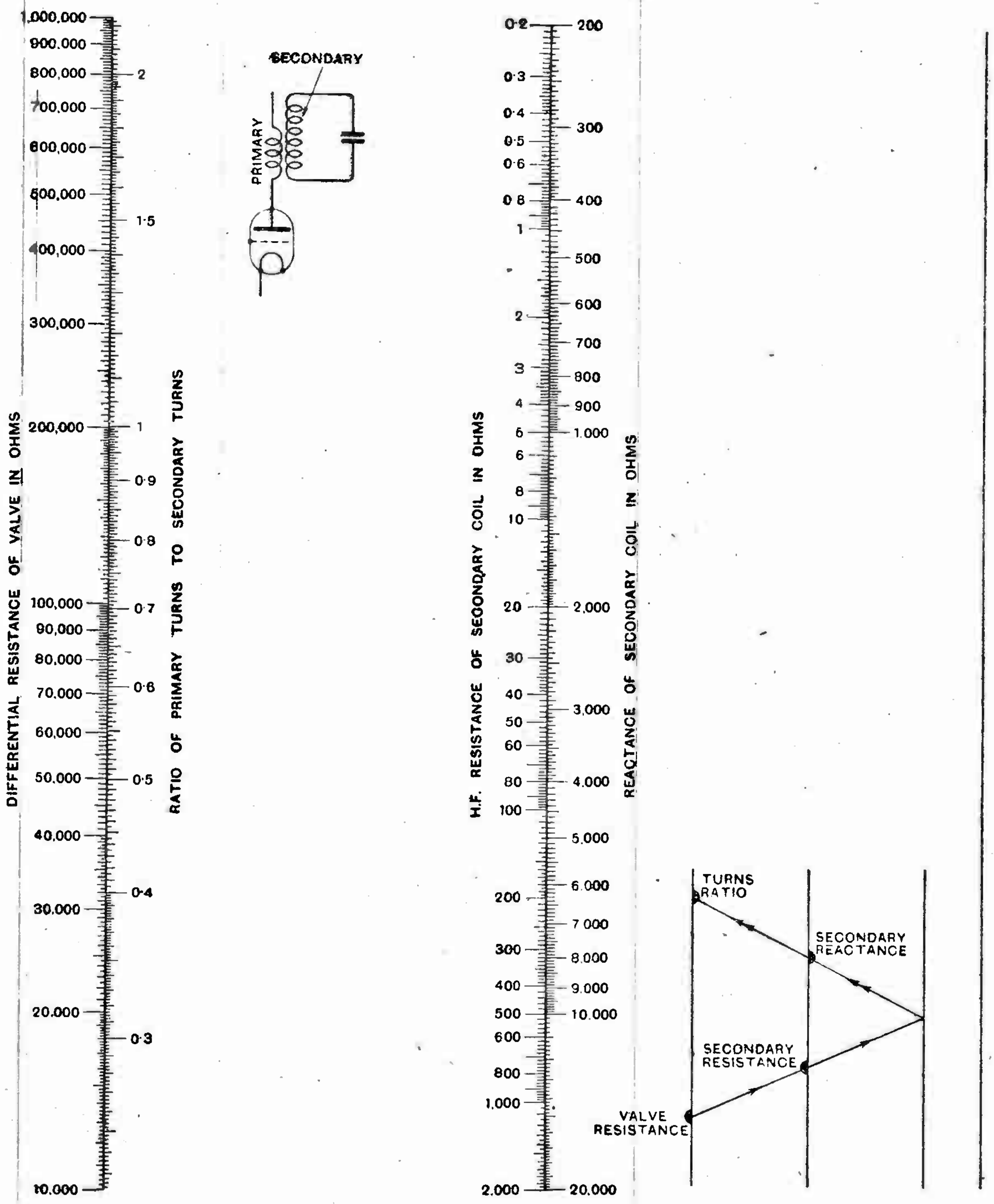
It is required to design a H.F. transformer for a 100,000 ohm screen-grid valve to work over the band 250-550 metres; the screen-grid valve is followed by an anode bend detector and a pentode.

The secondary coil, which is supposed to be tuned by a 0.0003 mfd. condenser, can be designed from abac 17. If we make its diameter 3in. and length 1.5in. its reactance will be about 2,000 ohms in the middle of the range and its H.F. resistance about 15 ohms when we allow for the load thrown upon it by the detector.

Abac 26 gives the answer for the turns ratio as 0.612, and it is desirable to increase this value by 10 per cent., as stated above, to allow for imperfect coupling and shape factor. The actual ratio is accordingly 0.673. In most cases the turns ratio will be found to be less than unity, but with very high resistance valves of about one megohm, which are now on the market, and long wavelengths, the ratio may exceed unity so that a step-down transformer will be req ired.

Limitations in Design.

In this method of design no account has been taken of reaction due to internal grid-plate coupling in the H.F. valve, so that it is only applicable when the system does not approach instability, as is usually the case with the screen-grid valve or when the system is neutralised in the case of the triode. Also, the correcting multiplier has only been worked out for a secondary of fixed shape with length equal to half the diameter.

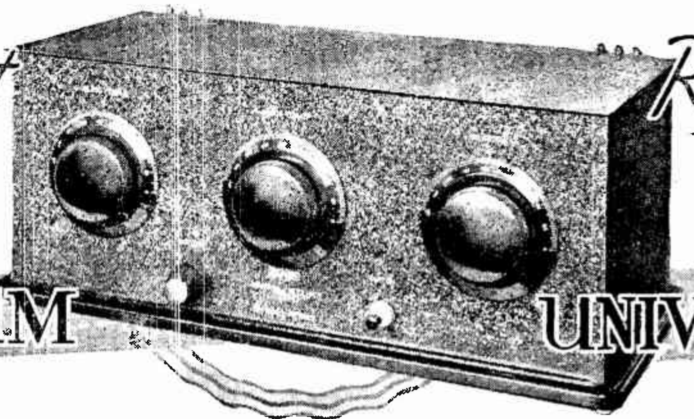


DESIGN OF H.F. TRANSFORMERS

W. W. ABAC

Nº 20

Broadcast Receivers

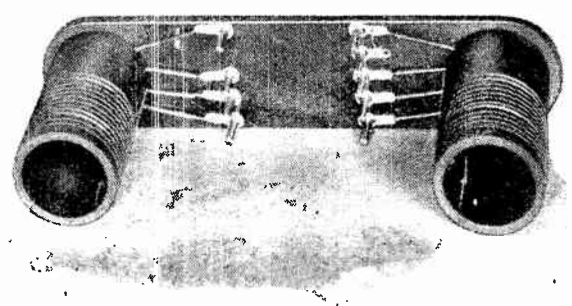


MAGNUM UNIVERSAL

Wavelengths from 15 to 2,000 Metres, with a Circuit including a Screen-grid H.F. Valve, and Pentode L.F. Amplifier.

THIS receiver made its debut at the last Radio Show at Olympia and attracted considerable notice and favourable comment on account of the ingenious design of the interchangeable coil units. Designed primarily as a short-wave receiver it should make a strong appeal to the overseas listener and also to those interested in long-distance short-wave reception in this country. The type of circuit chosen and the interchangeable coils enable the wave-range to be extended to include broadcast transmissions on the medium and long waves.

The circuit of the Magnum Universal receiver comprises three valves, the first a screen-grid H.F. amplifier, the second an ordinary three-electrode detector, and the third a pentode output valve. By far the most interesting and original feature of the layout is the arrangement of the interchangeable coil units. The coil-holder is mounted on the screen partition separating the aerial circuit and H.F. amplifier compartments, and the coils hang downwards, one in each compartment. Pin contacts are mounted on the underside of the horizontal ebonite strip connecting the coils. The aerial circuit consists of a tuned grid winding and a separate aperiodic aerial coil, and is therefore provided with four contact pins. The H.F. circuit carries five contacts, two for a reaction winding and three for the centre-tapped tuned-anode coil. The latter functions as an auto-transformer, giving a step-up ratio. In the case of the ultra-short-wave coils, however, the centre tap is omitted and the circuit is reduced to simple tuned-anode coupling.



"Twintuna" coil unit comprising aerial, tuned grid, tuned anode and reaction windings.

The screen-grid valve is mounted horizontally and passes through a hole in the screen partition. The screen-grid potential is supplied through a variable series resistance which is utilised as a volume control. The anode potential is taken from the same H.T. terminal as the output valve, but a large-capacity by-pass condenser is mounted close to the anode lead. Similar care has been taken to keep the wiring to the screen-grid by-pass condenser as short as possible.

Unwanted Couplings Avoided.

Special Polar condensers with phosphor-bronze ball bearings are used to tune the aerial and H.F. circuits, the object being to reduce intermittent contact noises on the ultra-short waves. It is interesting to note that the wires from these condensers to their respective tuning coils have been run parallel and close together in order to produce a compact circuit with a minimum stray field.

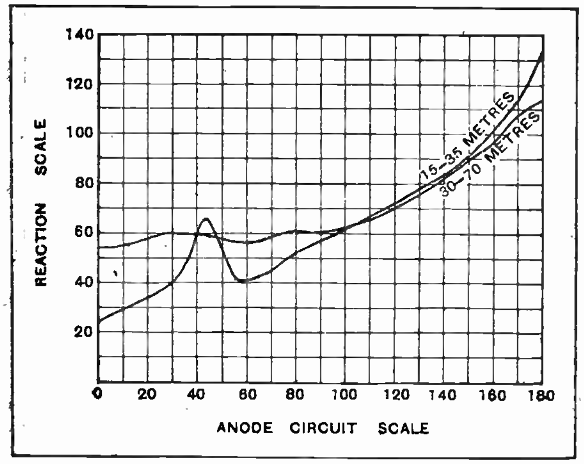
The detector functions as a leaky grid rectifier, the grid being biased from the positive terminal of the 2-volt filament circuit. A separate H.T. terminal is provided for the detector, and the anode current, after passing through the primary winding of the Igranic L.F. transformer, traverses two H.F. chokes in series and then the reaction winding before reaching the anode. One choke is designed for ultra-short waves and the other covers the normal broadcast wavelengths. The degree of reaction is controlled by a variable by-pass condenser shunting the reaction coil and valve.

A neat mounting has been arranged for the intervalve transformer. This is mounted upside down and is secured to the ebonite baseboard by means of the four terminal screws, connections being made to tags fitted underneath the baseboard. A resistance leak is connected across the transformer secondary. The pentode output valve feeds the loud speaker terminals direct without a filter feed circuit or transformer.

A flash-lamp fuse is included in the −H.T. lead and

Broadcast Receivers—Magnum Universal.—
the L.T. circuit is completed by a simple push-pull switch.

The metal cabinet is built up of heavy-gauge aluminium plates fitting into channelled corner posts of square



Interior view of the Magnum Universal receiver showing position of "Twintuna" coil unit.

section. The majority of the components are fixed to an ebonite baseboard raised about 1½in. above the base proper. The space under the baseboard has been freely used for wiring, with the result that the interiors of the compartments above the baseboard are comparatively free from wiring. The workmanship in general and the wiring in particular have been carried out with exemplary thoroughness.

The first step in testing the receiver was to check the wave range of each coil unit. The results were as follows:

RANGE (METRES).

Nominal	Measured
Coil No. 1, 15-35	15.3-41.5
Coil No. 2, 30-70	29.9-81
Coil No. 3, 250-550	209-607
Coil No. 4, 1000-2000	717-2020

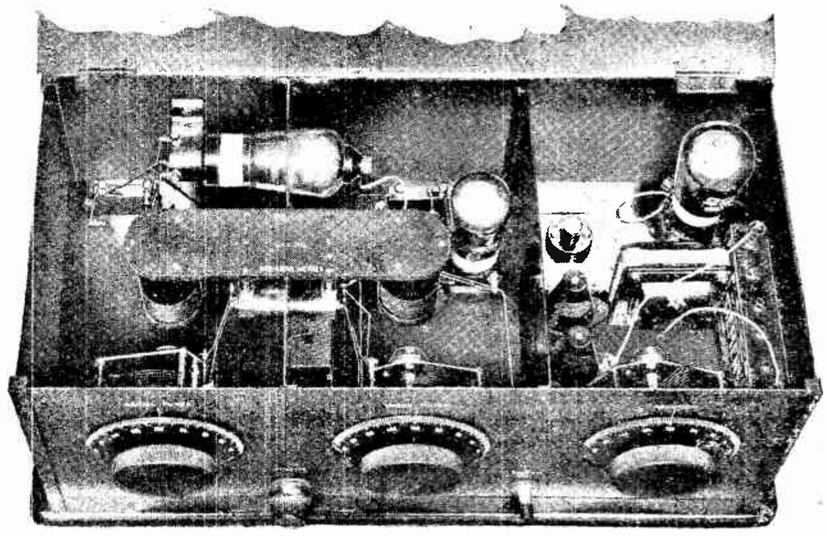
These figures show that the ranges specified are covered with a more than ample margin of safety.

For maximum signal strength and range the volume control rheostat was screwed up as far as it would go to the right and then taken back about half a turn. This adjustment gave best results on all four ranges and is evidently the setting which gives the optimum screen-grid potential. A reduction in volume is obtained on either side of this optimum setting, but in practice it is best to turn the control to the left, as this also reduces the H.T. current consumption. The total H.T. current ranges from 19 to 24 mA., depending on the volume control setting, the optimum value being about 22 mA. A current of this magnitude demands super-capacity dry cells, or, better, still, a suitably designed short-wave mains unit.

The reaction control on both short-wave ranges is smooth and free from backlash. On the medium and long-wave ranges, however, varying degrees of backlash up to 4 degrees of the dial were experienced. It is evident that the makers regard this set primarily as a short-wave receiver, and have accordingly adjusted the grid condenser and leak values for the lower wavebands. Critical adjustment of reaction is less important on the longer wavelengths, and it is only right that the short waves should receive first attention.

During the period of the tests atmospheric conditions were about as bad as they could be. Melbourne (Australia) and Schenectady (2XAF) were received and identified with difficulty, but the performance on European short-wave transmissions indicates that there is nothing seriously wrong with the short-wave sensitivity; under more favourable conditions there can be no possible doubt that the American and Australian stations would be well received.

The performance on the 250-550-metre broadcast band is really excellent. Range and selectivity are good, and we succeeded after dark in tuning-in ten foreign stations in central London during the evening transmission from 2LO. The volume from 5GB is more than the average loud speaker will stand, and the quality of reproduction is worthy of a moving-coil loud speaker. Compared with the medium-wave band, the long waves are disappointing. Considerable reaction is required to obtain



Reaction dial settings required to keep the receiver on the threshold of oscillation over the ultra-short wave bands.

good loud speaker strength in London from 5XX. However, provided that one is not so situated as to be dependent solely on 5XX for the B.B.C. programmes, the Magnum Universal Receiver merits the closest consideration of those listeners who wish to supplement first-class reception of British and European broadcasting with occasional programmes from overseas. The makers are Messrs. Burne-Jones and Co., Ltd., Magnum House, 296, Borough High Street, London, S.E.1, and the price of the set is £10, including four "Twintuna" coils, valves and royalty.

CURRENT TOPICS

Events of the Week in Brief Review.

SPAIN TO TELL THE WORLD.

An unconfirmed report from Spain states that a world-wide short-wave transmitter will be erected on Mount Tibidabo early in 1930. A medium-wave station is already in operation on the site.

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DISTANCE LENDS ENCHANTMENT . . .

A plea for the suppression of man-made static has been lodged with the Belgian Government by the Federation des Sociétés D'Etudes Radio-electriques, which also urges that the erection of powerful broadcasting stations should be forbidden near populous areas.

oooo

HIGH POWER BROADCASTING IN FRANCE.

With a view to securing better broadcast signal strength for Western France, the Bordeaux broadcasting authorities are contemplating a considerable increase in the power of the Lafayette transmitter. According to French wireless journals, the power may eventually reach 30 kilowatts.

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WIRELESS AT THE B.I.F.

Over six months before the opening of the next British Industries Fair only five per cent. of the total space in the new and enlarged Olympia, where the London section of the Fair is to be held from February 17th to 28th, remains unlet. As an indication of the size and importance of the wireless exhibit it is noteworthy that this section will occupy part of the ground floor of the New Hall.

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WHERE LISTENING IS FREE.

To popularise broadcasting no fee is charged for listening in Formosa, which owns a 1-kilowatt station erected in November last by the Tokyo Wireless Telegraph and Telephone Co., Ltd. H.M. Consul at Tamsui, Formosa, states that the number of applications for listening permits exceeded 8,000 in the first four months. Of the receivers in use 80 per cent. are cheap crystal sets, all of Japanese manufacture.

In the spring of 1930 a new 10-kilowatt station is to be opened at Itabashi, near Taihoku.

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WIRELESS AND THE BLIND.

At the recent annual meeting of the Hull and East Riding Institute for the Blind, it was stated that every blind person in the district had been provided with a broadcast receiver. A set maintenance service is carried on by a group of voluntary workers.

IN 1929!

A Sheffield "pirate" stated in court last week that he was unaware that a wireless licence was necessary.

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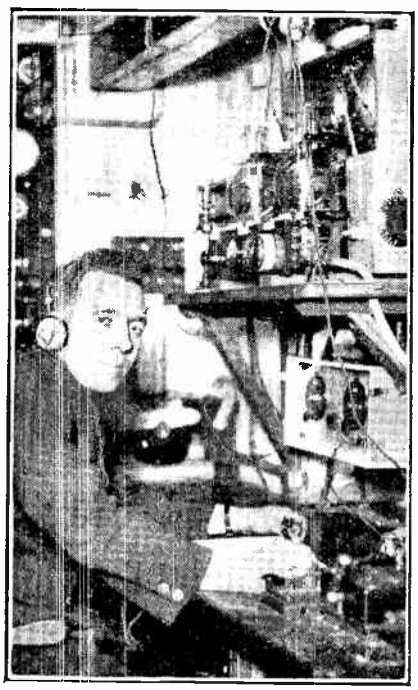
TIT FOR TAT.

By way of protest against the practice of the Copenhagen Municipal Electric Supply Corporation in retailing wireless sets, local wireless dealers have decided not to consume electricity on more than four days in each week.



SOUTHWARD BOUND. Operator Williams in the wireless cabin of the *Discovery*, which has now left Cardiff for Cape Town, where Sir Douglas Mawson, leader of the Antarctic expedition, will join the ship.

PARIS WIRELESS WAR.

There is no decline in the hostilities between the Paris Radio Manufacturers' Union, organisers of the National Wireless Show to be held in October, and the independent manufacturers who are staging an international radio show during September. In its efforts to boycott the international show, the Manufacturers' Union has now forbidden its members to participate.

FRENCH COLONIAL BROADCASTING.

The Eiffel Tower wireless station has discontinued tests on 49.5 metres and will soon resume on 31.5 metres. The object of the experiments is to determine the most suitable wavelength for broadcasting to the French Colonies.

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U.S. RADIO INVASION.

It is understood that negotiations are taking place for the formation of a British subsidiary company to the well-known American organisation, Grigsby, Grunow and Co., manufacturers of electrical goods and wireless apparatus.

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FARADAY ELECTRO-MAGNETIC CENTENARY.

Dates have been fixed for the celebration of the Centenary of Faraday's discovery of electro-magnetic induction, and the proceedings will commence in London on Monday, September 21st, 1931.

At a representative meeting of the Institution in February last the arrangements were placed in the hands of two committees, the first consisting of representatives of the Royal Institution, the Royal Society, the British Association, and other scientific societies, to deal with the purely scientific aspects of Faraday's work in relation to the proposed celebrations; the second committee, called together by the Institution of Electrical Engineers, is concerning itself with the industrial side.

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MORE POWER FROM LATVIA.

The Riga broadcasting station, which has recently been undergoing reconstruction, will shortly increase its power to 6 kilowatts.

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BLIND SPOT IN RUSSIA.

A Russian radio engineer, named Gordejev, who has been experimenting for some time on short-wave transmissions, has discovered totally "blind spots" in the southern part of Russia, writes a correspondent. In a triangle bounded by Odessa, Batoum and Feodosia (Crimea) short-wave reception was found impossible, although signals on medium and long waves were easily obtainable. At Feodosia itself no difficulty was registered.

In order to investigate these peculiar conditions the Soviet authorities have equipped a small steamer, the "Grusia," with the necessary radio equipment, and tests are made throughout the day and night on both 20 and 40 metres with an energy of roughly 20 watts in the aerial. The "Grusia" recently left Batoum, and in short stages will follow the coast line of the Black Sea. The call sign: X-UE-2BJ is given at the beginning and end of each transmission.

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STOCK AND SHARES AT SEA.

Share dealing will shortly be conducted at sea on the leading Atlantic liners by means of wireless, according to a recent decision of the Wall Street Stock Exchange to allow two of the principal brokerage houses to establish offices on ships. A "radio circuit" with a special wavelength will probably be employed, and it is understood that the first vessels to be equipped will be the United States liner "Leviathan," the Cunarders "Berengaria," "Mauretania," and "Aquitania," and the French liners "Ile de France," "Paris," and "France."

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STATE-CONTROLLED BROADCASTING IN AUSTRALIA.

Australian broadcasting is now put on a basis of State control by the Federal Government's acceptance of the tender submitted by the Australian Broadcasting Co., a group comprising Union Theatres, Ltd., Fuller's Theatres, Ltd., and J. Albert and Son, Ltd., music dealers, of Sydney. The tender provides for a three-year contract. Listeners will pay an annual licence fee of 24s., half of which will go to the programme contractors, who should thereby be assured under present conditions of an annual income of £240,000.

The contractor is required to furnish "programmes of general interest and of sufficient diversity to cater for the reasonable tastes of the community as a whole." Severe penalties are prescribed for non-compliance with the agreement, including the forfeiture of a bond of £5,000, wholly or in part, which the contractor is required to deposit.

The maintenance of stations and their equipment will be the responsibility of the Government, the sole duty of the contractor being to supply programmes.

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TRACKING "X's" BY FULTOGRAPH.

The Fultograph picture transmission system is to be put to a novel use at the Slough Radio Research Station for the purpose of recording atmospherics. By arrangement with the B.B.C. special Fultograph transmissions will be made from Daventry after the normal experimental periods, and these will be picked up at recording stations in various parts of Europe. The transmissions will not take the form of pictures; instead there will be sent out a series of straight lines, both horizontal and vertical, forming a grid or network. When an atmospheric occurs deformations of the straight lines will take place to an extent depending upon the intensity of the interference. It is hoped by this means that it may be possible to make records giving the most valuable data for research into the intensity, duration and origin of individual atmospherics. Since the drums of all receiving apparatus, wherever situated, are synchronised, it will be possible by comparing the results obtained in different places to determine the range at which an individual atmospheric can cause interference and the intensity of this interference in different localities.

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FARMERS AND THE MORSE CODE.

The Ministry of Agriculture has announced that farmers who own wireless sets of sufficient range and can read Morse may obtain later weather reports than those otherwise available. These reports are transmitted from twenty-two stations on 4,100 metres (C.W.).

Interviewed by a Press representative, Mr. John Garton, president of the National Farmers' Union, expressed the view that farmers were too busy to listen for weather reports several times a day. "As for Morse," he added, "farmers would not, in my opinion, take the trouble to learn it."

NEWS FROM THE CLUBS.

An Autumn Programme.

Slade Radio, Birmingham, is organising an interesting autumn programme which will include a trip to the Rugby wireless station on September 7th, direction finding tests on September 15th or 22nd, and a trip to the Olympia wireless exhibition on September 28th. Full details of the Society's activities may be obtained from the Hon. Secretary, 52, St. Thomas Road, Erdington, or Assistant Secretary, 110, Hillaries Road, Gravelly Hill, Birmingham.

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D.F. in Hertfordshire.

Although ordinary club activities have been generally suspended during the summer months several societies have held very successful field days in which transmission and direction finding have played an important part.

Recently the Golders Green and Hendon Radio Society and Scientific Society in co-operation with four other clubs carried out a profitable and instructive direction finding scheme near South Mimms. The club's transmitter was taken to an unknown point and concealed in a barn about 20 yards away from a road. The station was staffed by four amateur transmitters who worked the key in relays. Nine direction finding groups in cars assembled near Watford at 10.30 a.m., after which hour they were allowed to begin to search in any direction. Transmissions began from the concealed station at 11 o'clock on a wavelength of 153 metres. The first group to discover the transmitter consisted of members of the Western District Radio Society who arrived at 12.55 p.m. The second, who arrived at 2.5 p.m., represented the Golders Green Society. Ten minutes later a third group made its appearance consisting of members of the North Middlesex and Golders Green Societies. The fourth and fifth represented respectively the Muswell Hill and Western Postal District Societies, the last named not completing the search till 4.4 p.m. Owing to non-compliance with certain conditions of the scheme and to technical faults, the second group to arrive was placed after the third, and the fourth group after the fifth. In a subsequent discussion the leading groups were congratulated on their skill.

Enquiries with regard to membership of the Golders Green and Hendon Radio Society should be addressed to the Hon. Secretary, Lt.-Col. H. A. Scarlett, D.S.O., 60, Pattison Road, N.W.2.

Atmospherics Spoil Transmissions.

Conversations over Essex and Kent were conducted during a recent field day held by the Southend and District Radio Society at Rochford, Essex. Although the weather was good, atmospherics interfered considerably with working between stations. The Society's transmitter, operating under the call sign G5QK, exchanged signals and speech on 1.7 megacycles with station 2ABK, operated by Messrs. Revell and Horsnell.

Hon. Secretary, Mr. F. J. Waller, Lynthorpe, Grange Gardens, Southend-on-Sea.

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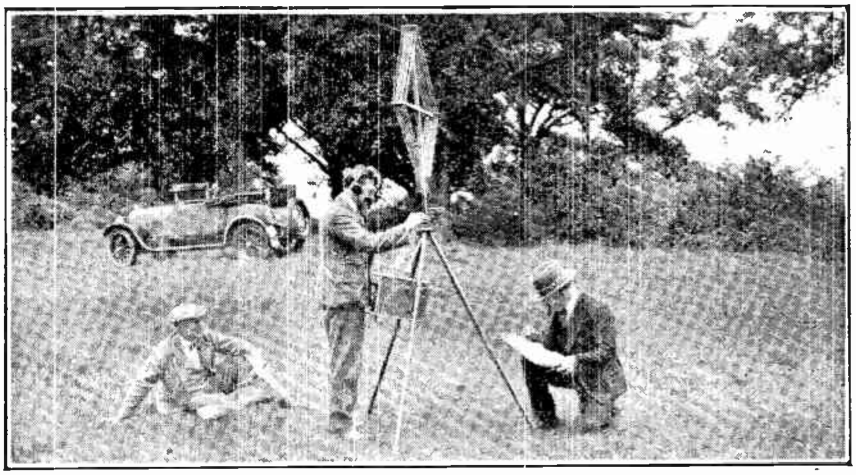
Public Address Tests.

The Newcastle-upon-Tyne Radio Society recently held its annual field day in the picturesque surroundings of the Allendale Valley, Northumberland. The Society was equipped with a Brown power public address equipment. The apparatus was installed at a suitable site on the hillside, the apparatus comprising a power loud speaker on tripod, a 4 stage, 9-valve amplifier, microphone and gramophone turntable. A high tension of 400 volts was obtained from the large capacity H.T. accumulators, weighing about a quarter of a ton. The last stage of the amplifier containing six L.S.5A valves in parallel gave an output of about 40 watts. Some interesting experiments were carried out in speech and music production over considerable distances. Not the least entertaining event of the day occurred after tea when the equipment was set up in the village square before a large crowd who listened to a recital of gramophone records.

The Society is busily preparing a syllabus for the coming session. Enquiries regarding membership will be welcomed by the Hon. Secretary, Mr. W. W. Pope, 7, Kimberley Gardens, Jesmond.



ON THE SCENT? A search party takes bearings during a recent concealed transmitter hunt organised by the Golders Green and Hendon Radio Society in conjunction with other societies in the London area.

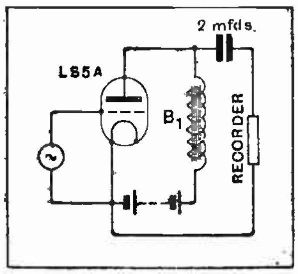
TRANSIENTS IN LOUD SPEAKERS AND AMPLIFIERS

The Important Effect of a Choke-filter Output.

By N. W. McLACHLAN, D.Sc., M.I.E.E., F.Inst.P.

(Concluded from page 121 of previous issue.)

THE next case is that of choke-condenser output as used on an average set. The choke is a Ferranti B_1 (30 henrys) with 2 mfd. condenser. The recorded waveform of Fig. 8 is similar in nature to that for the 25/1 transformer, but there is a greater tendency for the current to hold up at the beginning. This shows that the system would reproduce low frequencies better than the 25/1 transformer. Since the circuit contains an inductance and a condenser it will oscillate when impulsed, unless the damping of the valve is adequate to prevent this. In



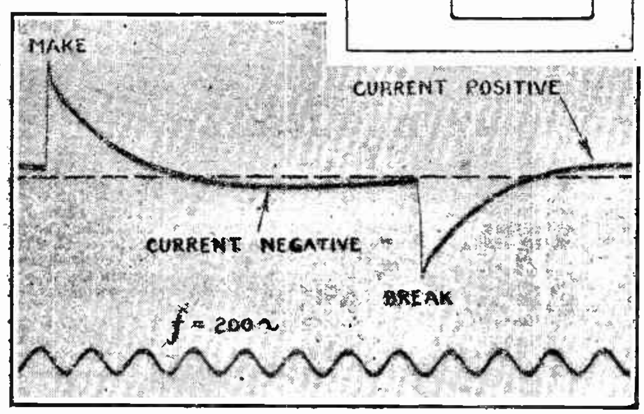


Fig. 8.—Record showing current in a choke-condenser output arrangement (choke, 40 henrys and condenser 2 mfd), when a rectangular waveform is applied to the grid of the valve.

Fig. 8 the current becomes negative and there is evidence of a damped oscillation of about 20 cycles, which, however, should not be serious since it is below the limit of audibility.[5] If the loud speaker response should be non-linear, harmonics will be created whose frequencies are (in the simplest case of non-linearity) 40, 60, 80 cycles, etc. Clearly the frequency of the oscillation can be reduced by increasing the capacity of the condenser. The influence of this is evident from Fig. 20 where the condenser is now 50 mfd. instead of 2 mfd. The waveform tends to be somewhat rectangular; actually the current falls away between make and break, this being concomitant with a natural oscillation, in the neighbourhood of 3 per second. I do not advocate a condenser of this magnitude for broadcast purposes. Any good it might do is quite undone by the loud speaker, as a glance at the transient picture gallery aforesaid will show.

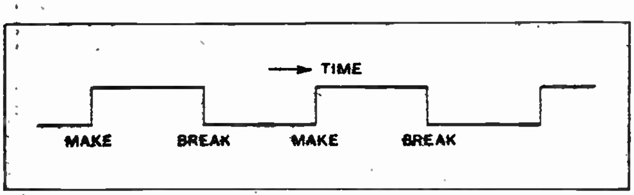
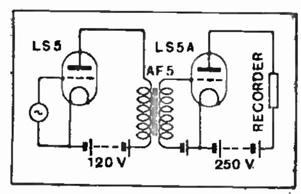


Fig. 9.—Diagram showing waveform of e.m.f. applied to the grid of the first valve of the combination under test.

The Case of L.F. Transformer Coupling.

Having mixed iron-cored apparatus with condensers, we pass back along the amplifier to a stage of inter-valve coupling where a transformer is used. Various cases present themselves. A normal case would be a Ferranti AF5 with an LS5 valve. The diagram for this case, in which the output is directly recorded, is exhibited in Fig. 10. There is a tendency to preserve a rectangular waveform, and undoubtedly this is due to the high primary inductance which enables the lower frequency components to be amplified. In Fig. 11 the effect of using an LS5B valve having an internal resistance of five times the LS5 is illustrated. Clearly the tendency to rectangular waveform has substantially disappeared. This is due to the internal resistance of the valve curbing the low frequency components. The valve also reduces the higher frequency components—due to the self-capacity of the secondary—since the



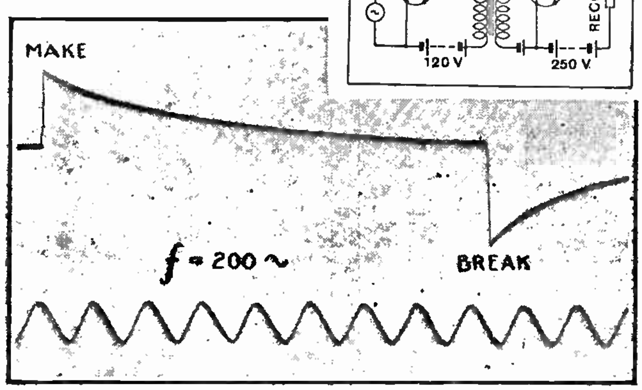
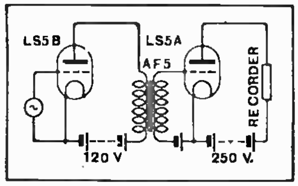


Fig. 10.—Waveform where the output is directly recorded.

[5] A smaller condenser might have rendered the system aperiodic.

Transients in Loud Speakers and Amplifiers.—
initial rate of rise of current is less than that of Fig. 10, although it may be difficult to trace in the reproduced version of the record. Obviously the LS5B is not a suitable valve for the AF5.

Following the above trend of events, we can take an extreme case of considerable interest depicted in Fig. 12. Here we have an AF5 in combination with a DEH-610 valve of internal resistance 70,000 ohms. Instead of a rectangular waveform we have a highly damped oscillation whose frequency is substantially that of the



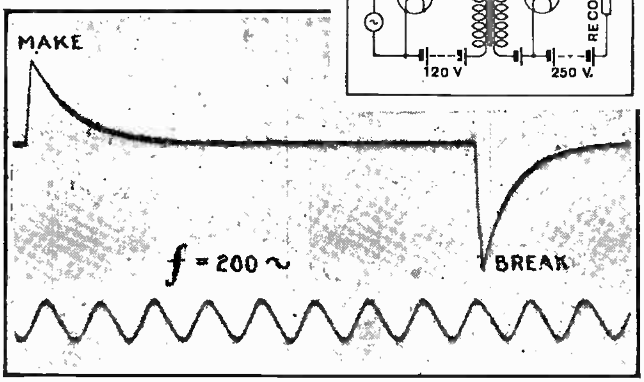
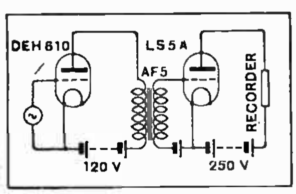


Fig. 11.—The effect of using a valve—the LS5B—having an internal resistance five times that of the LS5.

transformer secondary, namely, 300 cycles per second. Although the self-capacity of the secondary winding is low, the inductance exceeds 1,000 henrys, and thus the natural frequency—which is reduced slightly due to the effect of the valve — is comparatively low. The combination of the AF5 and DEH610 would yield a 300 cycle note each time a severe transient arrived, but, of course, this might be camouflaged by the natural oscillations of the loud speaker. However, it should be quite evident that such a combination is definitely undesirable.



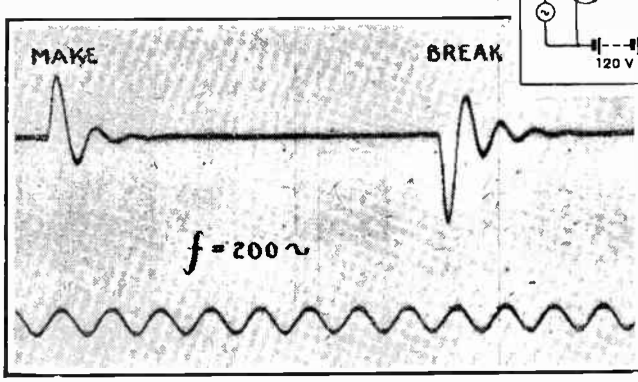


Fig. 12.—The case of an AF5 transformer preceded by a DEH610 valve. Instead of a rectangular waveform we have a damped oscillation.

The transformer oscillation is easily explained. A circuit equivalent to the valve and transformer is shown in Fig. 13. ρ represents the A.C. valve resistance, the inductance corresponds to the transformer primary, whilst the condenser is the capacity of the secondary multiplied by the square of the turns ratio, i.e., $3.5^2 = 12$. The LC circuit has a natural frequency of about 300 cycles, but when ρ = 5,000 ohms, as with an LS5 valve, the damping is so heavy that no oscillation occurs, i.e., the system is aperiodic. As ρ is increased, a critical point is reached where the damping is inadequate and oscillation occurs. The higher the transformer ratio or the smaller the primary inductance, the lower must be the valve resistance to prevent oscillation. As a case in point we have in Fig. 14 the result of an Ideal 8/1 transformer with LS5B and DEH610 valves. With the LS5B valve there is a moderately damped oscillation of 1,000 cycles. In this case the primary inductance is only about 6.5 henrys, as against that of 100 henrys for the AF5, also the ratio is 8/1, as against 3.5/1. Therefore, apart from good response characteristics, one cannot indiscriminately use *any* valve with a transformer.

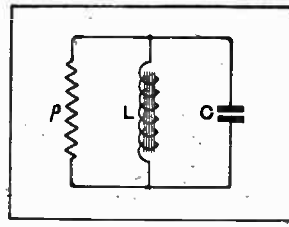


Fig. 13.—Circuit equivalent of valve and transformer.

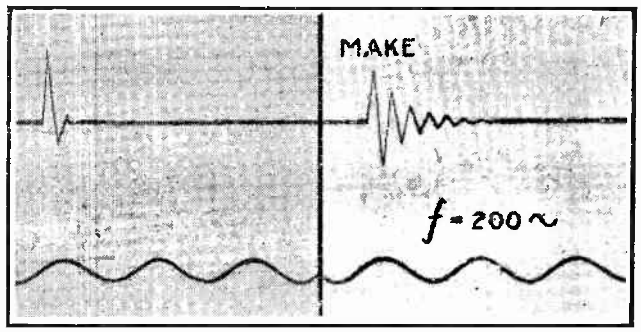


Fig. 14.—An Ideal 8 to 1 transformer preceded by an LS5B and a DEH610 valve.

Fig. 15 has been appended as a matter of interest, since it shows the rise and fall

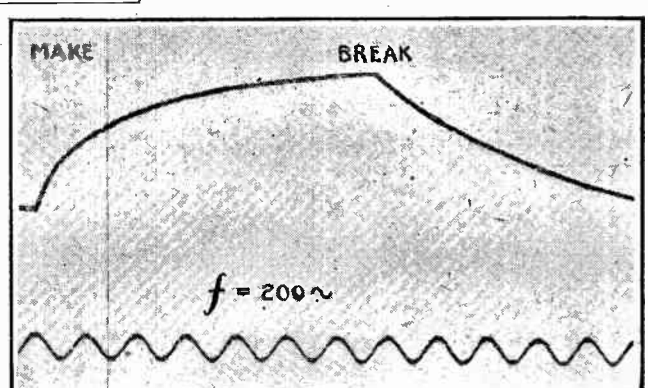


Fig. 15.—Showing the rise and fall of current in the primary of an AF5 transformer when used with an LS5 valve.

Transients in Loud Speakers and Amplifiers.—
of current in the primary of the AF5 transformer when used with an LS5 valve. The curves at make and break are similar to those obtained for any inductive circuit having series resistance. The secondary winding modifies the result slightly, due to the capacity,

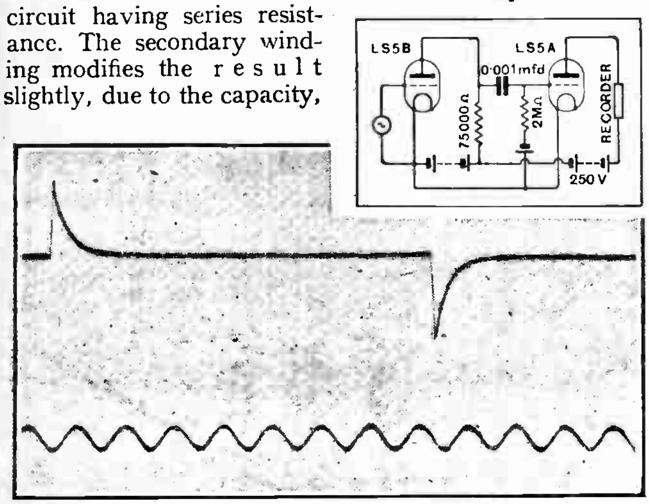


Fig. 16.—Resistance-capacity coupling where the coupling condenser is 0.001 mfd. The lower frequencies are lost.

as will be realised from an inspection of the equivalent circuit of Fig. 7.

Lastly we come to resistance-capacity coupling, the results for two cases being shown in Figs. 16, 17. In Fig. 16, where the coupling condenser is 0.001 mfd., the high frequencies are reproduced, since the initial rise is steep, but the rapid decay in current thereafter

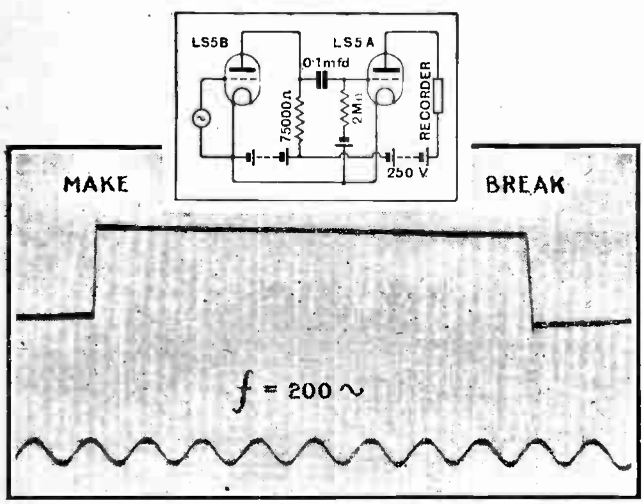


Fig. 17.—Resistance-capacity coupling using a 0.1 mfd. coupling condenser. In this case the rectangular waveform is very nearly reproduced.

indicates that the lower frequencies are not amplified. In other words, the coupling condenser is too small. The effect of a 0.1 mfd. coupling condenser is illustrated in Fig. 17, where the rectangular waveform is all but reproduced, the fall in the current between make and break being slight. The influence of a condenser of intermediate value, viz., 0.02 mfd., is depicted in Fig. 18, and this combination would be quite satisfactory for broadcast purposes. The influence on this arrangement of a 2 mfd. condenser-choke combination in the power valve stage is shown in Fig. 19. Clearly the profile is much less rectangular than that of Fig. 18, whilst the low frequency oscillation indicated in Fig. 8 is in evidence. By increasing the condenser to 50 mfd. the effect of the choke-condenser combination is substantially that of Fig. 18 where the output goes direct to the recorder. This is portrayed in Fig. 20. In comparing Figs. 18 and 20, due allowance must be made for the recorder speed being greater in the former case.

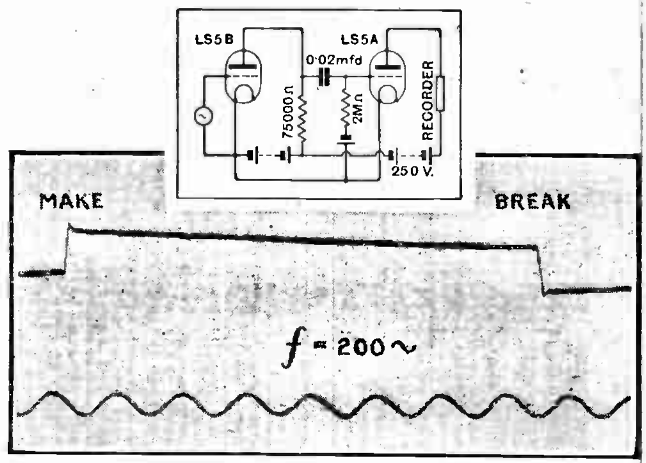


Fig. 18.—An intermediate value of coupling condenser, namely, 0.02 mfd., together with a two megohm leak, gives a satisfactory combination for broadcast reception.

So far as this investigation is concerned we find that amplifiers will superpose audible natural oscillations under the following conditions: (*a*) Transformer coupling with a valve having too high an internal resistance. (*b*) Choke-condenser output where the choke or the condenser is too small.

The value of the natural frequency $f=\frac{1}{2\pi}\times\left(\frac{1}{LC}\right)$ should be below audibility. The records also

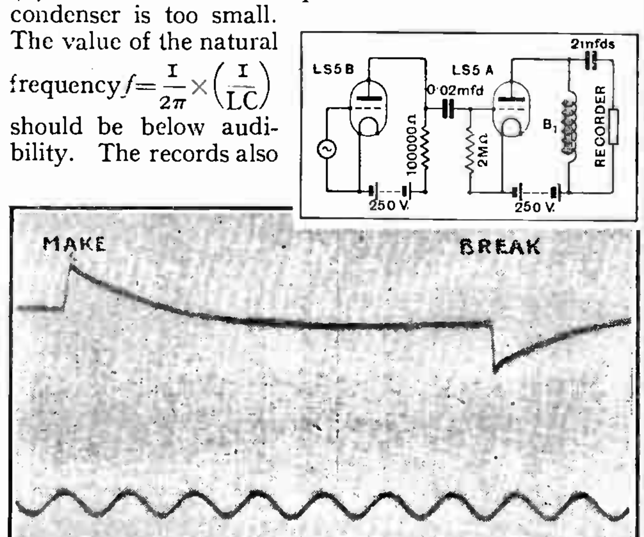
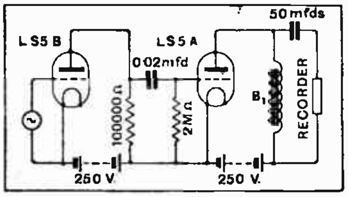


Fig. 19.—Where a choke filter output circuit is added to the amplifier shown in Fig. 18, the profile of the waveform is considerably less rectangular and there is evidence of low-frequency oscillation.

Transients in Loud Speakers and Amplifiers.—
show very clearly whether the amplifier is capable of reproducing low frequencies with any degree of accuracy; a point of importance with moving coil speakers.

So far as a rectangular waveform is concerned the records show that



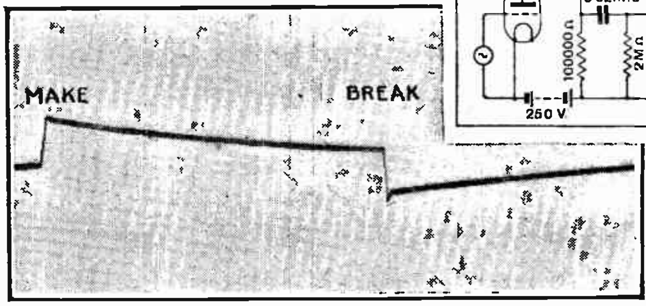


Fig. 20.—When a 50 mfd. output condenser is used the waveform is again substantially rectangular.

it is possible to design good amplifiers to work between certain frequencies, but with loud speakers the output, unfortunately, is distorted to a degree which is serious.

Low-frequency Amplifier Defects Masked.

So long as transients[6] are accompanied by the natural oscillations of a loud speaker (see Fig. 1) the latent defects of a modern L.F. amplifier will be difficult to detect.

It is only by conducting tests on the above lines that it is possible to ascertain the extent and characteristics of the distortion due to amplifiers or loud speakers. Having located the source of trouble one can take steps to avoid it by careful design.

A great deal has been written concerning the relative merits of transformer and resistance coupling; comparisons have been made with a sine-wave input, and little attention has hitherto been given to the effect of rectangular waveforms. The records clearly show that, having selected an L.F. valve, there are limitations in the choice of the coupling components.

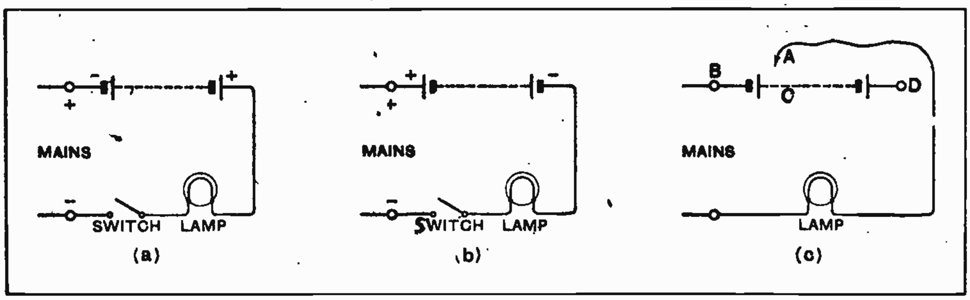
[6] For additional information see *Proc. Roy. Soc. A.*, Vol. 122, p. 604, 1929, also *Phil. Mag.*, Vol. 7, Supplement, p. 1011, June, 1929.

CHARGING HIGH-TENSION ACCUMULATORS.

The Question of Polarity.

IN charging high-tension accumulators from D.C. mains, it is usual to employ a lamp as a resistance to limit the current to that suitable for charging. It is not generally realised that this lamp can also be used for finding the polarity of the mains, and so ensuring that the accumulators really are charged, and not discharged by being connected wrongly.

A glance at (*a*) in the figure will show that if the negative end of the accumulator is connected to the positive pole of the mains, the voltage of mains and accumulator are added, giving a total voltage higher than that of the mains alone. If the circuit is now closed through the lamp, it will light with a brilliancy greater than normal. The current supplied to it is then partly derived from the mains, and partly from the accumulators, which are thus being discharged and not charged.



(a) Wrong connection: the accumulators are being discharged: the lamp lights with super-normal brilliance. (b) Correct connection: the accumulators are being charged: the lamp lights but dimly. (c) Before joining A to D, touch it on B and C to check polarity.

Conversely, if the negative end of the accumulator is joined to the negative pole of the mains, as in (*b*), the available voltage from the joint source will be equal to the difference, instead of to the sum, of their individual voltages, so that on closing the circuit the lamp will light with less than normal brilliance. In these conditions the accumulators are being charged, which is what is wanted.

A Useful Check.

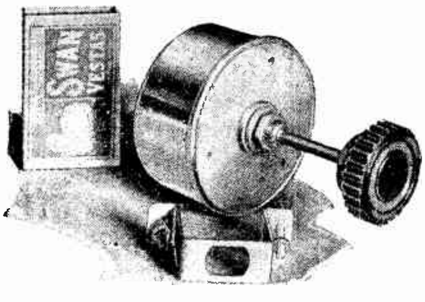
It will have been noticed that when the lamp is brighter than normal, the mains are wrongly connected, and when it is dimmer the connections are correct. Immediate comparisons of the lamp's brightness can be made by the arrangement shown at (*c*); the lead A is first touched on the terminal at B, when the lamp will light normally, and then at C, some twenty or thirty volts from B. If the lamp is now dimmer than before, A may be connected to D and charging commenced in earnest. If, on the other hand, the lamp is brighter when A is at C than when it is at B, the plug by which connection is made to the mains must be reversed in its socket before joining A to D.

To check polarity in this way before screwing the last wire under its terminal takes only a few seconds, and the assurance of correct connection that it gives is sufficiently definite to make mistakes practically impossible, and is obviously worth while.

A Review of the Latest Products of the Manufacturers.

SUPER-POWER CLAROSTAT.

The super-power Clarostat is a heavy-duty variable resistance functioning on the compression principle, and is rated to dissipate 250 watts. It is available in three resistance values, 0.25 to 10 ohms, 25 to 500 ohms, and 100 to 100,000 ohms. The lowest value is particularly suitable for controlling the filament current to a bank of large super-power output valves in public address equipment, or similar apparatus. For the higher values such functions as motor regulation, fine control of primary current in small-power transformers and many like uses, will readily suggest themselves to the radio engineer.



Super - power Clarostat with mounting bracket. The size can be gauged by comparison with a matchbox.

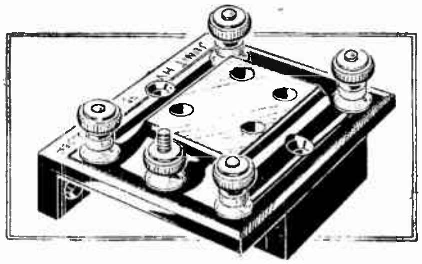
The sample sent in for test had a measured maximum resistance of 1,000 ohms, and a minimum value of 30 ohms. A slightly lower minimum than this could be obtained by applying more force than was considered desirable to the adjusting spindle. Further measurements were made after the device had been in use as a motor-generator input control (220 volts, about 50 watts).

Immediately after removing from the circuit and while the resistor was too hot for comfortable handling, the resistance values were found to be 12.5 ohms minimum and 1,100 ohms maximum. When cooled, further measurements showed that the minimum value had changed to 15 ohms, while the maximum had increased to about 3,000 ohms. These values did not change to any appreciable extent after further periods of use.

These resistances are supplied by Messrs. Claud Lyons, Ltd., 75, Old Hall Street, Liverpool, and the price has been fixed at 30s.

"JUNIT" VALVE HOLDER AND TERMINAL MOUNT.

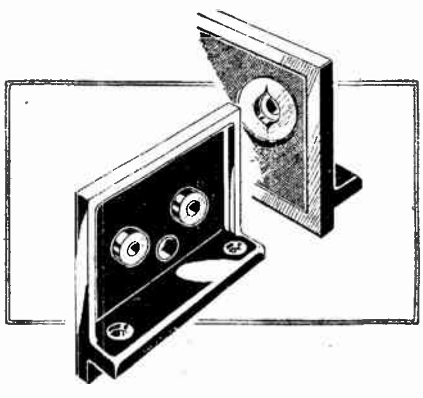
The "Junit" valve holder has been designed for horizontal or vertical mounting, and is provided also with a spare terminal which can be used as an anchorage for a wander lead, such as would be



"Junit" H.V. valve holder.

required for a pentode valve. It is essentially a universal valve holder, since it can be used for screen-grid valves, triodes, or pentodes. The body consists of a clean moulding with the valve sockets sunk below the top as a safety measure. The model illustrated is the type H.V., and is priced at 1s. 9d.

Another very useful accessory is a small moulded terminal strip measuring $2\frac{1}{4}$in. × 2in. high, with holes for two terminals and leads. It is moulded in black bakelite, and is provided with a flange on the inside face for fixing to the baseboard. The visible face is, therefore, free from unsightly screw heads. The makers are



"Junit" moulded terminal strip.

the Junit Manufacturing Co., Ltd., 2, Ravenscourt Square, London, W.6, and the price is 1s. 3d. a pair.

AMPLION "GUINEA CONE."

This is a redesigned, and incidentally an improved, version of the Amplion A.C.2 model "hanging type" cone loud speaker which we reviewed in our issue of February 8th, 1928. As its name implies, the price is one guinea only, but the performance is such that it could well be classified among those costing considerably more. The reproduction is clear, crisp, and free from objectionable resonances, although the movement used is of the single-acting reed type working into a fabric cone $9\frac{1}{2}$in. in diameter.

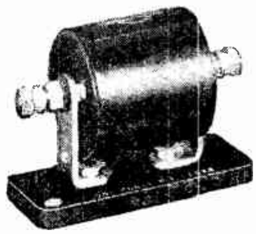
A small power valve with about 150 volts H.T. will deliver ample power to operate the loud speaker at sufficient volume to fill a room of average size comfortably. Its sensitivity to small electrical inputs is surprisingly good.

Amplion "Guinea Cone" loud speaker for wall suspension.

Like its predecessor, it is intended to be hung from the picture rail, and a silk cord is provided for this purpose. The protecting rim and support for the unit is moulded in one piece from mottled brown material, and the cone is finished appropriately. The design and finish are such as to be in harmony with most furnishing schemes. The makers are Messrs. Graham Amplion, Ltd., 26, Savile Row, Regent Street, London, W.1.

BOWYER-LOWE LONG-RANGE H.F. CHOKE.

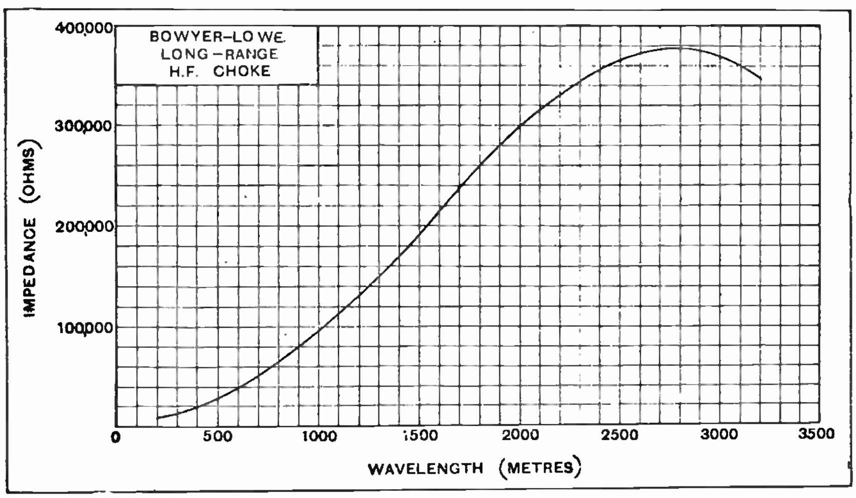
The outstanding feature of this component is the excellence of the electrical characteristics having regard to its small dimensions. In this respect the design



The Bowyer-Lowe long-range H.F. choke; D.C. resistance 400 ohms.

can be regarded as ideal, as the space available in the vicinity of the detector valve in the average set is generally limited. A choke of small dimensions permits a more logical arrangement of parts and wiring, and also reduces the possibility of coupling with other parts of the circuit.

The makers claim that the choke is suitable for wavelengths from $7\frac{1}{2}$ to 4,000 metres, and the measurements we have made indicate that this claim is justified. Even with the small external capacity associated with the measuring apparatus, the resonant wavelength is 2,800 metres, and under working conditions in a receiving circuit there is no reason to doubt that the resonance would approach 4,000 metres. With regard to the ultra-short waves, it is a matter of experience that chokes which have a long-wave resonance



Impedance curve of Bowyer-Lowe long-range H.F. choke; external capacity 8 micro-mfd.

and a comparatively flat impedance curve give results equal to and in many cases better than specially designed short-wave chokes. The impedance curves of the latter are "peaky," and the impedance at the foot of the curve is often no greater than that of the long-wave choke at the same wavelength.

The Bowyer-Lowe choke is free from subsidiary resonances, and the impedance at resonance is above the average. Impedance values at other important wavelengths are as follows:—

Wavelength (metres).	Impedance (ohms).
200	8,500
500	27,000
1,500	188,000

The wire is wound in a slotted ebonite former only $1\frac{1}{4}$in. diameter and $1\frac{3}{8}$in. long. A small ebonite base is provided for baseboard mounting, but the choke unit can be easily detached and suspended in the wiring of the set if desired.

The price is 7s., and the makers are The Bowyer-Lowe Co., Ltd., Letchworth, Herts.

BAWTREE HIGH TENSION ACCUMULATOR.

These batteries are supplied, normally, in units consisting of 12 cells and giving 24 volts. They are sent out with the plates unpasted, and before putting into use the positive plates must be filled with a paste made up from red lead and weak sulphuric acid, while the negative plates require filling with a paste prepared from litharge and acid.

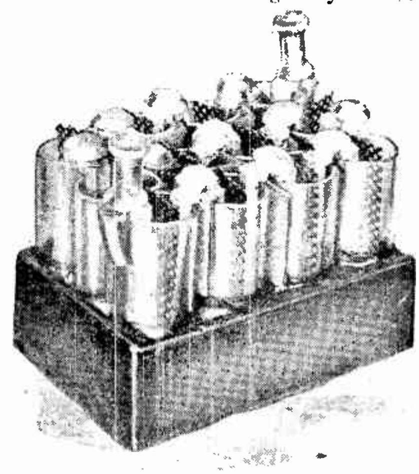
The electrolyte consists of sulphuric acid (accumulator acid) diluted with distilled water to a strength of 1,150. The initial charge should be for 6 hours at 0.1 amp., and subsequent charges for 8 hours at the same rate. The full capacity will not be obtained until the battery has been charged and discharged a number of times.

These batteries are supplied by Messrs. A. E. Bawtree, F.R.P.S., 20, Manor Park Road, Sutton, Surrey, and the price is 3d. per volt in 24-volt units. Smaller units can be supplied at an additional charge of 6d. per unit, a 10-volt unit costing 3s.

Spare plates and glass tubes cost 6d. each and spare ebonite separators 3d. each. It will thus be seen that the replacement of a faulty cell will be an easy matter.

"B.A.T." POWER TOGGLE SWITCHES.

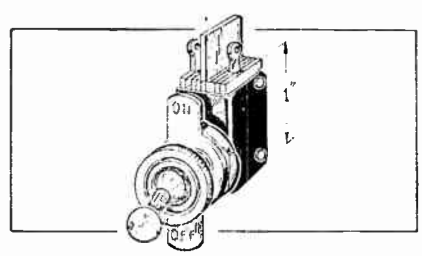
These miniature switches—they measure $1\frac{1}{4}$in. × $\frac{1}{2}$in. × $\frac{5}{8}$in. behind panel—are available in two types—a single-circuit and a double-circuit make-and-break. The single-circuit switch costs 2s. 5d., and the double-pole type is sold at 3s. 9d. In the "on" position the "live" contacts are bridged by a roller



Bawtree 24-volt H.T. accumulator unit.

which is held firmly in position by a helical spring. The two positions are positively defined, the lever moving into position with a reassuring snap.

All "live" parts are adequately protected, the lever, fixing bush and exposed metal work being insulated from the electrical contacts. Strips of paxolin are used for insulating purposes, the various pieces being shaped to form a hollow chamber which the roller contact operates.



"B.A.T." quick make-and-break miniature switch with one-hole fixing bush.

The external contact tags are separated by an extension of one of the paxolin strips and on each side of this there is a small ventilating hole giving access for air to the centre chamber.

The area of the contacting surfaces appears to be on the small side for a switch rated to carry 3 amps., at 250 volts; however, they functioned quite well on test and did not give any cause to justify doubt as to their ability to handle this wattage.

Their miniature size renders them ideal for use in portable sets, and the high standard of insulation achieved justifies their use in all types of mains equipment.

These switches are of American origin and are supplied in this country by Messrs Claud Lyons, Ltd., 75, Old Hall Street, Liverpool.

Regional Stage Fright ?—Ca' Canny at Brookman's Park.—B.B.C. and Sunday Programmes.

Peculiar Policy at Brookman's Park.

Since the B.B.C. will find time to carry out some radiation experiments from Brookman's Park before the service transmissions begin, it seems pertinent to ask why the "fade in" principle is to be adopted at all. We have been told that the change-over from the Oxford Street transmitter to the London Regional will be effected gradually, beginning with late dance music, and that each day will see a slight increase in the period of transmission from the new station until the existing 2LO is finally superseded.

For my part, I fail to see what object this ca' canny policy will achieve.

oooo

Why Prolong the Agony?

Possibly the B.B.C. is suffering from a sort of H.F. stage fright, fearing that those listeners who have no selective H.F. stages will run amok if suddenly faced with 25 kilowatts where there were only 3 kilowatts before.

The B.B.C. should take the risk. No good purpose will be served by prolonging the agony; there are no compensations in having teeth drawn slowly.

oooo

Period of Chastening.

Again, Savoy Hill has spent many weeks in telling the trade how to instruct customers in the alteration of their sets in preparation for more powerful signals. In many cases the listener has been advised to shorten his aerial.

The conscientious listener who has followed this advice will undergo a period of chastening while the transition is taking place. Half his evening will be spent in lengthening his aerial to pick up Oxford Street while the other half will be occupied in accommodating it to Brookman's Park.

oooo

Why Not an Inaugural Programme?

The best plan that the B.B.C. could adopt would be to fix a definite date—say September 14th—for the opening transmission from London Regional. The occasion—the inauguration of the Regional Scheme—merits a special programme.

As a safeguard against accidents, the Oxford Street transmitter could be retained for a month or two, but it must be remembered that Brookman's Park is not entitled to a long experimental period. 5GB has been the Regional Experimental station, as listeners to that station know to their cost!

oooo

A Sunday Innovation?

For a semi-Government organisation, the B.B.C. shows an astonishing and pleasing lack of inertia. All things considered, Savoy Hill is surprisingly responsive to listeners' demands in all except one respect. In accordance with the "spirit of the age," quite a number of people would like the Sunday programmes secularised to a greater degree than at present, but the B.B.C. has preserved a rigidity of outlook on this subject which seems to have awed even the profanest.

Now comes the startling possibility that on a Sunday in September the afternoon transmissions from all stations except 5GB may be devoted to a running commentary on the international air race to be flown over the Solent for the Schneider Trophy.

oooo

An International Event.

It is understood that this event will probably take place on September 7th, 8th or 9th, depending upon weather conditions. I hear that when the running commentary was first arranged it was decided that the broadcast would not take place if the race occurred on the 8th (Sunday). In view of the international importance of the race, however, official opinion has relented, so it is by no means unlikely that, for once, the Sunday programme may contain more race than grace.

oooo

An Empire Broadcast.

The B.B.C. microphone will be situated on the roof of the Ryde Pier Pavilion a few yards from the judge's stand. It is expected that it will be possible to receive and broadcast the lap positions and the final results within a few seconds of the judge's decision. There are ten competitors in the race, which covers seven laps of approximately 31 miles.

The lines in use for broadcasting will include the new cable beneath the Solent from Ryde to Portsmouth.

The transmission will also go out from 5SW, Chelmsford.

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Music at Meals.

Diners-out seem to have a legitimate grouse against the B.B.C. in the matter of restaurant music. It is complained that since the broadcasting of hotel orchestras began, the standard of musical performance has improved to such an extent as to interfere with the more serious business of mastication and digestion, the unfortunate diner being unable to concentrate on his victuals. The B.B.C. should supply soda bicarb.

oooo

Radio Drama.

The B.B.C. expects as big a success for the play, "One Day More," by Joseph Conrad, when it is broadcast from 5GB on Monday next, August 19th, as the distinguished author's "Lord Jim" met with when it was adapted for broadcasting by Cecil Lewis some two years ago. "One Day More" is one of the only two plays which Conrad wrote, though he also dramatised his novel, "The Secret Agent."

oooo

A Revival.

A noteworthy revival of next month will be that queer drama of life in Suburbia, "Squirrel's Cage." It is down for performance from 2LO on September 12th.

FUTURE FEATURES.

London and Daventry.

AUGUST 20TH.—Famous Northern Resorts Programme from Blackpool.

AUGUST 22ND.—A Feature Programme.

AUGUST 23RD.—The Canterbury Festival of Music and Drama—A Symphony Concert.

AUGUST 24TH. — "The Mulligatawny Medallion," a light play.

Daventry Experimental (5GB).

AUGUST 18TH.—An Orchestral Concert.

AUGUST 20TH.—Programme of Popular Chorus Songs.

AUGUST 22ND.—A Vaudeville Programme.

AUGUST 24TH.—Queen's Hall Promenade Concert.

Cardiff.

AUGUST 18TH.—Coleridge-Taylor Programme.

Manchester.

AUGUST 21ST.—Commentary on the Rydal Sheep Dog Trials.

Newcastle.

AUGUST 20TH.—The Electric Sparks Concert Party.

Glasgow.

AUGUST 24TH.—"What Ho! America," a revue.

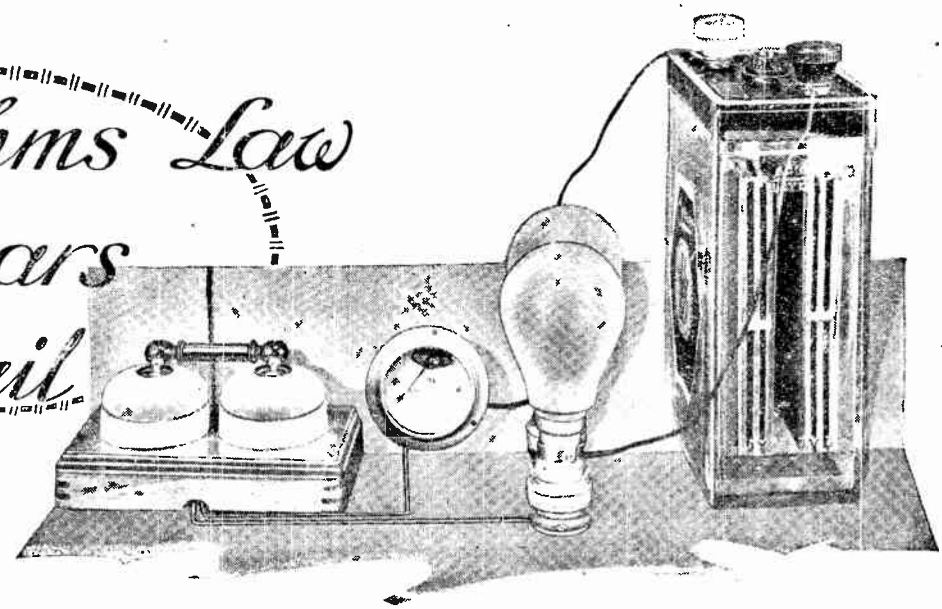
Aberdeen.

AUGUST 21ST.—A Scottish Concert.

Belfast.

AUGUST 22ND.—"Faust" (Gounod).

When Ohms Law Appears To Fail



By
N. P. VINCER-MINTER.

Seeming Inconsistencies Explained.

IN order to appreciate the points to be raised in this article, it is obviously necessary for the reader to be acquainted with Ohm's law itself, and although the writer has dealt with it at some length in previous issues of this journal he feels it desirable to recapitulate briefly the principles underlying this great natural law, one of the greatest, in fact, that has ever been discovered and promulgated by man, since it is the foundation stone upon which all the various branches of electrical engineering, including radiotelephony, are based.

Ohm's law is best expressed as a simple equation, namely, $I=\frac{E}{R}$, where I represents the current measured in amperes, E the electrical pressure measured in volts, and R the electrical resistance measured in ohms. From this equation it is obvious that, provided we know any two of the three measurements under consideration, it is but a matter of elementary calculation to discover the third; in other words, the equations $R=\frac{E}{I}$ and $E=IR$ are equally true.

Battery Charging Problems.

Now there is one other thing we require to know, and that is how to discover and express the power being dissipated in any electrical circuit. This is done by multiplying the current and voltage, which gives us a figure for power the unit of which is the watt. It will now be seen that if any three of the four quantities which we have just been discussing are known, the fourth is easily found.

We can now pass on to the consideration of instances where Ohm's law appears to fail. It never actually fails, of course, although the writer is aware that there are many who, through lack of clear thinking, allege that it does fail in certain cases.

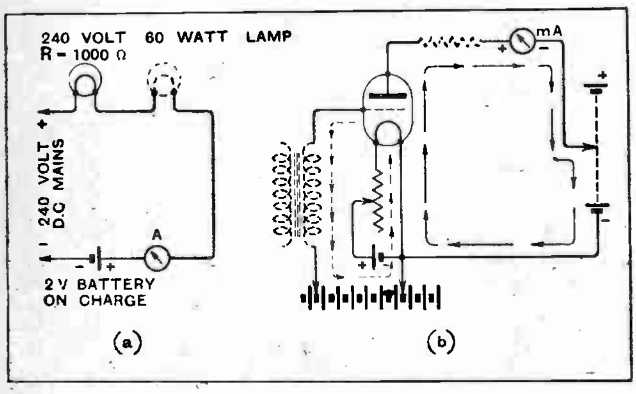
The first instance of apparent failure which the amateur is likely to encounter is in the charging of accumulators. We will assume that we have 250-volt D.C. mains, and wish to charge a small 2-volt accumulator the charging rate of which is 0.25 amperes. Now it is well known that the internal resistance of an accumulator cell in good condition is so low that it is virtually negligible. It is therefore obvious from Ohm's law that if the cell is connected directly to the mains there will be an enormous rush of current, and we must put a series resistance in circuit in order to limit the current to 0.25 amperes, which we have already assumed to be the normal charging rate of the accumulator. We will in this case ignore the back voltage of 2 due to the accumulator in order to simplify matters. A moment's work with Ohm's law shows us that a resistance of 1,000 ohms is required in circuit in order to limit the flow of current to 0.25 amperes. Now it is quite easy to obtain a reliable variable resistance of this value which is fully capable of carrying a much larger current than that stated without heating up. We can, however, choose one of the 250-volt 60-watt lamps which we have in the house, since it is clear from our knowledge of Ohm's law that its resistance *must* be 1,000 ohms, and if we put a reliable ammeter in circuit the reading will be found to be 0.25 ampères.

The Carborundum Crystal.

Let us suppose that, for some reason, we desire to halve the charging rate. The obvious idea of putting an additional lamp of the same rating as the original lamp in series in the circuit, as shown in Fig. (a), occurs to us, for we know by Ohm's law that doubling the resistance in circuit will halve the charging current. The lamps will now be burning dimly, as

When Ohm's Law Appears to Fail.—
the voltage across each will be only half the rated value, or, to put it another way, only half the current required to cause normal filament brilliance will be flowing. If we consult our ammeter, however, we shall find that our actual current is either considerably less than half or considerably more, according to whether our lamp is of the carbon or metal filament variety. It would appear, then, that Ohm's law has failed. This is, however, quite fallacious. What, then, has happened? Simply that the resistance of the lamp filament has changed. The explanation is that the resistance of a lamp filament changes with the temperature, and the resultant effect is the same as if we had been using a variable wire-wound resistance, and had failed to adjust it so as to include twice the amount of wire in circuit when desiring to halve the current.

Another thing to consider is the peculiar behaviour of the ordinary carborundum crystal. If a voltage be applied across this crystal, and gradually raised, a proportionately increasing current will flow until a certain critical point is reached, at which it accelerates more rapidly than the voltage. Apparently Ohm's law has failed; actually, however, the resistance of the crystal has suddenly become lowered.



In (a) is shown a simple battery charging circuit, while (b) shows a simple valve testing circuit. In the latter case it should be noted that the arrow shown in dotted lines indicates the direction that grid current flows if positive bias is applied.

The carborundum crystal is not alone in its peculiar properties of changing its resistance under certain conditions. Selenium, for example, changes its resistance under the influence of light, and many substances change their resistance under various influences, such as heat, mechanical pressure, etc. The modern photo-electric cell, of which the selenium cell was the precursor, possesses the property of altering its electrical resistance in accordance with the degree of light thrown upon it, and it is this property that has rendered possible the advent of talking films and such success in television as has already been obtained.

Ohm's Law and the Thermionic Valve.

We can now pass on to a point which concerns us most, namely, the apparently anarchic attitude of the ordinary three-electrode valve towards Ohm's law. In order to discuss this matter we will consider a valve which has a milliammeter in its plate circuit and which is provided with the usual H.T., L.T., and grid bias batteries. When all is connected up correctly, a steady current will, of course, pass from the valve filament across to plate through the milliammeter and H.T. battery back to filament, and then across to plate once more as indicated in Fig. (b) by the full arrows. We can ignore completely the actual filament heating circuit, which may be considered as a simple local circuit which does not here concern us.

Valve Resistance Altered by Grid Bias.

Now if we try the experiment of raising and lowering the value of voltage on the grid we shall at once notice that the plate milliammeter is varying in its readings in sympathy with the varying voltages we put on the grid. At first sight it would appear that Ohm's law has failed us altogether, for the current in the filament-plate-H.T. battery circuit (usually known as the plate circuit) is changing without our altering in any way the H.T. battery voltage or the value of any resistance in the circuit, such as an anode resistance, which we could, if we so desired, put in series with the milliammeter. Let it be said at once that if the plate circuit *could* be changed without any alterations being made to the voltage or resistance of the circuit, then would our faith in Ohm have been in vain. Actually, however, the cause of the varying plate current is the varying of the valve resistance.

It must be remembered that the grid in the valve is mounted directly in the path of the "electron stream" (a synonym for electric current) passing from filament to grid, and if we bias the grid negatively, or, in other words, force electrons from the grid battery on to the grid, they repel, to a certain extent, the electrons leaving the filament *en route* for the plate. The greater the negative bias, therefore, the less the number of electrons reaching the plate, and *vice versa*. The grid then merely acts as a variable valve resistance.

If we withdraw electrons from the grid by biasing it positively, we shall not only get a heavy plate current, but shall start a new thing, namely, grid current, which consists of electrons leaving the filament passing to the grid and then passing *via* the grid leak or transformer secondary to the negative end of our valve filament. An interesting point to notice here is that when grid current flows, it is in the direction of the dotted arrows, and so *tends* to charge the grid battery, and if we used a small accumulator for our grid battery it would actually charge it if the current were large enough to produce any definite chemical effect. The foregoing remark has somewhat of a Hibernian flavour, but is nevertheless true. Screen-grid valves and pentodes are, of course, equally as amenable to Ohm's law as the triode.

There are many other points in connection with the valve and Ohm's law upon which space forbids us to dwell. Similar considerations also forbid any discussion of Ohm's law and alternating current, and the writer can only state that in alternating current work, be it of the power variety, the "L.F. amplifier" variety, or the high-frequency variety, Ohm's law is still impregnable; there are many traps for the unwary who think they have found its Achilles heel.

"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.

Grid Circuit Decoupling Resistance.

I notice that in one or two receivers described in The Wireless World, *decoupling resistances and by-pass condensers are included in the grid circuit, particularly of an anode bend detector. Can you give me an idea as to the best resistance value to use, as there seems to be no general agreement on this point?* L. W. E.

The addition of a decoupling scheme to the detector-grid circuit is likely to be of some advantage when this valve is preceded by a highly efficient H.F. amplifier, and when bias is obtained from an unscreened battery common to other valves. As to the value of the resistance, a good deal depends on whether it is considered necessary to take precautions against L.F. interaction, as well as to restrict the flow of H.F. currents. Up to a point, the value is not critical, but the use of too large a resistance is apt to accentuate troubles brought about by the intermittent flow of grid current—which may sometimes take place in the best regulated set. Grid-leak type resistances are handy for this purpose, and we suggest a value of something between 10,000 ohms and 50,000 ohms.

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Audio-Transformer Coupling.

In almost every case, designers of sets with S.G. high-frequency valves make a point of the fact that a compromise between the requirements of selectivity, sensitivity and amplification can be made by suitably adjusting the number of primary turns of the tuned intervalve transformer. My own set is coupled by the tuned anode method. Is there any easy and simple way of effecting similar adjustments without radical alteration to the design? S. C. G.

Practically speaking, the advantages offered in this direction by double-wound transformers can be obtained in cases where tuned anode couplings are used by converting the coil into an auto-transformer.

The method of procedure will be made clear to you by a consideration of Fig. 1, in which the conventional connection between valve anode and coil is shown by a full line. When it is desired to improve selectivity, or to reduce amplification so that stability may be obtained, this connection is transferred to a tapping on the winding, as indicated by the dotted line. As this tapping is moved towards the end of the coil in connection with H.T.+, there will be progressive improvement in selectivity and, generally, a falling-off in amplification (unless the valve has an impedance well below the average).

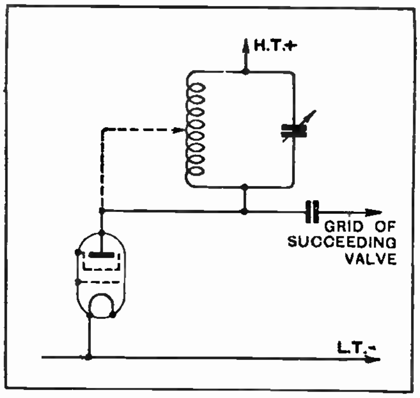

Fig. 1.—Illustrating a method of improving the selectivity of a "tuned anode" H.F. coupling.

RULES.

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

(2.) 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.

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

(4.) Practical wiring plans cannot be supplied or considered.

(5.) Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.

(6.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

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The "Everyman Four" and Gramophone Reproduction.

I am told that there is a very simple method of connecting a pick-up to an "Everyman Four" without the need of any alterations whatsoever. Will you please describe it? V. L.

Without a doubt, the simplest way of making this addition is to join the pick-up directly across the grid leak associated with the first L.F. valve. Of course, the H.F. valve filament, will be turned off, and, strictly speaking, provision should be made for extinguishing the detector filament in some way—a separate rheostat for it is not included in the original design.

As you will have gathered from recent articles on the subject, the majority of modern pick-ups give a sufficient output to operate with a two-stage L.F. amplifier—into which, in effect, the set is converted by fitting a pick-up in the manner described.

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H.F. Input Control.

A good deal has been written on the subject of pre-detection volume control, but I have seen no mention of the device I am at present using. This consists of a variable resistance of 250,000 ohms maximum value, connected directly across the aerial-grid coil. Do you consider that this scheme has any serious technical disadvantage? F. S. G.

In your locality, almost midway between two main stations, we would expect this simple volume control to work quite well, because selectivity cannot be a very serious problem to you. The scheme has but a limited field of usefulness for the reason that the selectivity of a tuned circuit is greatly reduced when a comparatively low ohmic resistance is connected across it, and it is invariably considered better to use a potentiometer device in which the tuned circuit is shunted by a high resistance, the desired signal voltage being picked up by means of a variable contact.

Eddy Current Coupling.

A good deal of attention has been paid of late to the question of screening in H.F. amplifiers. If we assume that plate and grid circuits, with their associated components, are completely enclosed in metallic boxes, is there any possibility of unwanted coupling between the coils? C. F. W.

Unfortunately, even the most complete screening does not preclude all possibility of undesirable couplings through magnetic interaction, although in almost all cases it reduces it to an almost negligible value. In amplifiers of the highest efficiency, in which maximum stage gain is aimed at, a certain amount of trouble is sometimes experienced through what is known as "eddy current coupling." This can generally be overcome by suitable disposition of the coils, and by careful choice of the earthing points on the metallic screens, although it might sometimes be necessary to go to the length of using double screening.

Anode Detector and Pentode.

The suggestion has been made that a pentode output valve is not altogether suitable for use immediately after an anode bend detector when these two valves are coupled by an L.F. transformer. Do you consider that there is any basic objection to this scheme? I may add that I have tried it with, apparently, very pleasing results. M. C. M.

There is no real reason why this arrangement should not work well, but in order to get the best results from it, certain precautions should be observed. The main disability of the scheme is associated with the fact that the pentode cannot handle a very large input voltage, while the anode detector preceding it works at its best under these conditions. This being so, it is not hard to see that, when the detector is working at its best, there is a serious risk of overloading the pentode, particularly if L.F. voltage is "stepped up" by a coupling transformer, and accordingly one is tempted to operate the detector incorrectly—from the point of view of quality—by reducing the H.F. input to it. The need for doing this can be avoided by shunting the primary of the transformer with a variable resistance, so that excess magnification can be thrown away when necessary.

Complicated Switching.

The H.F. stage of my set is transformer-coupled, and waveband switching is included, the method adopted being that in which low-potential ends of primaries and secondaries are connected together, while appropriate connections of the other ends of these windings are made by the blades of a double-pole switch. Long- and short-wave couplings are separate components, mounted with the coil axes at right angles. I now propose to add capacity-controlled reaction, winding the necessary extra coil on each transformer. Will you please show me how a four-pole two-way switch, already in my possession, may be used for waveband changing? N. G. S.

A satisfactory method of switching, applicable to the arrangement you specify, is shown in Fig. 2. We fear that it looks complicated, but it is hardly possible to simplify matters without introducing some modification to your proposed scheme. In any case, you will find it easy enough to trace out the connections, which are quite straightforward.

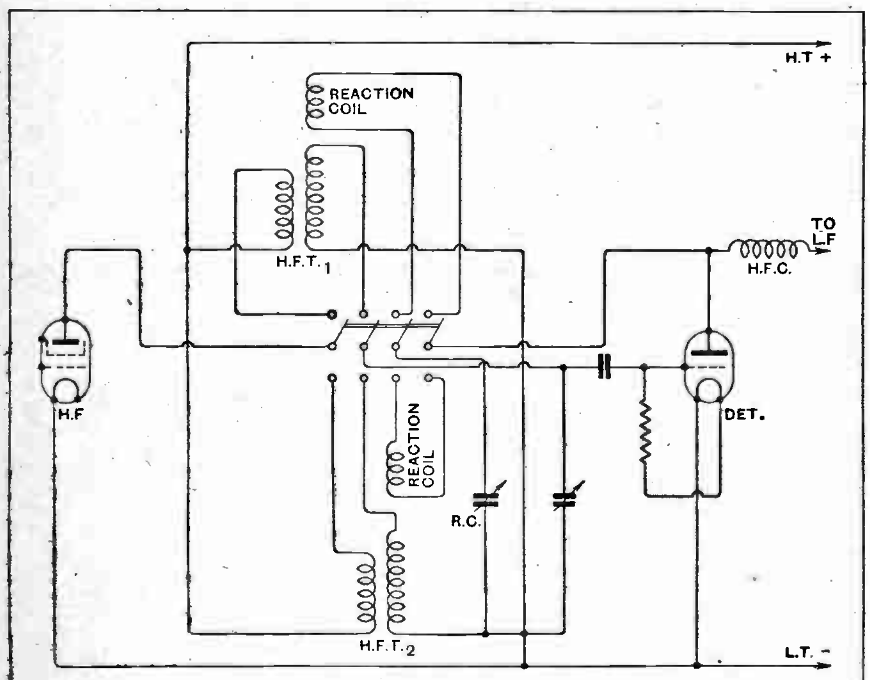

Fig. 2.—Connections for switching H.F. transformers and reaction coils where short-circuiting is not employed.

Gramophone Volume Control.

My set is fitted with a volume control resistance which is shunted across the L.F. transformer primary in the detector valve anode circuit. I am about to fit a pick-up, and should like to know whether the control will still be operative (and satisfactory) when the set is used for gramophone reproduction. J. D. S.

This all depends on the position of your pick-up; if it is inserted in the grid circuit of the valve in the anode circuit of which the shunted transformer is included, this method of volume control will work admirably. It would, however, be inoperative were the pick-up connected in the first grid circuit of a two-stage amplifier.

A Matter of Frequency.

(Referring to a reply to a previous query) . . . . I notice that you recommend me to insert a 20,000-ohm decoupling resistance in series with the anode of my S.G. high-frequency valve. Can it be assumed that a lower value—say, 600 or 1,000 ohms, as usually specified—would do equally well? I have practically no surplus voltage in my accumulator H.T. battery; hence this question. P. M.

We do not recommend any considerable reduction in the value of the decoupling resistance, as suggested in our first reply. Your trouble is L.F. instability, which we concluded to be largely due to feed-back to the detector grid *via* the tuned anode coil; the H.F. side of the set is apparently quite stable. Therefore it is necessary to choose a decoupling resistance of a high value; although it happens to be in series with an H.F. valve, it is intended to cope (in conjunction with its associated by-pass condenser) entirely with L.F. currents.

Pentode Output.

I have a Marconiphone moving coil loud speaker which, as you will know, includes a built-in output transformer designed to work in conjunction with a valve of roughly 2,000 ohms impedance. My problem is this: I am building a new set, intended mainly for long-distance reception, in which a pentode output valve is to be used; will it be essential to replace the loud speaker output transformer with another instrument specially designed for the pentode, or will the existing output device prove to be satisfactory. T. E. W.

Strictly speaking, a special output transformer, with primary and secondary windings designed respectively for the impedances of the pentode and of the moving coil, should be used. However, you will find that the existing instrument, without any modification, will give very pleasing results, and we doubt if you will find it nesessary to alter it.

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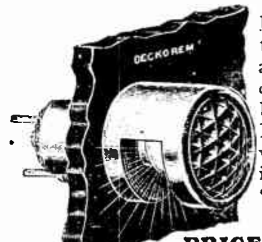

RECEIVERS FOR SALE.

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

3-VALVE All-wave Receiver, latest type, powerful, perfect; £4.—V. Taylor, 57, Studley Rd., Stockwell, London. [0274

WIRELESS is a Fascinating Subject, but makes heavy demands upon the purses of its devotees. For one who is determined to keep abreast of the times, there are always new components to be bought, and sets and loud-speakers to be superseded.

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THE Principal of this Firm, who has been a professional wireless engineer since 1910, and has been manager for the Sterling Telephone Co., radio expert to the General Electric Co., and Chairman of the Technical Committee of the National Association of Radio Manufacturers, will willingly give advice to those who are desirous of purchasing apparatus; we are entirely unbiased and will recommend the best apparatus for your particular purpose; you save money by having genuine expert advice.

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TANTALUM Electrode Strips for H.T. Rectifiers, suitable for A.C. mains eliminators; 2d. each, or set of 8, 1/-.—1.7, Dalton St., West Norwood, S.E.27. [0308

TANTALUM and Lionium for A.C. Rectifiers; make up your own inexpensive chargers; blue prints for H.T. and L.T., 1/- each; Lionium electrodes fitted with terminals 2-3 amps., and 5-8 amps.—Blackwell's Metallurgical Works, Ltd., Liverpool. [4593

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S. PULSFORD.—Coils, transformers; Europa portable, 21/- pair; Multiple valve portable, 21/6; S.G. Regional, 37/6 pair; Selective Two, 15/-; flat dwellers' A.C.3, 16/6; Kilo-mag Four, 60/- set; modulated wavemeters, 21/- pair; 600 ohm resistances, 1/6 each.

S. PULSFORD.—Foreign Listeners' Four medium wave coils, 31/6 set; long wave coils, 31/6 set; bases 1/6 each.—S. Pulsford, 135, Hockley Hill, Birmingham. [5817

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MORTLEY Generator, 1,500 volts, 100 m.a., £10, or near offer; Lucas dynamo, 12 volts, 250 Watts, Zenith transformer, 230 volts primary, secondary, 25 volts 5 amps., 12 volts 8 amps., centre tapped, what offers?—Newsomia, Bull Lane, Rayleigh, Essex. [5834

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QUARTZ Oscillating Lenses; 2/-; oscillate without reaction.—Smith, Bryn Rodyn, Colwyn Bay. [5799

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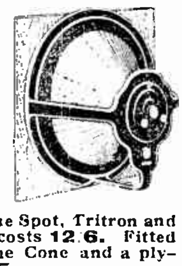

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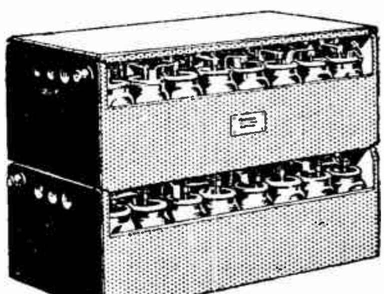

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P.M.22 (Pentone), slightly used, 12/6; P.M.4D.X., new 5/6; P.M.2, 5/-.—Freakley, 25, Sweetman St., Wolverhampton. [5788

TWO Mullard 4-volt Pentodes, little used; 28/- the 2.—2, Holly Park, Finchley, N.3. [5824

PERFECT, P.M.254 valve, full emission; 7/6.—77, Hartland Rd., N.W.6. [5823

MULLARD Valves, practically new, S.G., P.M.14, 12/6; P.M.4D, 5/6; Pentone P.M.24, 15/-.—79, Broadwater Rd., Bruce Grove, Tottenham. [5839

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600 Ohms Decoupling Resistances; see advert. under Coils. — Groves Brothers (Manufacturers). [5719

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COPPER Screening Boxes for Kilo-Mag Four, 27/6 each, cash with order; also copper screening boxes of all sizes made to order, prices on application. Rigby and Woolfenden, Sheet Metal Workers, Rochdale. [5455

POTENTIAL Dividers, 10,000, 15,000, 20,000, 25,000, and 30,000 ohms, 5 variable tappings; 2/- each.—Below.

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PERFECT.—Pye 32h. choke, 6/6; 2 Lissen 20,000 W.W. resistances with holders, 2/6 each; Igranic potentiometer, 2/6; T.C.C. condensers, 1/- each; Sifam M.C. milliameter, 0-20, not quite dead beat, 7/6; many plug-in coils, 1/- each.—Write 77, Hartland Rd., N.W.6. [5821

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EDISWAN 2-voyt Pentode, 12/6; Ferranti O.P.1 transformer, 10/6.—Santler, Howsell, Malvern. [5811

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KILO-MAG Four.—Screening boxes, as specified, 25/6; coils, 33/- set.—Stott, 63, Syke Rd., Rochdale. [5813

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THE Proprietor of British Patent No. 251521, dated October 9, 1925, relating to Improvements in Wireless Antenna, is desirous of entering into arrangements by way of a license or otherwise on reasonable terms for the purpose of exploiting the above patent and ensuring its practical working in Great Britain.—All enquiries to be addressed to Mr. B. Singer, Woolworth Building, New York City, N.Y., U.S.A. [5744

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PATENTS and Trade Marks, British and foreign.—Gee and Co. (H. T. P. Gee, Member R.S.G.B. and A.M.I.R.E.), 51-52, Chancery Lane, London, W.C.2. 'Phone: Holborn 1525. [0001

REPAIRS.

SCOTT SESSIONS and Co., Great Britain's radio doctors; read advertisement under Miscellaneous column. [0263

TWELVE Months' Guarantee Accompanies All Our Repairs; any make of L.F. transformer, headphones, or loud-speaker repaired and despatched within 48 hours; 4/- post free; don't discard if burnt out; terms to trade.—Transformer Repair Co. (Dept. W.), 214, High St., Colliers Wood, S.W.19. [0011

KINGSTON-ON-THAMES.—Loud-speakers, phones, transformers, repaired; 4/- post free.—Minter, 156, Cambridge Rd. 'Phone: Kingston 4665. [4832

REPAIRS Returned Post Free, and to ensure satisfaction send remittance after approval of same.—Leeds Wireless Repair Service.

LOUD-SPEAKERS, headphones, rewound to any resistance and remagnetised, 3/-; transformers rewound, 4/-; Blue Spots, Triotrons, and 4-pole units, 4/6; work guaranteed.—Leeds Wireless Repair Service, 5, Boston Place, Green Rd., Leeds. [5366

GUARANTEED Repairs by Experts; loud-speakers, headphones, cone units, pick-ups, any make or type, rewound, remagnetised, and adjusted, post free 4/-; L.F. transformers and chokes, rewound, from 4/- post free.—Howell, 42, Fotheringham Rd., Enfield, Middlesex. [5808

WANTED.

METRO-VIC ACP2, or Mullard D.O.20 valves, in good condition.—Walker, 89, Southgate, Sleaford. [5772

IGRANIO Potential Divider, Igranic L.T. choke and choke for D.C. mains set, also D.C. eliminator passing not less than 30 milliamps.—Box 2614, c/o *The Wireless World.* [5835

WANTED, Megavox Three eliminator, as described by "W.W.," December 19th, 1928.—95, Priory Rd., Southampton. [5789

WANTED, 2v. screened grid V, A.F.3.—W. H., 15, The Hale, Highams Park, E.4. [5787

CYLDON Dual Condensers, Indigraph dials, P.M.14 and P.M.4D.X. valves, M.C. meters, Utility switches, Ferranti A.F.5C. condensers, grid leaks, anode feed resistances, volume control resistances, valve holders, headphones, hydrometer, microphone transformer, and transmitting gear.—Box 2541, c/o *The Wireless World.* [5773

AGENCIES.

AGENTS Wanted, spare time, wireless experience, to demonstrate and sell the world's best and cheapest 3-valve set.—Mag-Radio, 112, Warstone Lane, Birmingham. [2667

EXCHANGE.

YOUR Old Apparatus Taken in Part Payment for Latest Type; see our advert. in column Receivers for Sale.—Scientific Development Co., 51, Fishergate, Preston. [0230

WANTED, good set or parts, have Master Three Star Blue Spot speaker, in cabinet, 3ft. 6in. high, month old, also motor cycle, all-chain, kick start, good condition; exchange either or sell.—Write Symmons, 20, Thompsons Av., Camberwell, S.E.5. [5780

EXCHANGE Zeiss Prism Binoculars for Portable Gramophone or Lion Standard Chassis.—H. W. Cook, near Post Office, Capel St. Mary's, Ipswich. [5798

PHOTOGRAPHERS.—Two fine outfits offered in exchange for portable or up-to-date components, 1/4 plate double extension camera, f/6.8 double anastigmat lens, speeded shutter, rising front, leather bellows and covering, 6 slides, focus screen, also small Ica Kinamo Cine camera, Zeiss Tessar lens, etc., cost £20, both outfits almost new; seen London.—Box 2542, c/o *The Wireless World.* [5774

FERRANTI O.P.1 Transformer for Output Choke; sell 10/6.—Santler, Howsell, Malvern. [5810

WANTED, D.C. mains eliminator, or exchange for new stuff; state requirements.—Box 2615, c/o *The Wireless World.* [5836

SITUATIONS VACANT.

WIRELESS Operating Appointments Assured; short qualifying course, day, evening; fees payable after appointment for boarding students; Morse classes.—Manager, Wireless School, 21, Manor Gardens, London, N.7. Archway 3694. [5368

WANTED, reliable sales manager, to take full charge of wireless department, must have good technical knowledge and experience.—Apply F. E. Wootten, Ltd., 55, High St., Oxford. [5792

Situations Vacant.—Contd.

WANTED Immediately, experienced men accustomed to the wiring of powerful low frequency amplifiers.—Apply, stating age, experience, salary desired, Box 2622, c/o *The Wireless World.* [5840

WANTED, improvers for wireless amplifier work.—Write, stating age and experience if any, Box 2623, c/o *The Wireless World.* [5841

LEADING Firm of Gramophone Record Manufacturers Requires Assistant Recording Engineer, must have first class knowledge of amplifier design and general electrical practice, previous recording experience and some musical knowledge desirable, but not essential.—Write in confidence, stating experience and salary required, to Box 200, c/o Pool's, 65, London Wall, E.C.2. [5830

SITUATIONS WANTED.

GENTLEMAN, residing in mid-Lancashire, with excellent connection amongst wholesalers and dealers, requires additional lines; commission only.—Write Box 2600, c/o *The Wireless World.* [5791

RADIO Engineer, 20, single, requires post September onward, Chatham district preferable, 6 years actual working experience of wireless and small power, moving coil installations, good technical knowledge.—Box 2601, c/o *The Wireless World.* [5794

INTEREST to Manufacturers.—Salesman-supervisor-tester, desires position, P.M.G. first grade certificate, salesmanship diploma, 5 years operating, retail experience; age 29, married.—Box 2618, c/o *The Wireless World.* [5838

YOUTH (22), experienced in high class radio service and constructional work, seeks position; good references.—R. Lloyd, 3, Stanley Av., Wallasey, Cheshire. [5806

HERE'S Your Man; live, adaptable, radio salesman and maintenance man, age 26, sound experience of mains receivers, L.F. amplifiers, and gramo-radio, etc.; not amateur; qualified electrician, 10 years' experience, desires position on salary and commission basis; preferably London area.—Box 2616, c/o *The Wireless World.* [5809

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WANTED, active partnership in radio business, small investment, or business going cheap with scope for improvement considered.—R.B., Box 2617, c/o *The Wireless World.* [5837

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OLD-ESTABLISHED Wireless and Photographic Business in Cardiff for Sale, plenty of scope for man with small capital; genuine reason for disposal.—Box 2543, c/o *The Wireless World.* [5775

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STEP by Step Wireless, a complete course of the theory of electricity in relation to the practical design of wireless apparatus, eliminators, circuits, etc., with extracts from a designer's notebook, giving up-to-date practical application; issued weekly, send 1/- p.o. for first 4 weeks.—Clifford Pressland, A.M.I.E.E., Eng., Dept. W.W., Hampton-on-Thames. [0195

WET H.T. Batteries are now a proved success; write for new illustrated booklet, giving cost and method of building and maintaining free; mention paper.—Taylor, 57, Studley Rd., Stockwell, London. [0077

FREE.—Inventor's Guide on Patents.—T. A. A., 253 (W) Gray's Inn Rd., London, W.C.1. [4127

"EXPERIMENTAL Wireless," Nos. 1 to 45, unbound, good condition; take 15/-.—A. G. Dickson, 76, Fern Av., Newcastle-on-Tyne. [5796

2,000 Wireless World, Amateur, Popular and Modern Wireless, Wireless Mag., etc; parcels of 1 dozen, assorted, 2/3 post free.—Dent, 25, Carrington Rd., Stockport. [5826

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INDEX TO ADVERTISEMENTS.

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BUILDING THE NEW KILO-MAG FOUR.

The Wireless World AND RADIO REVIEW

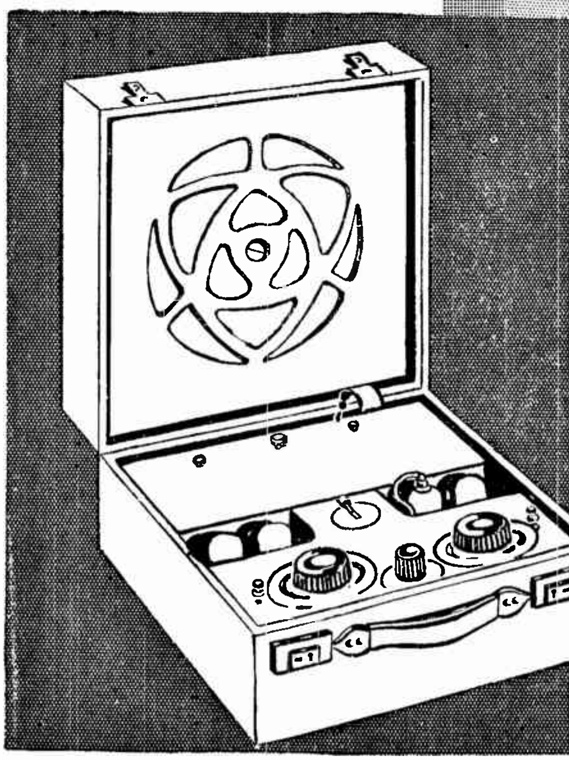
3D

The Paper for Every Wireless Amateur

Wednesday, August 21st, 1929.

No. 521. Vol. XXV. No. 8.

Beneath the trees, on the river, beside the sea, magic minstrelsy entertains the company with living music from across a continent—Burndept Portable Radio is your modern troubadour



4 valves, including Screened Grid; enclosed cone loud-speaker; calibrated wavelength scales; single switch for long and medium waves; fitted with turn-table; Complete in crocodile grained hide or mahogany cases.

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Like the Minstrels of old, you can now carry your music and your entertainment with you. Take a Burndept Screened Portable wherever you go—to tennis, or picnics, or holidays—and dance to continental bands or listen to the best music at home and abroad. The Burndept Screened Portable gives you the choice of some 20 programmes at clear loud-speaker strength – its magic is complete within a handsome attache case. Thousands of lovers of the open-air this summer are discovering the reliability, the simplicity and the perfection of the

Burndept

SCREENED PORTABLE

£25 . 12 . 6

Hear the Burndept Screened Portable at Keith Prowse, Harrods, Mudie's or the leading dealers in all parts of the country.

N.B.—The new wavelengths will not necessitate any alterations to current Burndept Receivers.

Write for Catalogues and Hire Purchase Terms to:

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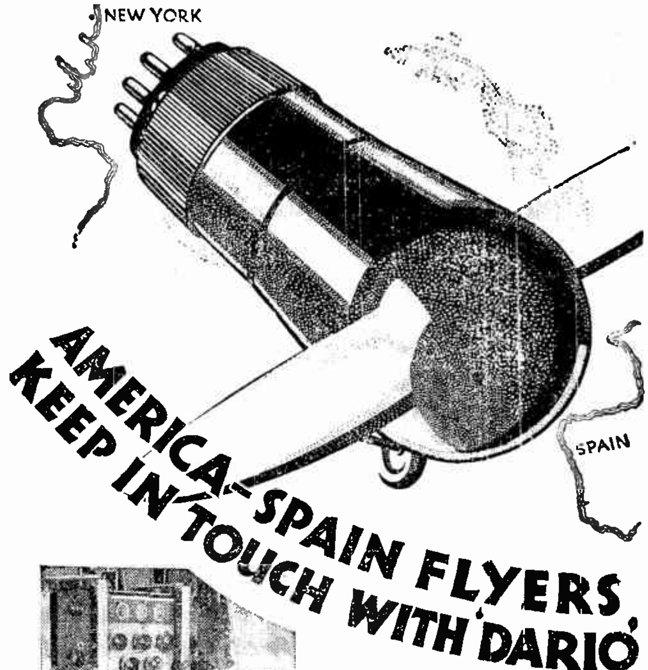

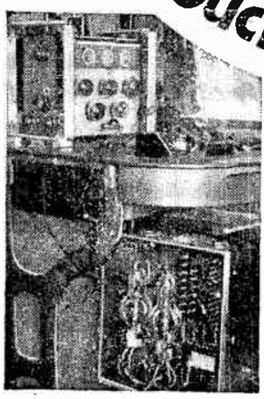

(On left) The wireless receiving and transmitting set on the airplane "Yellow Bird," shewing the "Dario" Valves.

THE "Yellow Bird's" and its heroic occupants' flight from New York to Santander, Spain, is already well known. All the time on this journey wireless communication was maintained with Dario Valves. Why not use Dario Valves yourself? They've proved themselves in a matter of life and death—they will improve your set beyond all expectations. Dario prices are little short of marvellous—they are due to one of the biggest and most modern valve outputs in the World. Ask your dealer or write direct for full particulars.

5/6 G.P. & R.C.C. POWER **7/6**

TWO VOLT	
General Purpose	5/6
R.C.C.	5/6
Super Power	7/6
Super H.F. & R.C.C.	7/6
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Super H.F. & R.C.C.	7/6
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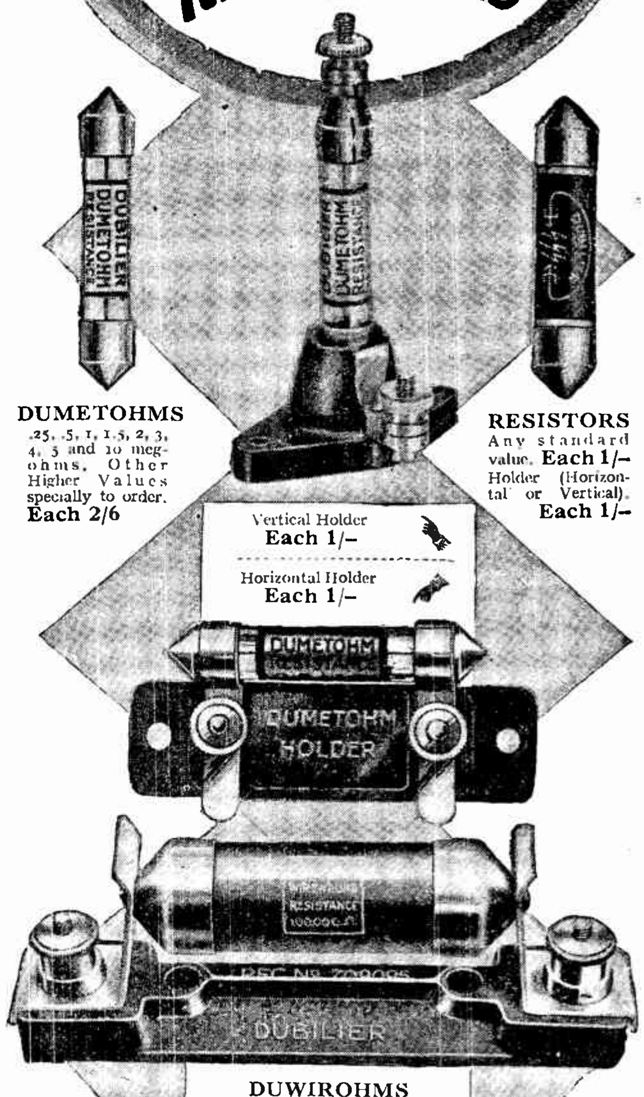

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.25, .5, 1, 1.5, 2, 3, 4, 5 and 10 megohms. Other Higher Values specially to order.
Each 2/6

RESISTORS
Any standard value. **Each 1/-**
Holder (Horizontal or Vertical). **Each 1/-**

Vertical Holder **Each 1/-**

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10,000 to 100,000 ohms	5/-
150,000 and 200,000 ohms	8/-
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300,000 ohms	11/6
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"TOREADOR SCREEN-GRID FOUR." This set incorporates the latest developments in Receiver design—full constructional details free on request.

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250/R

Newcomers-

H.T.3 gives 120 volts 20 m.a. D.C.
Price 21/-

H.T.4 gives 180 volts 30 m.a. D.C.
Price 37/6

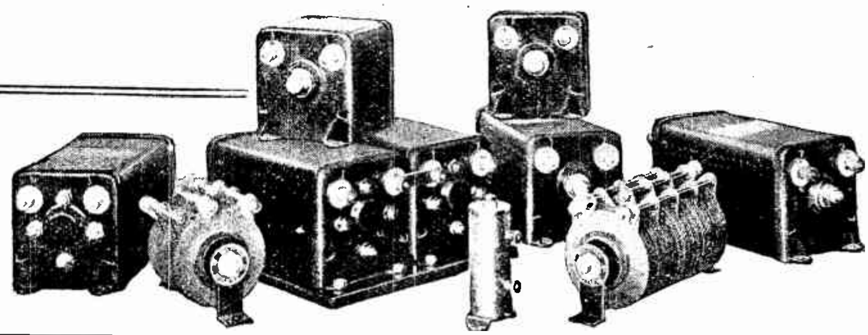
TWO NEW

WESTINGHOUSE

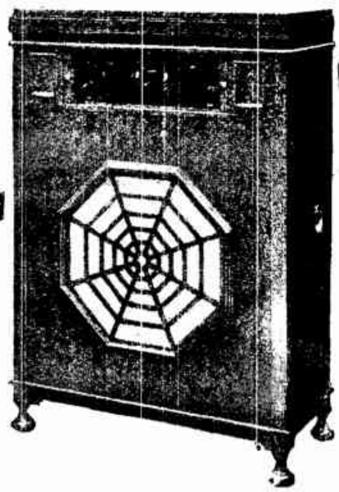
ALL METAL RECTIFIERS
TYPES H.T.3 & H.T.4

which, together with the established models shown below, form a group from which any type of eliminator or charger, from 6 volts to 350 volts, can be constructed.

Obtainable from the makers or through any dealer.



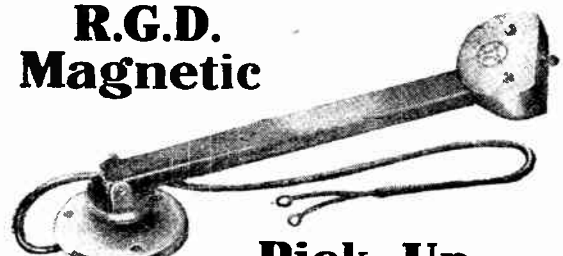
The Westinghouse Brake & Saxby Signal Co., Ltd.,
82, York Road, King's Cross,
London, N.1.
Telephone: North 2416.



The R.G.D. Radiogramophone.

An entirely new six-valve instrument giving the highest possible quality for both radio and record, with ample volume, incorporating the latest design of moving coil speaker, operates entirely from electric mains, A.C. any voltage, or D.C. 200 volts or over.

The
R.G.D. Magnetic



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The R.G.D. Magnetic Pick-up, as used in the R.G.D. Radiogramophone. No record wear, perfect tracking, a scientific instrument, specially developed for moving coil speaker reproduction. Price **£3** in bronze, **£3 . 3 . 0** in oxidised silver.

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Literature on application.

The RADIO GRAMOPHONE DEVELOPMENT Co.,
ST. PETER'S PLACE, BROAD ST., BIRMINGHAM.

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(17th 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.

THE BRITISH AMATEUR.

OUR recent comments on the status of the British amateur have provoked interest throughout the country, and by every post we are receiving letters from individual amateurs and from the various wireless societies. We are naturally only able to publish a few of these letters in our correspondence columns, but we would particularly refer our readers to certain letters which are to be found included in that section in this issue.

What stands out, perhaps, more clearly than anything else in the correspondence which we have received is the very positive evidence that the amateur is by no means dead, and that the same enthusiasm amongst amateurs still exists as it did in the past, but is lying dormant for want of leadership. This absence of proper leadership and failure to maintain the unity of the amateur movement is admitted in practically every communication which we have received, and admitted, too, with a tone of regret which leads us to believe that if an effort were made at the present time it would be possible to reunite and achieve the result which we so earnestly desire to see brought about.

There is a suggestion in some communications that *The Wireless World* should choose some existing amateur organisation and give it active support, and that by so doing the remaining organisations and individual amateurs could be brought together in a common organisation. This may sound all very well in theory, but we must say right away that we do not consider *The Wireless World* should be asked to shoulder the responsibility of making any such selection from amongst the existing amateur organisations.

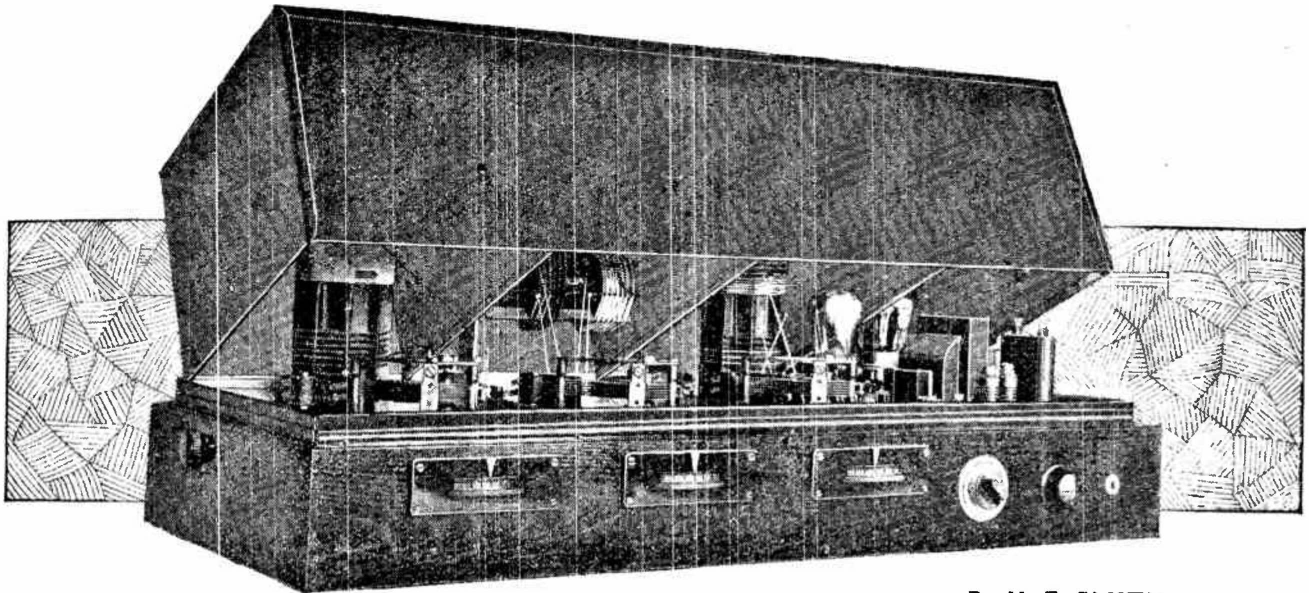
It will be recollected that for a number of years *The Wireless World* acted as the official organ of the Radio Society of Great Britain, but that, at our request, we were released by the Society from that obligation for the reason that we wished to be entirely independent and not hampered in any way in our policy should we at any time consider comment or criticism necessary in the interests of the amateurs as a body.

Appoint a Committee.

We now desire to see some action taken to further what, evidence goes to show, is the common desire of the British amateurs to be once more united and able to speak with one voice. We do not ourselves feel that it is by any means essential that there should be but one so-called "parent society" if it should prove to be the wishes of the majority that the identity and individuality of the various organisations should not be lost. We think that by way of a start it should be possible for quite a small committee to be appointed whose duty it would be to investigate the whole amateur position and prepare a report for submission to those by whom the committee was selected. Representation on such a committee could conveniently be arrived at on the basis of net membership of the various organisations.

It is very essential that in any negotiations to this end the welfare of the amateur collectively should be borne in mind, and any temptation which may arise to take advantage of the opportunity to manœuvre for position, either as individuals or as societies, should be firmly suppressed.

We look to the amateur organisations to make the next move and, whilst for the reasons which we have given above, it is not our intention to interfere in the politics of the amateur or support any particular party, yet we shall welcome the opportunity of doing anything possible which would help to bring about a better understanding and a proper unity amongst British amateurs.



By H. F. SMITH.

The New Kilo-Mag Four

Constructional Details and Operating Instructions.

(*Concluded from page 144 of last week's issue.*)

HAVING prepared the formers for the two sets of intervalve couplings—the slots can best be turned in a lathe, but it is not too laborious a task to cut them with a saw and ward file—the process of winding may be started. Here, again, some form of mechanical winder is of advantage, but by no means essential. It is best to begin with the secondaries; for the medium-wave coil (left-hand section of Fig. 4 (C)) a total of 60 turns, disposed in 6 sections of 10 turns each of No. 26 D.C.C. wire will be required. It will be realised that the wire cannot be led straight from the end of one section to the beginning of the other as it would interfere with the interwound primary. This difficulty is overcome by placing a strip of thin insulating material measuring approximately 1in. by ½in. between two adjacent ribs in such a way that it rests against the tubular body of the former; when the end of a section is reached, instead of passing directly to the next, the wire is guided under this strip, and, in consequence, the space immediately between the "pancake" coils is kept clear.

Still winding in the same direction, and making similar provision for the primary, the long-wave secondary is wound in the remaining series of six deep slots, each of which is filled with 35 turns of No. 32 D.S.C. wire. The writer would take this opportunity of pointing out that this winding is identical with L_1, the long-wave aerial-grid coil, for which double silk-covered wire is also used—not D.C.C. as stated in the first instalment. It should also be stated that the foot of the H.F. transformer mounting bracket is turned inwards and not outwards as shown in Fig. 4. The low-potential end of the medium-wave winding and the high-potential end of the long-wave section are joined together and to the tag marked *y*.

It is difficult to be definite with regard to primary windings. As always, this is essentially a matter for compromise and adjustment if best results are to be attained: selectivity will be improved, and any tendency towards instability will be checked as the number of turns are progressively reduced below the optimum value giving most amplification.

Primary Turns: the Best Compromise.

Unfortunately, it is a fact that gains in these directions are obviously offset by a concomitant falling-off in sensitivity, but, thanks very largely to the use of anode-bend detection, is is possible to work with reasonably large primaries, and, for average conditions, it is safe to plump for a medium-wave coil of 32 turns of No. 40 D.C.C. wire (four sections of eight turns). The corresponding long-wave winding has 105 turns of No. 40 D.S.C. (three sections of 35 turns). The wire must be adequately insulated and spaced from the secondary, where it passes from section to section: this can be arranged by leading it diagonally over a strip of insu-

The New Kilo-Mag Four.—
lating material of nearly the width of the space between adjacent ribs, or in any other convenient manner. Insulation between primary and secondary is a matter of some importance, and several cases of trouble with the original "Kilo-Mag Four" have been traced to defects in this respect.

In preparing the foregoing specification it is assumed that one of the popular types of S.G. valves, with an impedance in the order of a quarter-megohm, will be used. Fortunately, H.F. transformers are to a great extent self-adjusting to widely varying characteristics as they exist at the present time, and the transformers as described do not really call for any alteration when used with the new valves shortly to be available.

The method of mounting many of the components will be obvious from the accompanying photographs and drawings, but in two or three cases some few words of advice will be helpful. With regard to the wooden base—that illustrated is made of oak—it is recommended that the front panel should be not more than ¼in. thick; almost all components on the market are arranged for mounting on a panel of that thickness. Sides and back may be of ⅜in. wood.

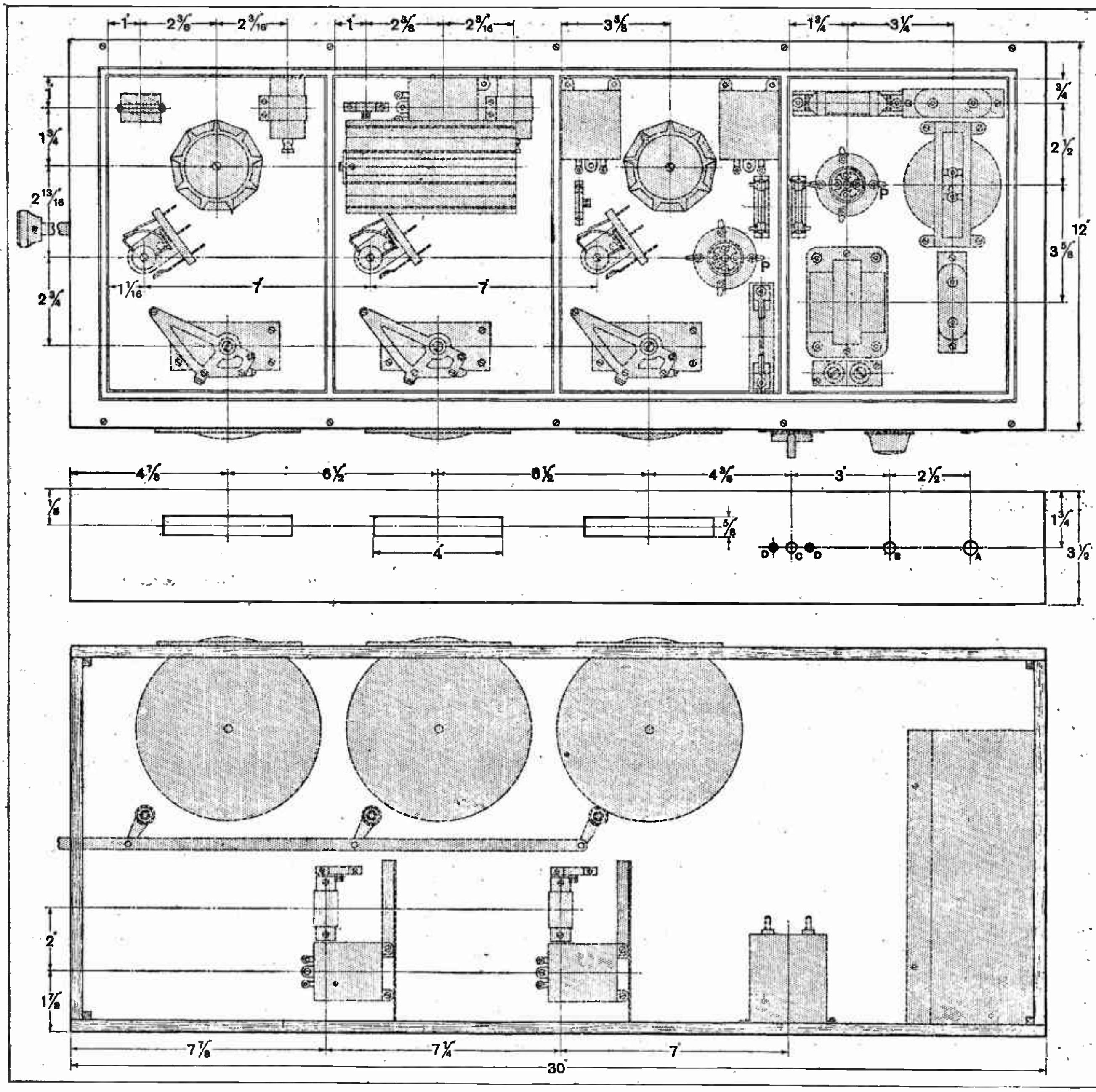


Fig. 5.—Layout of components in the screening compartments and in the base tray. In centre: drilling details of the front panel and positions of the condenser dial slots. A, 7/16 in. dia.; B, 3/8 in. dia.; C, 5/16 in. dia.; D, 5/32 in. dia., countersunk.

The New Kilo-Mag Four.—

Detailed instructions for making the large edgewise tuning dials and their escutcheon plates need hardly be given, as it is understood that commercial products will shortly be available. Those used in the set described are experimental models, turned from $\frac{1}{2}$in. ebonite sheet, with an overall diameter over the knurled rim, of $5\frac{3}{4}$in., and $5\frac{9}{16}$in. over the part carrying the scale (in the form of a band). Although weight could obviously be reduced by cutting away unnecessary material, it will be clear that these dimensions could not be substantially changed without altering the positions of the condenser spindle holes and possibly the dimensions of the container itself. As the diameter is so large, a slow-motion device is unnecessary.

It is desirable that the front panel of the base should be removable—it may be secured by wood screws to the side members—so that, after having fitted the condensers and dials, slots may be cut in the wood before it is placed in position, to coincide with the latter. Alternatively, these slots may be made oversize, so that the edges of the dials may be inserted in their slots and then raised to engage their centre holes with the condenser spindles. Of course, if this method of construction is adopted, the escutcheon plates must be large enough to conceal the apertures in the woodwork.

A very simple method of "ganging" the three switches has been adopted: though not above criticism on the grounds of mechanical soundness, it works quite satisfactorily, but can be altered to satisfy the hyper-

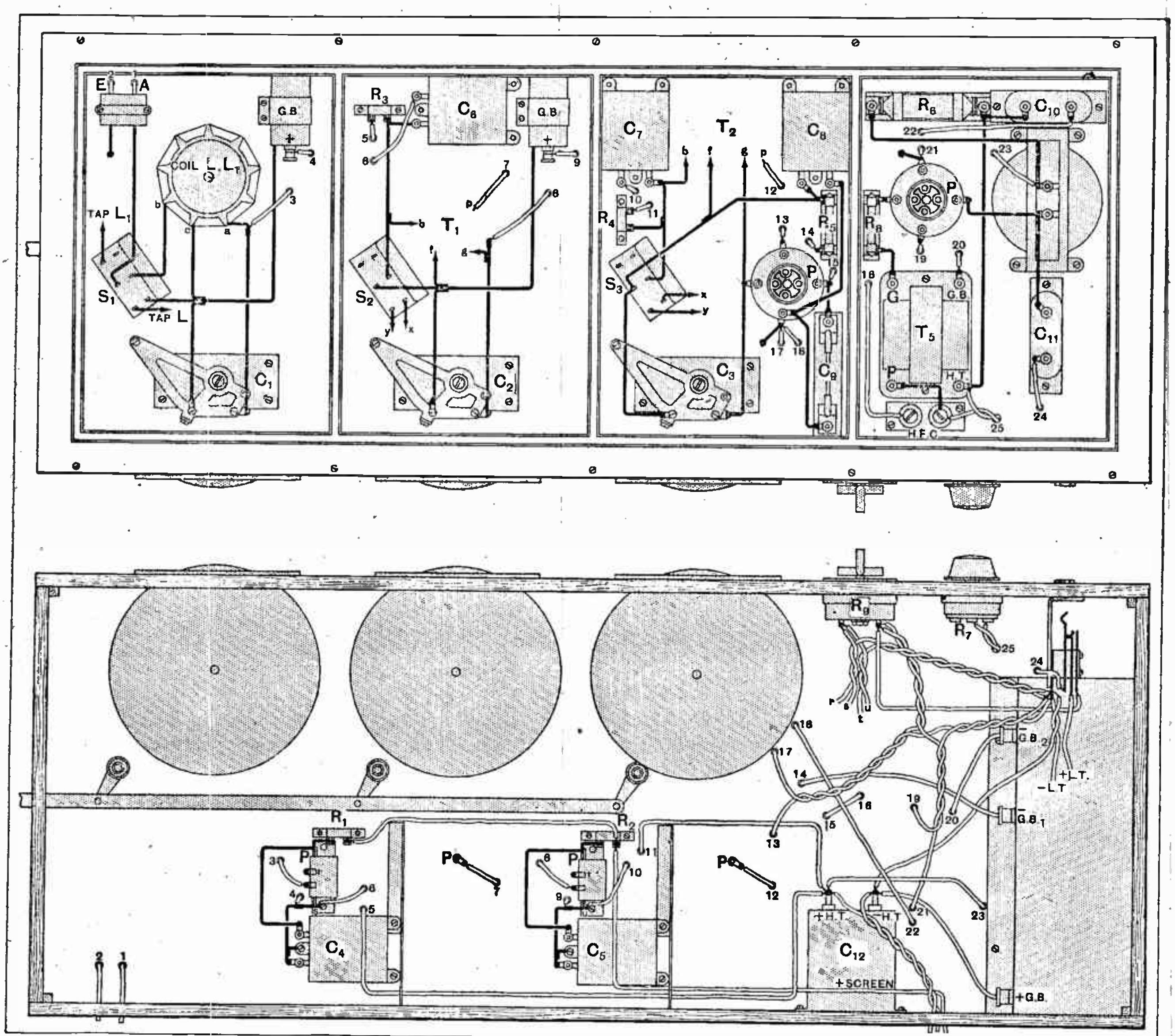


Fig. 6.—Practical wiring plan. H.F. transformers are not shown, but connections to their various terminals are indicated by the letters p, g, f, etc. Similarly, H.F. valve filament leads, run in the manner shown in the preceding photograph, are broken, their connections to the valve holders being indicated by corresponding lettering. Wires passing through the base are numbered in the same manner. Note that the holes for plate and grid leads passing out from the screened compartments are in such a position that the unshielded length is as short as possible.

The New Kilo-Mag Four.—

critical by the addition of an extra link and two guides. The control as shown is effected through a strip of brass, $\frac{3}{8}$in. × $\frac{1}{16}$in., measuring 18in. in length. Three holes, 7in. between centres, are drilled through this strip and correspond with holes drilled in the arrowhead switch pointer arms. A 6 B.A. screw, secured by a nut and locknut, is passed through both holes at each point, sufficient looseness being allowed to ensure free movement. One end of this strip passes out through a slot in the side of the inverted base tray and is fitted with a knob, the slot must be slightly wider than the width of the strip, of which the movement is not entirely confined to a lateral direction.

There is no need to insulate the "one-hole fitting" bushes of the switches from the metal work; they can easily be mounted through holes of the correct diameter, but some care should be taken to set them at the correct angle, so that the pointers are facing towards the front of the set when the moving contacts are at "off."

Many components can be secured by short woodscrews passing through the metal base into the plywood sub-baseboard, or, in the case of those on the lower compartment, directly into the wood, but in several instances it is best to use 6 B.A. or 4 B.A. screws and nuts, particularly in mounting the large by-pass condensers, of which the metal cases should be earthed.

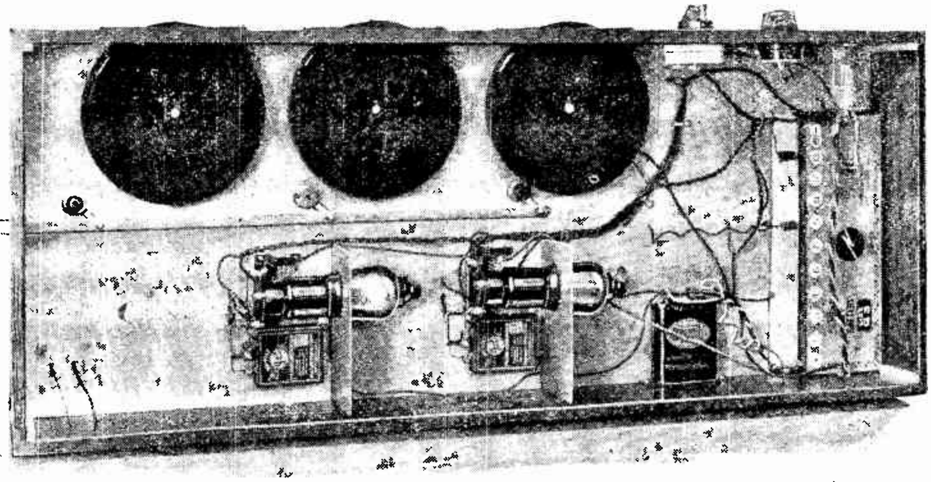
Points Needing Special Attention.

It will be seen that the single bias cells are held in position by simple metal clips, and that all three tuning condensers are mounted on rectangular strips of ebonite, it is necessary that their spindles should be insulated by drilling large clearance holes through the metal.

For wiring up the set, it is convenient to use both stiff wires and flexible leads. The former are suitable for use inside the screening compartment, while the latter will serve for connections in the base and for those passing through it. In cases where these are at high potential they may well be insulated from the metal by a short length of sleeving in addition to their rubber covering.

Each negative filament terminal should be "earthed" direct to the nearest point on the metal base; in the case of the H.F. valve, this is conveniently done by taking a lead to the head of one of the by-pass condenser holding-down screws, which passes through the wooden sub-baseboard and makes contact with the metal work.

It will be observed that the volume control resistance R_7 (see Fig. 6) is fitted with three terminals, one of which is idle. The component actually used is a potentiometer, but, for our present purpose a simple variable resistance only is necessary. Another small point likely to puzzle the constructor is in connection with the detector anode circuit wiring. Referring to the same diagram, a lead is passed down from the third screening compartment (from the left) into the base, and then up



Interior of the base compartment.

again into the "L.F." section and to the high-frequency choke. Of course, this wire could equally well be led through an aperture cut in the channel between the two compartments, but it was judged to be quite unnecessary to complicate the construction of the container by this addition. The connection in question is numbered 15 and 16.

With regard to the choice of H.F. valves, nothing need be added to what has already been said; for a detector, the Marconi or Osram "D.E.L." class or a Mullard "D." or "D.X." in 2-, 4- or 6-volt ranges are representative of the best type of valve for the rather difficult function of anode bend detection preceding an L.F. transformer. It is possible to load quite an ambitious valve—say a P.625—in the L.F. position without running into detector grid current, and, where an H.T. voltage in excess of 150 is available, it is best to provide a separate feed for the output valve. On voltages of between 120 and 150 a common anode supply with an extra connection for the screening grids, as provided in the design, is both adequate and simple.

Small metal screens of sheet aluminium measuring 3in. deep by 5in. wide are fitted to the H.F. valve, but in view of the particular constructional methods adopted they can hardly be considered as essential, although it is just possible to detect a slight improvement in stability when they are mounted in position. As usual, these shields should coincide with the internal screens of the valves; they are "earthed" through their securing screws, which make contact with the metal base.

If there is any tendency towards self-oscillation as the circuits are brought into tune, the first step should be to assure oneself that screening is as perfect as possible, and all contacting surfaces on cover and base

The New Kilo-Mag Four.—
should be carefully examined. If the trouble still persists, a few turns may be removed from the "plate" ends of the transformer primaries. It shoud be emphasised that this course will seldom be necessary, and that the need for any considerable reduction will indicate faulty screening or decoupling, or will suggest that the residual capacity of the H.F. valves is above the average.

A similar procedure may be adopted in order to increase selectivity in exceptionally difficult situations, but before altering the primaries it is well to try the effect of moving the aerial tapping nearer to the earthed end of the aerial-grid coil, medium- or long-wave, as the case may be. It is useless to blind ourselves to the fact that either of these adjustments will reduce signal strength, but fortunately overall magnification, even with a primary appreciably smaller than the optimum, is as great as can be handled under average conditions.

In any case, if this loss of sensitivity is considered as objectionable, there is a way out of the difficulty. Dare it be suggested that a separately tuned aerial circuit, involving one more control in a set already having three condenser dials, should be considered as a possible elaboration? The writer will take the risk of doing so, and, with the Editor's permission, hopes to describe a way of introducing this refinement as an addition rather than as an alteration to the design as it stands. A two-circuit tuner, by reducing shock-excitation of the input grid circuit, improves selectivity to an extent that can hardly be attained in any other way—even by reducing coil resistance to a value low enough to bring about a definite and perceptible loss of high notes. An extra tuning control is not a serious drawback in a set having more than one, or perhaps two, variable condensers, which must of necessity be operated either on the "step by step" plan or by reference to a previousy prepared calibration chart. It should be made clear that this alteration need only be considered by those living, in the wireless sense, under the shadow of a powerful transmitter.

This set is available for inspection at the Editorial Offices, 116-117, Fleet Street, London, E.C.4.

PARLOPHONE SOUND TEST RECORDS.

A Convenient Source of A.C. for Acoustic Experiments.

THESE records have been produced by the Parlophone Co., Ltd., 85, City Road, London, E.C.1, under the supervision of Drs. E. Meyer and H. Salinger, of the Heinrich Hertz Institute, Dusseldorf. The work of Dr. Erwin Meyer in connection with loud speaker characteristics is already known to readers of this journal and the Parlophone records embody the fruits of his experience in this sphere.

The first record in the series (No. P9794—I) gives a pure sine wave output starting at 6,000 cycles and falling steadily to 100 cycles. A curve is supplied with the record giving the frequency at any point in terms of the number of revolutions from the commencement of the 6,000 cycle note or alternatively in terms of the distance of the needle in centimetres from the starting groove. Provided the speed of the turntable is carefully adjusted to 80 revolutions per minute this method of estimating the frequency at any point will be sufficiently acurate for all practical purposes and should prove invaluable to experimenters who lack the musical training required to estimate frequency by ear.

The applications of this record are numerous. In the first place it may be used to examine the output characteristics of gramophone pick-ups, a valve voltmeter being connected across the leads to measure the terminal voltage. Resonances will thus be indicated visually, and the frequencies at which they occur can be easily ascertained by keeping count of the number of revolutions of the record.

An examination of the groove reveals that the amplitude of the sine wave increases as the needle approaches the lower frequencies near the centre of the record. In order to obtain a constant A.C. output the amplitude should vary inversely as the frequency, but a deviation from strict proportionality amounting to two decibels (about 25 per cent.) is permissible before the difference can be detected by the human ear. The makers state that the amplitude is correct to ± 20 per cent., so that for most acoustic purposes the output may be regarded as constant.

Having used the record P6964-I to discover a pick-up having good characteristic, the output may be amplified through one or more stages of resistance coupling and applied to any type of loud speaker, when it will be possible to obtain an aural estimate of the quality of reproduction. The frequencies at which resonances occur can be arrived at in terms of the position of the needle on the record, and it will be possible to judge whether the acoustic output is evenly distributed over the frequency scale or limited to certain definite zones. A little practice with a good moving coil speaker as a basis for comparison will soon give the experimenter a standard by which to judge performance. He will also be able to recognise the change in quality which indicates that the loud speaker movement is itself introducing harmonics.

A word of caution is, however, necessary in connection with the use of the P6474-1 record for loud speaker tests. It is well known that standing waves are formed in a room due to reflection from the walls. This fact can be easily verified by closing one ear and moving the head towards one of the walls during the transmission of the B.B.C. tuning note. In the case of the continuously changing frequency there is a continual redistribution of the nodes and antinodes. Whenever one of these antinodes passes the head of the observer it causes the illusion of a resonance in the loud speaker itself. The same applies when a condenser microphone is used to make accurate measurements of the acoustic output, and it is for this reason that this work is generally carried out in the open.

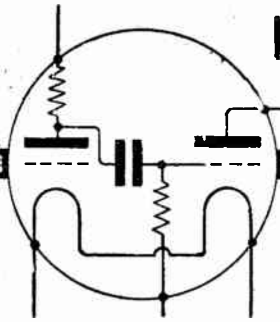
This source of error has been ingeniously overcome on the reverse side of the continuously decreasing frequency record. The same range of frequencies is covered by this record (No. P9794-II), but a rapid fluctuation of ± 50 cycles is superimposed which causes the nodes and antinodes to move their position slightly. Actually the standing waves shift their position 10 times per second, which effectively eliminates the semblance of imaginary resonances and gives a true *mean* reading at any point in the room.

Standing waves are also troublesome when determining the echo characteristics of rooms and the permeability of walls to sounds of various frequencies and special records for work of this nature have been included in the Parlophone Sound Test series. In these records the mean frequency is constant, and as distinct from the falling mean frequency of the P9794-II record. The mean frequencies and $\frac{1}{10}$ second variations of frequency are as follows :—

Record.		Mean Frequency.	Variation.
P 9795	I ...	150 ...	± 50
		300 ...	± 50
	II ...	600 ...	± 50
		1200 ...	± 50
P 9796	I ...	4800 ...	± 50
		2400 ...	± 50
	II ...	950 ...	± 650
		1800 ...	± 1600

The complete set of three records in an album, together with instruction booklet, costs two guineas, and supplies are obtainable direct from the address given above.

NEW H.F. AMPLIFIER CIRCUIT



Remarkable Stage Gain Using Aperiodic Coupling.

MOST readers will know, by name at least, the multiple valve made by the Loewe Radio Company containing in one large bulb a detector valve, a low-frequency amplifier, and an output valve, together with the necessary resistances and coupling condensers. This valve was used in *The Wireless World* "Multiple-valve S.G. Portable" set (April 17th). The method of construction makes for cheapness and compactness, but in a low-frequency amplifier the reduction of unwanted capacity afforded by such a mode of construction can at best offer only a small reduction of the loss of high notes for a given degree of amplification per stage. Up to the present all efforts to attain good amplification at high frequency by resistance coupling have failed, to some extent at least, on account of these same stray capacities, so that it would seem that the assembly of the entire amplifier, with coupling resistances and condensers, in a single bulb would offer considerable possibilities in this direction. Such an assembly has been available for some time in the Loewe 2H.F. multiple valve, which contains two four-electrode valves and is suitable for use where one such valve only is required to precede the detector.

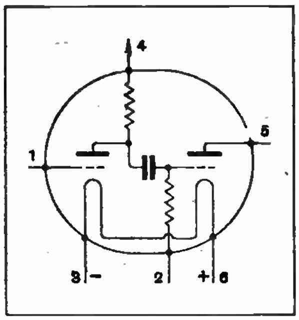
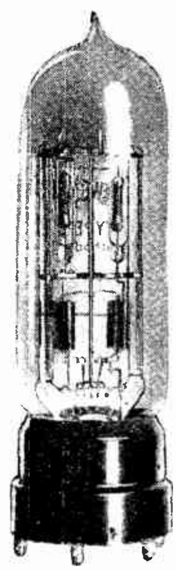


Fig. 1.—The circuit of the amplifier within the bulb of the double valve.

Stray Capacities Reduced to a Minimum.

This model, however, has not been found completely satisfactory where several such valves are to be used in series, and for this particular purpose a new model has been designed. Specimens of this type have reached us from Germany for test, but manufacture in England has not yet commenced. Nevertheless, it is felt that readers will welcome advance information of this valve, which is of unusual interest in several respects.

The bulb contains two complete three-electrode valves, one anode resistance, one coupling condenser, and one grid-leak, and is equipped with a six-pin base for use with the special valve-holder used for the other types of multiple valve. In Fig. 1 the large circle represents the bulb, which contains all components shown within the circle. The points numbered 1 to 6 represent the six pins of the base, the numbers running consecutively round the base of the actual valve.



A general idea of the structure of the multiple valve may be gained from this photograph. The anode resistance and the grid-leak may be seen above the valves proper.

One of the first points in construction that attracts attention is the design of the base. Six equidistant pins are mounted on a ring of insulating material, and the wires coming through the glass "pinch" from the electrodes are led direct to the pins and soldered. To prevent damage, a thin disc of insulating material, which does not touch any metal connections at any point, fills up the centre of the ring. Any losses due to this disc should be negligible.

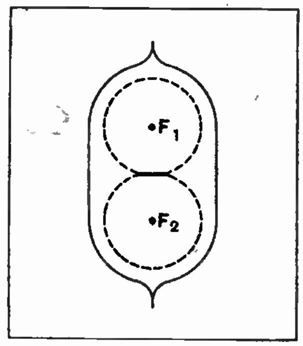


Fig. 2.—Diagrammatic representation of one valve. The filaments F_1 and F_2 are connected in parallel, the grids have a common support, and one plate surrounds the whole. The doubling of filament and grid serves to improve the characteristics of the valve.

Apart from the fact that one pair of leads (4 and 5) cross on the way from the pinch to the pins, it would seem that both dielectric losses and stray capacities due to the valve-base have been reduced to the commercially practicable minimum.

The assembly is built up on a "U" of glass, of which the bottom forms the pinch through which the leads are taken. The valves themselves sit side by side at the bottom of the "U," and are noteworthy for the fact that each contains two straight two-volt filaments connected in parallel. Each filament has its own grid, the two being mounted on a common support, and the whole is surrounded by a single plate, as indicated in Fig. 2. The filaments of the two valves are connected in series, so that the unit requires a 4-volt accumulator, from which it draws a filament current of 0.37 amp.

Immediately above the valves proper, set vertically and at right-angles to the plane of

New H.F. Amplifier Circuit.—

the "U," is the coupling condenser, which is joined to the plate and grid respectively of the two valves by leads less than half an inch long, and spaced as far away as possible from all other leads and components. This condenser, we understand, has a capacity of the order of 0.0001 mfd.

On either side of the condenser a resistance of "grid-leak type" is mounted vertically; one actually is a grid-leak, the other the anode resistance. Rather long leads run the whole length of the bulb from the top end of these resistances to the pinch (2 and 4), but as both are at earth potential so far as signals are concerned this is of no great consequence. Leads 1 and 5 come through the pinch at opposite ends, and extend above it for less than half an inch. It is apparent that great care has been taken in the whole layout and construction of the valve to avoid any unnecessary additions to the stray capacities which, if allowed to rise above a very small value, would be liable to reduce the amplification to negligible proportions.

The Static Characteristics.

The static characteristics of the valve were measured as nearly as practicable in the manner employed for those of ordinary valves. It will be seen from Fig. 1 that if the terminal 2 is connected to the L.T. – terminal 3 the second valve is given a grid-bias of – 2 volts, owing to the voltage drop of this amount in the filament of the first valve. With this connection made, which represents practical working conditions, the anode current of the second valve alone was measured for different anode voltages. The figures obtained are shown in the curve of Fig. 3, and lead to the value of about 13,000 ohms for the A.C. resistance of the valve.

Measurements of the plate-current at different grid voltages elicited the fact that grid current does not flow provided that the grid is not less than 1.2 volts negative with respect to its own filament, and that the amplification factor of the valve examined was 10.

The assumption was then made that the two valves in the bulb were identical in electrical performance as well as in appearance, and on this basis it was found,

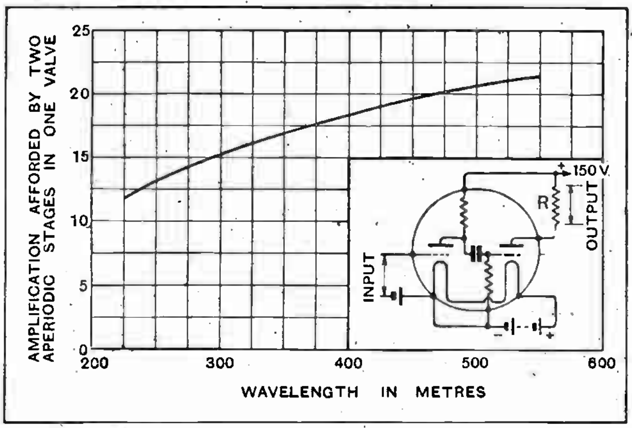


Fig. 4.—Measured amplification of multiple valve at various wavelengths. The resistance R is 22,000 ohms.

by taking the characteristics of the first valve, that the anode resistance incorporated in its plate circuit had a value of 22,000 ohms, and that with the resistance in position this valve had an A.C. resistance, under normal operating conditions, of 18,000 ohms.

With these figures available it is possible to calculate the amplification that should be attained by each of the stages in the double valve, using an external anode resistance of 22,000 ohms for the second valve, and ignoring the effects of inter-electrode and stray capacities in lowering the amplification. On this basis the amplification of each stage should be 5.5 times, giving $(5.5)^2$ or about 30 times as the overall amplification of the two stages. For comparison with this the amplification actually attained at various wavelengths within the broadcast range was measured, the results obtained being plotted against wavelength in Fig. 4. It will at once be seen that the amplification achieved varies between 10 and 21 times over the range investigated—results which are extremely good for resistance amplification at the wavelengths mentioned.

At first sight, it may be surprising that valves of so low an amplification factor as 10 should be employed for a resistance-coupled amplifier, and one may be inclined to suggest that if valves of the high-impedance type had been used instead the amplification would have been greater. It is a well-known fact, however, that the inter-electrode capacities of a valve under working conditions rise very rapidly as the amplification factor of the valve is increased, being, indeed, very approximately proportional to this figure. Consequently as the "μ" of the valve is increased the proportion of the theoretical amplification that is attained in a practical high-frequency amplifier drops very rapidly, and such valves give, for this purpose, not

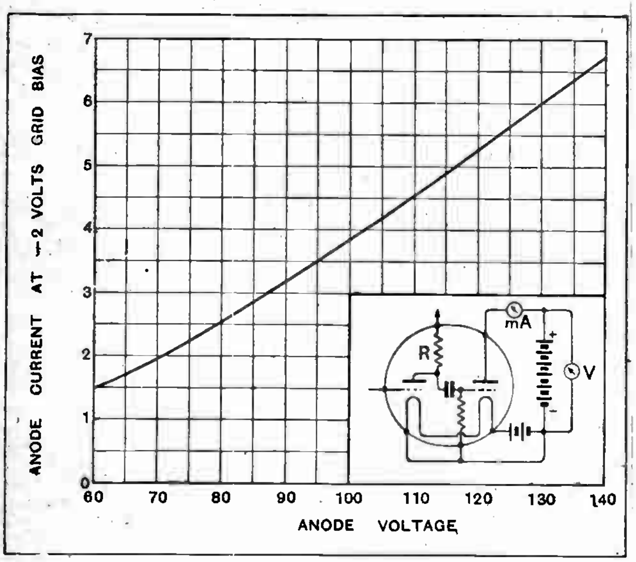


Fig. 3.—Plate-voltage plate-current characteristic of second valve in the Loewe 2H.F. multiple valve, without anode resistance and "natural" grid bias of –2 volts. The circuit is as shown. The valve characteristics are as follows: R_0 = 13,000 ohms at 150 volts, or 18,000 ohms with plate resistance of 22,000 ohms. μ = 10.

New H.F. Amplifier Circuit.—
more but less actual amplification than those of lower amplification factor. The drop in amplification due to stray capacities becomes most rapid when the actual amplification is in the neighbourhood of 70 per cent. of the theoretical value, so that if valves of higher amplification factor than correspond to this condition are used the theoretical increase is more than offset by the extra loss due to additional stray capacity. If, on the other hand, valves of lower "μ" are employed, the closer approach of actual to theoretical amplification is more than counterbalanced by the decrease in the amplification factor of the valves. There is thus an optimum value for the amplification factor of the valves, above and below which the amplification attained in practice falls off. and the value chosen must be such that the amplification is some 70 per cent. of that calculated without allowing for stray capacities.

It is interesting to note that at 300 metres the amplification given is 15 times for two stages, or 3.9 times for one stage, and that this value is exactly 70 per cent. of the theoretical amplification of 5.5 times that one stage would yield if stray capacities could be neglected. This comparison confirms the belief that this multiple valve is very skilfully designed, and suggests that it offers the greatest measure of aperiodic amplification that is likely to be achieved on the broadcast band for some time to come.[1]

Owing to the fact that no resistance is incorporated in the anode circuit of the second valve of the assembly, a tuned circuit can be used, if desired, to couple the multiple valve to the valve that follows it. When the next valve is another high-frequency amplifier, the use of a tuned circuit as coupling is optional, but the designer of the valve strongly recommends that a tuned circuit should immediately precede the detector

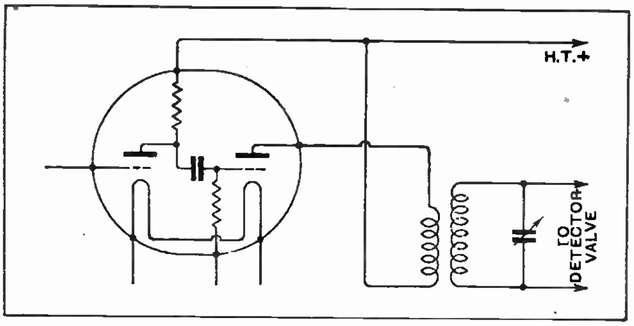


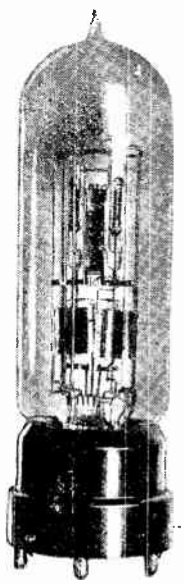
Fig. 5.—The multiple valve followed by a high-frequency transformer in place of a resistance. No neutralising is required. The overall amplification afforded by this circuit is about 100 times at 300 metres.

valve, since by this means freedom from motor-boating and kindred troubles is assured. The reader will therefore be tempted to enquire as to the overall amplification that may be expected from this arrangement, which is shown diagrammatically in Fig. 5.

The second valve, with a standard Litz coil of 68 turns on a 3in. paxolin former as transformer secondary, requires a primary of some 14 or 15 turns, and may be expected to give an amplification of about 23 times at 300 metres. This, together with the measured amplification of 3.9 times due to the first resistance-coupled stage at this wavelength, gives a reasonable expectation of a total amplification of 90 times. On measurement the amplification at this wavelength turned out to be 102 times, the excess being very readily accounted for by the fact that the change in effective capacity caused by altering the output circuit from resistance to transformer coupling slightly increases the amplification of the first stage.

Absence of Input Damping.

All the measurements of amplification so far mentioned were made by feeding to the first grid of the multiple valve a voltage obtained by passing a measured high-frequency current through a resistance of known low value. There was thus no opportunity for the valve to decrease the voltage applied to its grid



Taken from a slightly different angle from the last, this shows the position of the coupling condenser, placed between anode resistance and grid-leak.

[1] Since examining this valve, a newer model, none of which has yet appeared in England, has been designed. It follows the valve here described very closely, but the two stages taken together give nearly 30% greater amplification.

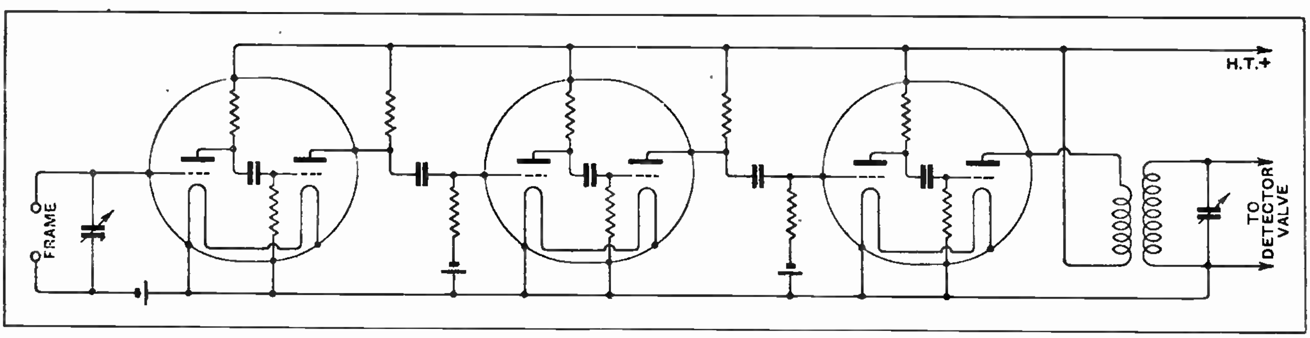


Fig. 6.—A high-frequency amplifier built up from three multiple valves. The overall amplification would be about 20,000 times at 300 metres, but the selectivity would be that associated with two tuned circuits only. Compare Fig. 7.

New H.F. Amplifier Circuit.—

by the negative reaction that is usually a prominent feature of aperiodic amplifiers. If, however, the valve is to be connected across a tuned circuit, such as a frame aerial, having, say, a dynamic resistance of a quarter of a megohm, this effect, if present, may be very serious. If reception is carried out on a frame, and this is damped by the valve to such an extent that only one-tenth of the normal voltage is developed across it, then this reduced voltage, after a 15-times amplification, would be only $1\frac{1}{2}$ times that obtained from the frame direct, and for all practical purposes the valve would be useless.

A frame aerial was therefore connected to the grid of the valve, and the voltage developed across it by the local station was measured with the filaments of the multiple valve first cold and then heated. Resistance-coupling was in use in both stages, and the normal working voltages were applied. It was found that the voltage on the frame rose by about six per cent. when the multiple valve was lighted, showing that so far from there being any damping introduced into the frame-aerial circuit, there was a small gain due to reaction. The full measured amplification of the valve will therefore be effective in a practical receiver, with a trifling bonus thrown in.

This valve has been discussed at some length, although it is not yet available to the general public (we understand that it will be in full production this autumn) partly because it raises a number of problems of considerable practical and theoretical interest, and partly because it offers an opportunity, for those who are so inclined, to design or build receivers of novel type.

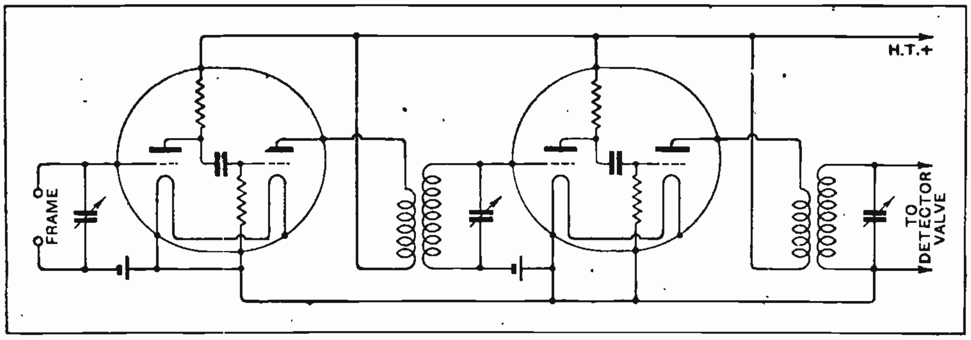


Fig. 7.—A high-frequency amplifier containing two multiple valves. The overall amplification would be about 10,000 times at 300 metres, and the selectivity would be high, as there are three tuned circuits. Compare Fig. 6.

Ordinarily, it is necessary to add one tuned circuit to the receiver for every valve acting as high-frequency amplifier, with the result that both the design and operation of a highly sensitive set become very difficult. Even if the most extensive screening is employed, the stability of a receiver containing two or three stages of efficient high-frequency amplification is usually a matter for speculation until the set is built, and if, as is likely, such a set is to be used with a frame aerial the selectivity attained is usually excessive, so that tuning becomes unnecessarily difficult, and the side-bands of received telephony are liable to be cut off. With an aperiodic amplifier these difficulties are less prominent, though high amplification can readily be attained by using a sufficient number of stages. Moreover, the selectivity can be adjusted independently of the sensitivity, for one may use just enough tuned circuits to give the selectivity that is found necessary, and then make up the total amplification with aperiodic stages.

Receivers for the Valve.

With the valve we have discussed, for example, an overall amplification of the order of 10,000 times might be attained in either of two ways. Three double valves might be connected in cascade, using, besides the frame, only one tuned circuit immediately before the detector, as suggested in Fig. 6. Or, if the selectivity conferred by two tuned circuits were regarded as insufficient for the particular locality in which the receiver was to be used, one might prefer to employ only two double valves, using a tuned circuit as coupling between the two as well as immediately before the detector, as in Fig. 7. The amplification attained would be very roughly the same in both cases, but there would be a very considerable difference in selectivity between the two receivers.

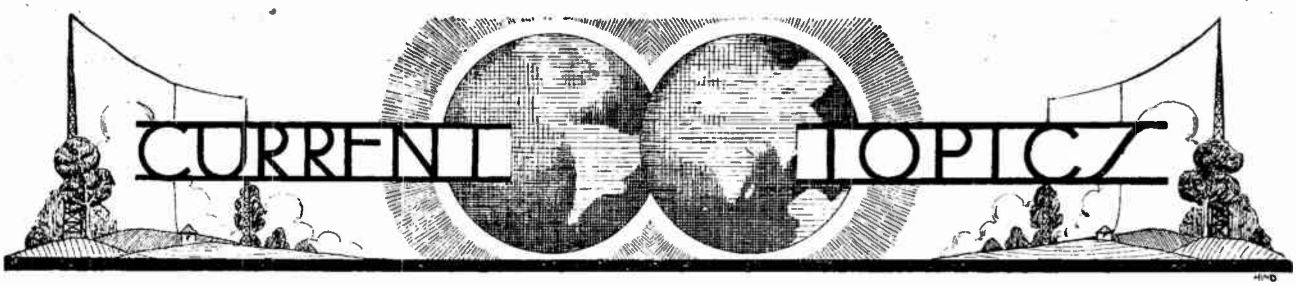
In an amplifier in which tuned couplings are used throughout it is inevitable that the amplification attained should be greater at the lower end of the tuning range than at the upper. It will be seen from Fig. 4 that with the resistance-coupled stages of the multiple valve the opposite effect is experienced, the amplification rising as the wavelength is increased. It will therefore be clear that by a judicious combination of tuned and aperiodic couplings it should be possible to construct a receiver yielding practically constant amplification over the whole of its tuning range or with any desired wavelength-amplification characteristic.

BOOKS RECEIVED.

Code for Protection against Lightning.—Approved April, 1929, by the American Standards Association. With Appendix giving short dissertation on lighting, its origin, characteristics and effects. Published by the Bureau of Standards, Washington, D.C., U.S.A. Price 25 cents.

Der Weg zum Rundfunkhören, by Dr. Hanns von Hartel.—Describing the nature and functions of apparatus in general use for broadcast reception. Pp. 56, with 38 illustrations. Published by Rothgiesser und Diesing A.G., Berlin. Price R.M. 1.30.

Kennrufe der Rundfunksender.—List of 170 European broadcasting stations giving the geographical position, wavelength, identification signals and other particulars of each station. Pp. 173. Published by Rothgiesser und Diesing A.G., Berlin. Price R.M.2



Events of the Week in Brief Review.

CHICAGO'S FLYING SQUAD.

The Chicago police department is so impressed with the efficiency of Scotland Yard's flying squad that it intends not only following their example, but even going one (or many points) better. We hear that a 5 kW central station is to be erected, and 150 cars are equipped with wireless receiving sets. The larger cars are to be manned by five police officers, and will be armed with machine guns, shot guns, tear bombs, cameras and finger-print equipment. The enterprising burglar will have no cause to lament the monotony of life and the lack of thrills in the pursuit of his calling.

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WIRELESS PHOTOGRAPHY IN AUSTRALIA.

Pictures of events in Australia will probably be transmitted to us at no very distant date, as Amalgamated Wireless (Australasia), Ltd., who own the majority of the important broadcasting stations in Australia, have concluded with Messrs. William Blogg and Co., Ltd., the Fultograph agents in that country, a five years contract for a still-picture service. Transmissions from Melbourne are expected to begin shortly. All short-wave enthusiasts in this country will hope that 3LO, the 31.5-metre Melbourne station, which is now temporarily closed, will start work again, and that we shall have still pictures from the Antipodes. Both 3LO and 2FC (Sydney) on 31.28 metres are well heard over here, and there is no reason why good reception of pictures from the other side of the world should not be possible.

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CANADA'S SHORT-WAVE STATION.

CJRX, the short-wave broadcasting station, has been moved from the Grain Exchange Building in Winnipeg to a point about 10 miles from the city, and is now transmitting again on 25.5 metres with an input of 2 kW. Reports on the new station's signals will be welcomed by the owners, Messrs. James Richardson & Co., Grain Exchange Buildings, Winnipeg, Manitoba.

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A VERY NORTHERLY STATION.

The Russian expedition to Franz Josef Land has selected a site for the wireless station on Hooker Island, and has already begun to unload material for its erection from the ice-breaker. The proposed station will be 80° 19′ N.

A GOOD MIXER.

We understand that it is intended to install an "inverter" at the experimental short-wave station of the International Telegraph and Telephone Corporation at Trappes, near St. Cyr, France. The object of this apparatus, which we believe has been designed by Standard Telephones and Cables, Ltd., is to prevent telephone messages being picked up by promiscuous listeners, and this result is achieved by inverting the frequencies of the speech sounds so that high notes become correspondingly low and low ones high until the receiving equipment re-converts the frequencies to normal. Wireless eavesdroppers, therefore, who may chance to pick it up will probably think they are listening to ultra-modern music.

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BERLIN WIRELESS EXHIBITION.

The annual Wireless Exhibition, which, as stated in our issue of July 10th, will be opened at Berlin on August 30th and continued until September 8th, will no doubt attract a great number of wireless enthusiasts from all parts of the world to the Kaiserdamm grounds. It will surpass its predecessors in size and interest.

FIRST LAMME MEDALLIST.

The late Benjamin G. Lamme, chief engineer of the Westinghouse Electric and Manufacturing Co., under the terms of his will directed that a medal should be given "for meritorious achievement in the design of electrical machinery," the recipient to be chosen by the American Institute of Electrical Engineers. The first holder of the Lamme medal is an Englishman, Mr. Allen Bertram Field, Consulting Engineer to the Metropolitan Vickers Co., Ltd., for "the mathematical and experimental investigation of eddy-current losses in large slot-wound conductors in electrical machinery."

The ceremony of presentation was broadcast through the short-wave set of KDKA.

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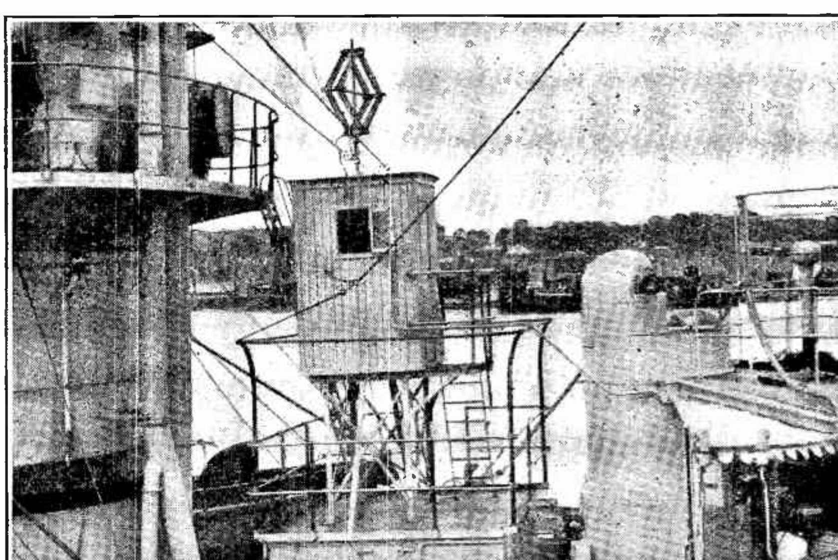
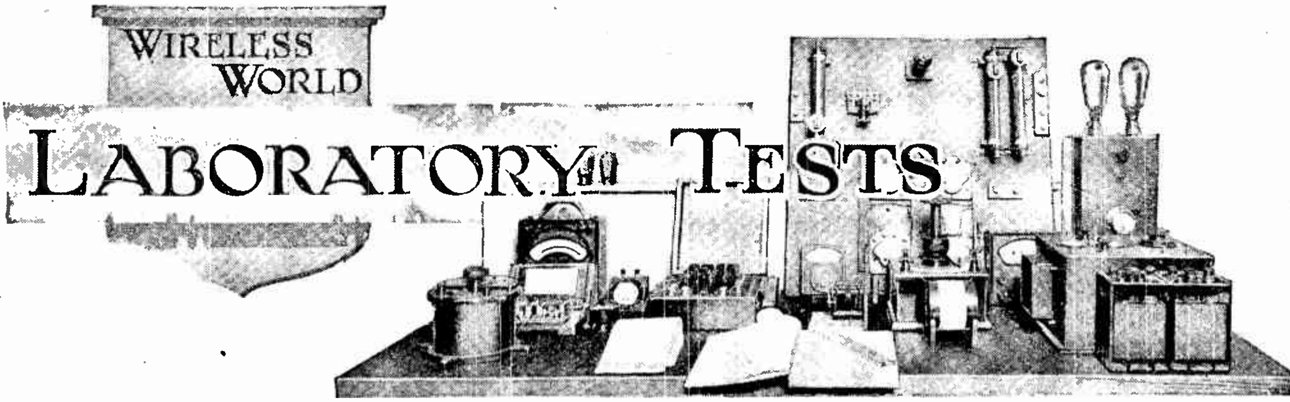
MAGNUM UNIVERSAL, A CORRECTION.

We regret two errors in our description of the "Magnum Universal" broadcast receiver which appeared in our issue of August 14th. On page 151 the captions to the two illustrations were inadvertently reversed and the price should have read £18 and not £10. We trust that the manufacturers, Messrs. Burne-Jones & Co., Ltd., 296, Borough High Street, S.E.1, have not been inconvenienced by the error.



Photograph taken on board the Italian cruiser Ferruccio, showing the special directional frame aerial equipment housed separately from the main wireless installation.



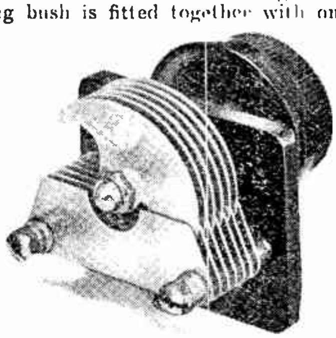
A Review of Manufacturers' Recent Products.

"MAGNUM" REACTION CONDENSER.

This is a miniature variable condenser particularly suitable for use in portable and transportable sets or in such cases where panel space is strictly limited. Furthermore, the minimum capacity has been kept as low as possible so as to permit of its use also in sets fitted with H.F. stages.

The moving vanes have been shaped to give a gradual increase in capacity on first interleaving with the fixed plates. This feature contributes to easy control of reaction, especially in such cases where a small feed back is sufficient to start oscillation.

The measured minimum capacity of the sample sent in for test was 5.5 micro-microfarads, and the maximum capacity 0.000094 mfd. It is rated as a 0.0001 mfd. condenser. A single hole fixing bush is fitted together with one end bearing for the moving vanes. This is of generous size and there is no trace of "whip."


"Magnum" miniature reaction condenser.

The makers are Messrs. Burne-Jones and Co., Ltd., Magnum House, 296, Borough High Street, London, S.E.1, and the price is 4s.

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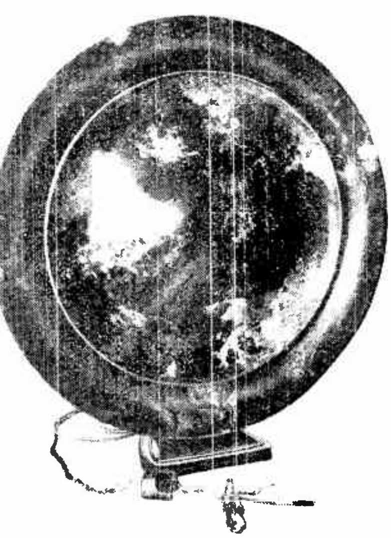
PHILIPS' LOUD SPEAKER, MODEL 2007.

This consists of a free-edged cone diaphragm driven by a differential movement, the whole being carried on a moulded frame. A feature of special interest is the provision of a dished baffle supported on four pillars and mounted in front of the cone. An annular space is left between the baffle and the frame for the egress of the sound waves. The cone is, therefore, working against a cushion of air; the conditions obtaining in a horn-type loud speaker being partially reproduced without the attendant disadvantages. This undoubtedly contributes to the good sensitivity to weak electrical inputs recorded during test.


Philips' cone loud speaker. A switch to adjust the impedance for best operating conditions is incorporated in the lead.

An addition of no little importance is a three-position switch which enables the impedance of the instrument to be adjusted to the value most suitable for the particular valve used. Measurements of the D.C. resistance of the windings show that this gives a choice of either 490 ohms, 1,340 ohms, or 1,840 ohms. The highest value was found to give the best all-round results in conjunction with output valves between 4,000 and 6,000 ohms A.C. resistance.

Speech is clear and crisp and on music the general level of response is good over the whole audible scale. There are no objectionable resonances. Models are available finished in orange, black and gold; violet, black and gold; or brown, black and gold; the price being £5 5s. The makers are Philips Lamps, Ltd., Philips House, 145, Charing Cross Rd., London, W.C.2.

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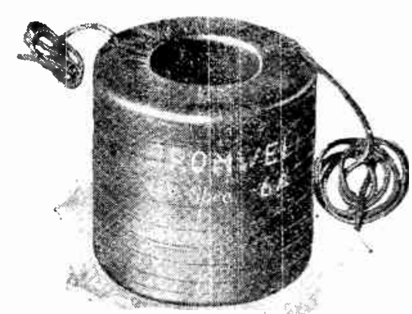
MOVING COIL LOUD SPEAKER "POT" WINDINGS.

Since one of the principal factors governing the efficiency of a moving-coil loud speaker is the ampere turns on the field coil, this portion of the equipment requires very careful and skilful winding. Pots energised from the mains are less difficult to wind than those drawing current from a low-voltage accumulator, since in the first case a fine gauge of wire is used, whereas in the low-voltage types a very heavy gauge must be employed.


Cromwell pot coil wound with special "ribbon" wire.

Hitherto the amateur experimenter has been obliged either to wind his own pots, probably without adequate facilities, or adapt the commercially made article to his particular design. The Cromwell Engineering Co., 81, Oxford Avenue, Merton Park, London, S.W.20, have now developed a new type of ribbon-wound coil, and it is claimed that many more turns can be accommodated in a given volume than with round section wire.

These pot coils are available for many of the well-known makes of loud speakers, and coils can be supplied wound to constructors' requirements. The sample sent in for review and shown in the illustration contains 9lb. of this particular wire, but measures 4¼in. in diameter by 4in. long over the insulation, and is designed to fit on to a 2in. core. It is for 6-volt excitation, and since the measured D.C. resistance is 9.8 ohms, it will pass just over 0.6 amp. The price has been fixed at 40s.

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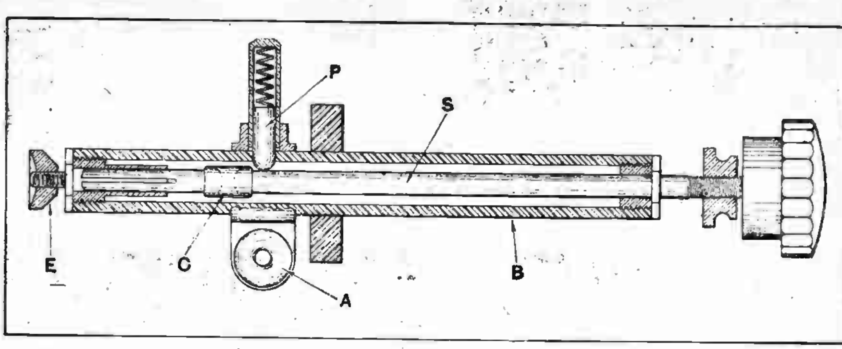
"BICO" SAFETY AERIAL LEAD-IN.

This is a combined aerial lead-in and earthing switch possessing the distinct advantage that the switch is totally enclosed and entirely weatherproof. Furthermore, the switch is outside the building, and when in the "safety" position completely isolates the set from the aerial and at the same time connects the down-lead direct to earth. The action is simple but effective. A hollow ebonite tube ½in. in diameter (outside) is fitted with a brass spindle divided by an insulating collar in such a manner that when the spindle is pulled out the aerial is connected, *via* a spring-controlled plunger, to the earth lead. On pushing in the spindle the insulating collar rides over the plunger and connects the aerial to that portion of the spindle to which the lead to the aerial terminal of the set is connected.

The aerial down lead is taken to the terminal which contacts with the plunger, while the earth lead joins to the terminal on the outside end of the tube; a lead from the "E" terminal of the set goes to earth in the usual manner.

These safety lead-in tubes are available in three sizes: 7in. long at 3s. 6d., 9in. size costs 4s., and 12in. tubes are 4s. 6d. The makers are the Burner Insulator Co., "Bico" Works, 51, Wellington Street, Woolwich, London, S.E.18.



Section through "Bico" safety lead-in switch. A, aerial terminal; E, earth terminal; P, plunger; S, spindle; C, insulating collar and B the barrel.

GRAMOPHONE PICK-UP CHARACTERISTICS.

Methods to be Adopted in Presenting Results of Forthcoming Laboratory Tests.

READERS will remember that in the special Gramophone issue of March 6th this year we gave figures for most of the pick-ups then on the market, showing the voltage output at a few representative frequencies. While these figures were useful as an indication of the general character of the output and as a means of estimating the degree of amplification required, they were not sufficiently detailed to disclose resonances and, as was mentioned at the time, could not be taken as a final criterion of performance.

It is now proposed to give complete characteristics plotted from readings taken at small increments of frequency from 100 to 8,000 cycles. The standard frequency records specially prepared by the Gramophone Company, Ltd., will be used, and these will enable readings of output to be obtained at approximately 80 points over the range of frequency already mentioned.

The records provide frequencies down to 25 cycles per second, but experience shows that it is impracticable to give readings below 100 cycles. As is well known, the amplitude of the groove, for a given A.C. output, is much greater at low than at high frequencies; the amplitude is, in fact, inversely proportional to the frequency. In ordinary records it is necessary to restrict the amplitude of notes below about 250 cycles in order that the vibrations may be contained within the standard pitch of the groove. In the standard frequency records, however, a special pitch has been employed for the lower frequencies in order that the correct amplitude may be attained. Only pick-up devices of special design are able to follow the groove, and most of the commercial electromagnetic pick-ups jump the groove below 100 cycles, some even below 200 or 250 cycles.

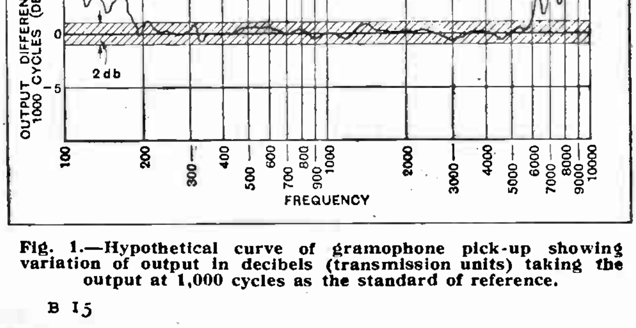


Fig. 1.—Hypothetical curve of gramophone pick-up showing variation of output in decibels (transmission units) taking the output at 1,000 cycles as the standard of reference.

While every effort has been made in preparing the standard records to obtain strict proportionality between amplitude and frequency, it is only to be expected that slight discrepancies have crept in. These deviations from the correct amplitude have been carefully measured and tabulated by the Gramophone Company. The amplitude of the 1,000-cycle note has been taken as the basis of comparison, and differences in the output at other frequencies have been expressed in decibels[1] (transmission units). This suggests a very convenient method of plotting the pick-up characteristic.

If we take the voltage output from the pick-up at 1,000 cycles as our standard and express the outputs at all the other frequencies as differences (either positive or negative) in decibels from the 1,000-cycle standard, it is quite a simple matter to correct for discrepancies in the records merely by adding or subtracting the correction factors supplied with the records. The curve would then take the form shown in Fig. 1. It will be observed that the zero line passes through the curve at 1,000 cycles, and that where the curve appears above the zero line an increase of output above normal is indicated.

Unfortunately this method of presentation does not give any indication of the absolute value of the voltage output, but it has many points in its favour. For instance, we know that the ear is incapable of detecting differences of sound intensity of less than 2 decibels. Thus, if we cover the general trend of the curve with a band 2 decibels wide, small irregularities due to minor resonance will pass undetected by the ear, provided they fall within the limits of the 2 decibel band.

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[1] For a full discussion of this unit see the note on page 74 of the July 24th issue.

Gramophone Pick-up Characteristics.—

The output from the ideal pick-up should fall within the limits of this band from about 250 to 4,000 cycles. Below 250 an increase in the output is desirable to compensate for the restricted amplitude of low notes in the average record. Up to 4,000 cycles we are concerned with the fundamental frequencies of musical instruments, and it is essential that the trend of the curve up to this point should be horizontal. The region above 4,000 cycles is responsible for the overtones, and consequently the timbre of the fundamentals lower down the frequency scale. Assuming a perfect amplifier, it would seem desirable for the curve to continue horizontally to the upper limit of frequency. Many practical amplifiers suffer from high-note loss, so that a slight upward trend above 4,000 cycles would seem to be indicated. Few electromagnetic pick-ups, however, are capable of producing this increase at high frequencies, and here it would seem necessary to modify the amplifier to suit the pick-up.

When the curve is plotted with output voltage against frequency, the irregularities are exaggerated, as will be seen by comparing Fig. 2 with Fig. 1. The general form of the curve is, however, the same, and it is possible to estimate the performance by inspection, bearing in mind that a change in output of 25 per cent. is approximately equivalent to 2 decibels. After careful consideration we have decided that the voltage output curve is the more useful of the two methods of presenting the results. The R.M.S. voltage at the terminals of the pick-up is a tangible quantity which can be visualised by the beginner as well as the expert, and useful information can be obtained with regard to the type of valve and grid bias to be used in the first stage of the amplifier. Those who prefer to work with the decibel unit can easily convert the voltage readings by using the formula $D=20 \log \frac{V}{V_{1000}}$, where D = output difference in decibels, V = voltage output at any given frequency, and V_{1000} = voltage output at 1,000 cycles.

The voltage curves form a fairly reliable guide to the grid bias required for the first amplifier valve. For instance, let us suppose that the highest point of the curve is 2.0 volts R.M.S. The peak value of the voltage will therefore be $2 \times \sqrt{2} = 2.83$, which must be covered by a bias of -3 volts. Actually the general level of the output from the average record is about half that of the standard frequency records, but in view of the presence of peaks and transients it is best to take the amplitude of the frequency records as the basis for estimating the grid bias.

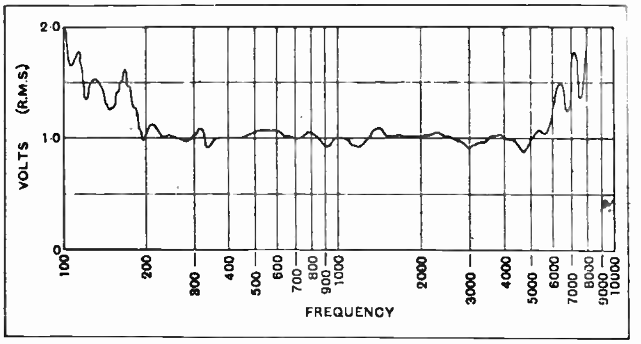


Fig. 2.—Curve showing variation of output voltage with frequency. The readings correspond with the curve of Fig. 1, but it will be observed that the peaks are more pronounced.

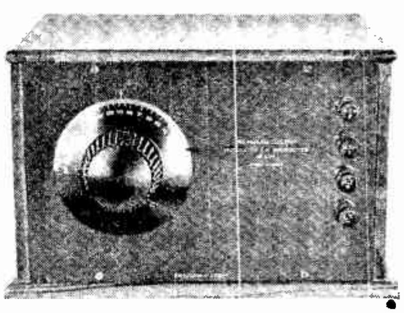
The level of the output is governed to a certain extent by the type of needle employed in the pick-up. Unless otherwise stated, the voltage readings for the curve will be taken with a Tungstyle needle, and a few readings with other needles may be given in order to demonstrate the effect on the output.

The series will be inaugurated in the "Laboratory Tests" section next week with the B.T.H. pick-up.

SCREEN-GRID MODULATED C.W. WAVEMETER.

The McLachlan Wavemeter in which the Calibration is Independent of the Valve.

THE steady demand for long range receivers shows that the fascination in trying to identify foreign stations is not waning. How many listeners have a knowledge of more than one or two foreign languages? Yet how many are prepared to guarantee the identity of a station basing their statement on mere



The wavemeter is extremely compact—

speculation? The modulated wavemeter under review affords a ready means of either identifying unknown stations or finding the correct setting on a receiver for the reception of a distant station the wavelength of which is known.

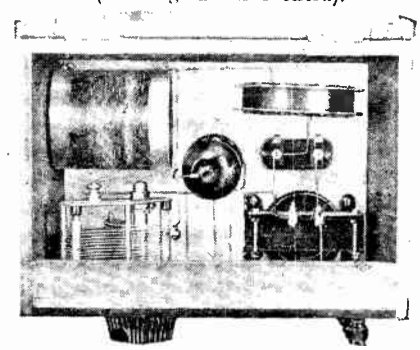
This wavemeter operates on a new principle, use being made of the inherent negative resistance property of the screen-grid valve. In the anode circuit a coil and variable condenser tuned to the radio frequency are connected in series with a suitably proportioned audio-frequency circuit. Two different oscillations are generated and a tuning note is radiated, i.e., the instrument is a miniature broadcasting station.

The tuning note is heard in the loud speaker so that a receiver can be accurately tuned to any wavelength without the aid of an incoming transmission. This instrument has the great advantage that the calibration is independent of the valve, and furthermore neither reaction coil nor heterodyne oscillator are required. The meter can also be used to heterodyne an incoming carrier, zero beat being obtained when the musical note is purest.

Sharp Tuning.

When tested we found that the tuning of the wavemeter was sharp, and that no frequency change took place when the anode voltage was varied between 30 and 70, while maintaining the screen at 100 volts. A two-volt screened valve was used and a variation of filament volts between 1.9 and 2.1 caused a negligible change in frequency. Thus the contention that the calibration is independent of the valve is well borne out in practice. The plate, screen and filament current for the screened valve can be derived from the batteries feeding the receiver.

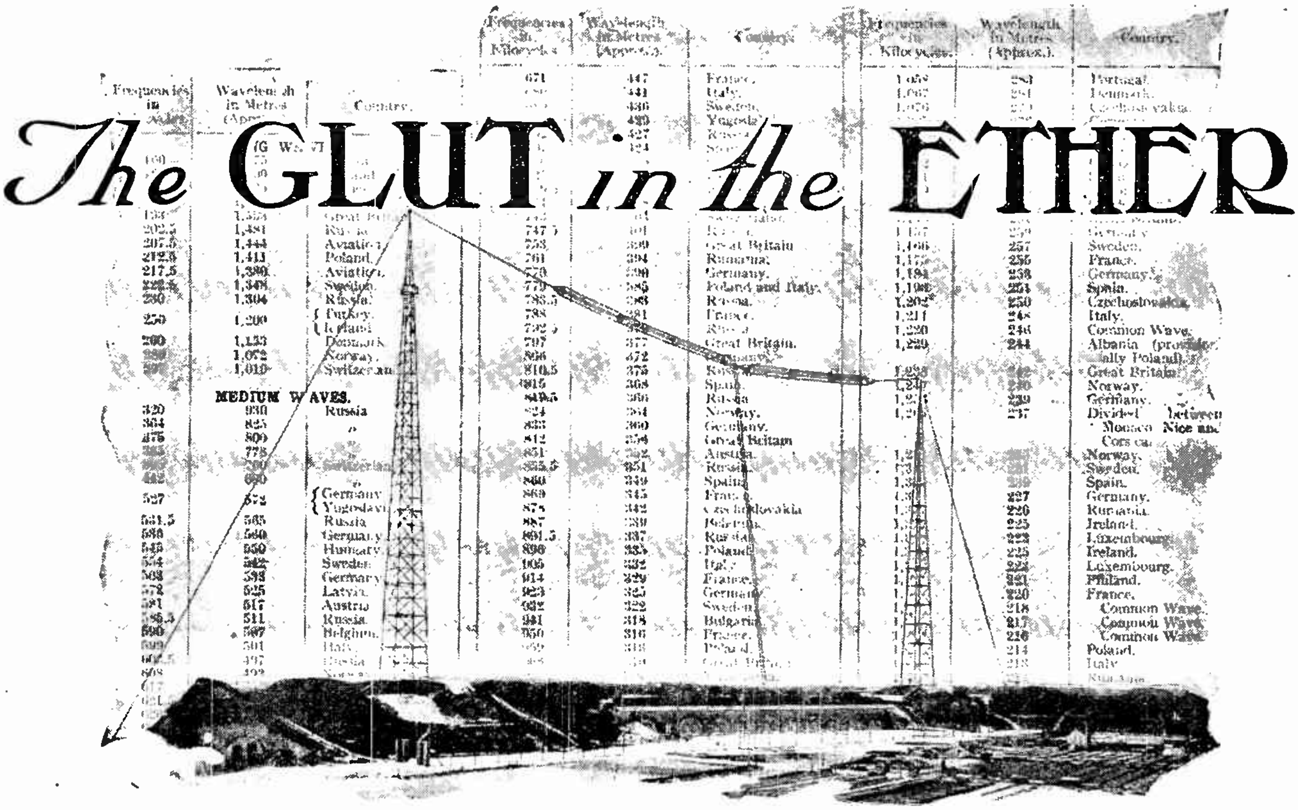
The instrument is supplied with three coils and three calibration charts embracing the band from 100 to 1,600 kilocycles (3,000 to 180 metres), and sells at £4 15s. (screen-grid valve extra).



—an interior view.

Those desiring an instrument designed along these lines but of great accuracy for precision measurements can obtain special valves in which the anode-to-screen-grid capacity has been reduced from the usual 10 or 12 $\mu\mu$F to about 3 $\mu\mu$F. The makers of the wavemeter are Messrs. H. W. Sullivan, Ltd., Leo Street, Peckham, London, S.E.15.

The GLUT in the ETHER



Problems of an Overstocked Waveband.

By J. GODCHAUX ABRAHAMS.

TO-DAY, if we examine a list of European broadcasting stations, we find that, excluding Russia, they have reached a total number of close on two hundred transmitters. In view of the fact that the wavebands allowed to broadcasting are strictly limited, and cannot comfortably include all these stations, is it surprising that the average amateur, when endeavouring to tune-in individual transmissions, should often find himself confronted with an unpleasant mixture of heterodyne whistles and groans, or a background of insistent morse?

Is your set entirely to blame when an attempt to tune-in foreign stations brings in an unsolicited chorus of shrieks and groans? The author of this article would say "No," contending that the European ether is overstocked with stations and that the efforts made by the various authorities to distribute wavelengths evenly over the available band have led to the preferential treatment of certain countries, with results which can benefit none.

It seems probable that the wavelength shuffling to which the authorities have resorted at the Geneva, Brussels and Prague Conferences can prove but a feeble attempt to alleviate a painful situation which must needs grow worse as further stations are erected, or, alternately, as the power of some of the transmitters is increased. Although much has been written with regard to the minimum frequency separation necessary to obtain a more or less satisfactory reception of a number of individual transmissions, it has never been made clear for what reason the stations in Europe have gradually reached so high a number. Was this step justified in all countries? On what basis were calculations made to warrant the erection of extra stations once an initial broadcasting service had been established?

The writer has prepared a tabular survey of the European broadcasting systems, which will show at a glance the relative areas of the various states in thousands of square miles, the number of transmitters actually in operation, the exclusive wavelengths individually allotted to the respective countries, according to the latest *Plan de Prague*, and, finally (where the information is available), the percentage of registered listeners to total population.

What are the factors to be taken into consideration if the claims put forward by a country for the erection of transmitters are to be judged on their merits? If a satisfactory verdict is to be given, we must study the area of the state, its total population, and its actual requirements in respect to a broadcasting service.

Admittedly it is not an easy matter to work merely on this data, for in certain instances it may be necessary to make special concessions, inasmuch as, although a particular country, according to these factors, would be entitled only to a small number of stations, the question

The Glut in the Ether.—

of diverse languages would necessarily influence a decision. Belgium, for instance, possessing some seven and a half million souls, and covering an area roughly equal to that of Yorkshire, is endowed at present with six broadcasting stations (of which one only can be officially recognised) and has been allocated three exclusive wavelengths; yet, if statistics are to be believed, the country boasts of 2.6 registered listeners per one hundred head of population! The reorganisation of Belgium's broadcasting system under State control will give her one dual- and one single-wave station to enable broadcasts to be carried out in French, Flemish and German, the last-named language for the sole benefit of a limited number of listeners in the Eupen and Malmedy districts, forcibly ceded to her by Germany at the end of the Great War. The case of Belgium is cited as an example; here the claim to a third exclusive wavelength is but weakly justified.[1]

Geological conditions also may alter our basic factors, as in the case of Switzerland, where high mountains considerably restrict the range of the transmitters. Here we register a population of four million people in an area of approximately 1,600 square miles. The proposed reorganised system calls for two high-power transmitters at Sursee and Moudon, and a series of smaller stations (Basle, Berne, Lausanne, Zurich, and Geneva), to which are to be added relays at Olten, St. Gall, Sitten, and Chur. Possibly for the benefit of the Tessin district, in which the inhabitants speak only Italian, a further station will be erected at Locarno, Lugano or Bellinzona.

EUROPEAN STATES.

Country.	App. Area in 1,000 sq. Miles.	Transmitters Working.	Exclusive WLs (Prague Plan).	Percentage of Licences to Population.
Austria	31.75	5	2	5.7
Belgium	11.5	6	3	2.6
Bulgaria	40	—	1	—
Czecho-Slovakia	54.5	4	5 (plus 1 shared)	1.9
Denmark	15	2	2	7.6
Esthonia	18	1	1	1.1
Finland	150	5	3	2.2
France	213	27	16	2.3
Germany	182.2	28	13 (plus 1 shared and four on loan)	4.6
Great Britain and N. Ireland	95	20	10 (plus 1 free)	6.0
Greece	40	—	1	—
Holland	12.8	2	2 (plus 1 borrowed)	1.7
Hungary	36	1	2	2.0
Iceland	41	1	Shared	—
Irish Free State	26.5	2	2	0.8
Italy	120	6	7	0.1
Jugo-Slavia	248	3	3 (plus 1 shared)	—
Latvia	41	1	1	1.2
Lithuania	20	1	Taken from upper band	0.6
Luxembourg	1	1	1	—
Norway	124	10	5	2.4
Poland	150	5	8	0.7
Portugal	55.5	1	1	—
Roumania	160	1	3	0.2
Russia	1,492	60 (roughly)	21	0.1
Spain	197	9	6	0.5
Sweden	173	30	6	6.6
Switzerland	16	5	5	1.9
Turkey	10	1	Shared	—

Except where otherwise stated, the above table does not take into consideration wavelengths which are common to two or more countries. It should also be noted that such extra-European stations as Algiers, Rabat and Angora do not appear in the Prague list.

Surprising Figures

The latest statistics show that broadcasting in Switzerland has appealed to only 1.9 per cent. of the total population. Observe, however, that five exclusive wavelengths have been granted to that country: it is apparent that a number of transmitters will be compelled to share waves.

Austria, on the other hand, as the table shows, is almost three times the size of Belgium, and her population is over six millions; she possesses five transmitters, but only two exclusive wavelengths have been allotted to her. Yet her percentage of registered licence holders reaches the astonishing figure of 5.7.

If we turn to Poland, we find that, although she now has five stations working for a population of twenty-seven millions, eight exclusive waves have fallen to her share; yet only 0.7 per cent. of her inhabitants are interested in radio programmes!

In passing, it may be mentioned that of all European countries Denmark is the one which has shown the most enthusiasm for broadcasting, for, with a population of about three millions spread over an area of approximately fifteen thousand square miles, 7.6 per cent. of the inhabitants are registered licence holders. At the Prague Conference Denmark secured two exclusive wavelengths; but, as the slogan adopted there is "fewer stations, higher power," it seems that, in one country at least, a solution has been found to the problem of giving everyone an efficient service.

The more the table is studied the more difficult is it to understand on what basis the distribution of wavelengths was carried out, for there seems little doubt that some countries have received preferential treatment.

Take France, a newcomer to the European Broadcasting Union, which may now dispose of sixteen exclusive wavelengths, whereas Italy, not far short in population, is allotted only seven!

Moreover, the grievances expressed by Dutch listeners would appear to be justified, for to Holland the authorities have allotted two wavelengths, namely, 1,875 metres, to replace the nominal 1,852 metres hitherto used by Huizen, and 298 metres in the middle waveband.[2] Huizen is a comparatively new arrival on the ether; not only was it erected several years after Hilversum had organised a regular broadcasting service, but it was originally destined to work on short waves. What, then, must become of Hilversum if it is no longer allowed to operate on 1,071 metres, seeing that this wavelength has been given to Norway? Is Hilversum to be closed down, or must her trans-

[1] Since this article was written the National scheme has been rejected by the Belgian Parliament, and for the present no reorganisation can take place. Belgium, therefore, has withdrawn its request for the third exclusive wavelength.—[Ed.]

[2] The Dutch Ministry of Transport has allocated the wavelength of 1,875 metres (allotted to Holland) to the Huizen *transmitter*, and 1,071 and 298 metres to the Hilversum *transmitter*. As 1,071 metres has been given by the *Plan de Prague* to Norway, from January 1, 1930, Holland will lose this wavelength. The arrangements regarding the use of the two Dutch stations by the various programme associations do not concern this article.

The Glut in the Ether.—
missions be buried in the full-to-overflowing medium broadcast band, namely, on 298 metres? The Dutchmen consider that their plea of unfairness is justified, inasmuch as the *Plan de Prague* has comfortably housed Kalundborg, which, again, is of comparatively recent establishment.

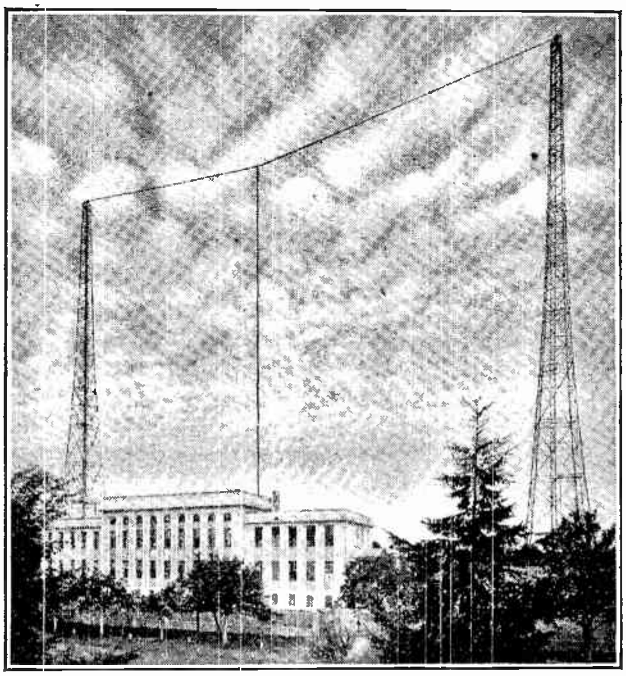
"Pioneer" Prerogatives.

With regard to Great Britain and Germany, the only conclusion to be drawn is that, as these countries were pioneers of broadcasting in Europe, and obviously, first in the field, they were given every opportunity of choosing both the number and position of wavelengths desired. It is true that both countries have made concessions as and when they were needed for the benefit of Continental countries generally, but the number of exclusives retained by these two "pioneers" still seems out of proportion to their requirements. Can it be that their demands are based on the assumption that the bulk of listeners still own simple crystal sets capable only of receiving local transmissions? It would be difficult to obtain accurate statistics in Great Britain to-day regarding the increased use of valve receivers, for our licences from the outset have made no distinction as to the class of apparatus installed by the listener. It may be assumed, however, that the steady growth in the number of valve receivers sold monthly indicates that the more primitive crystal is being replaced. Also, the considerable increase in the popularity of multi-valve portable receivers in most European countries demonstrates that the average wireless enthusiast is not content to derive all his programmes from the local station. This being the case (and trade figures undoubtedly supply the necessary confirmation), the more extended use of valve sets has enlarged the effective working range of broadcast transmitters, which are then able to cover districts *beyond those for which they were primarily erected.* Moreover, the extra energy with which some of these reconstructed transmitters have been endowed has also added to their efficiency, and without doubt, if a careful revision were made, based on the new conditions, it would be found that a number of stations in many countries may be considered superfluous.

As improvements in both radio circuits and valves have been made, so the smaller and more convenient frame aerial has gradually replaced the unsightly outside "clothes-line," again reducing the number of crystal owners. Generally speaking, it will be found that the more primitive receiver is found only in densely populated cities in close proximity to a broadcasting station.

If all classes of the community are to be satisfied, we have but two alternatives; either it is necessary to install a large number of relay stations of strictly limited power for the use of listeners who will not forgo their small crystal sets, or two or three super-power transmitters must be erected to radiate programmes which can be received at much greater distances by owners of more expensive valve apparatus.

It would seem that the only way in which European broadcasting can be extricated from its present congested state is by a drastic pruning of what can be termed unnecessary growths; the number of transmitters possessed by individual states must be reduced to reasonable proportions commensurate with the service they are called upon to give to their listening population.



ONE OF THE TWO HUNDRED. Breslau, a well-known German broadcaster operating with 4 kW. on a wavelength of 253 metres.

Practical experiments in Germany and Great Britain show that several low-power relay stations can be made to work on a common wavelength, providing their frequency can be accurately maintained, without any risk of mutual interference. If, therefore, the need for a relatively large number of small transmitters actually exists in a country, more use should be made of the *onde commune,* the stations taking their programme from a central studio which, for obvious reasons, would in most instances be situated in the capital. Such reorganisation of the broadcasting system in many lands would release a corresponding number of exclusive waves, and by so doing might permit a greater frequency difference between higher-powered stations, and thus reduce the interference trouble.

This step, in conjunction with the weeding-out of superfluous units, would lead to a healthier condition of the European ether.

NEXT WEEK'S ISSUE

will contain constructional details of a High Tension eliminator for D.C. mains, in which a special filter circuit is employed. The unit will meet the requirements of those having 3-, 4- or 5-valve sets and will deliver a current quite free of ripple even from the "roughest" of mains.

By Our Special Correspondent.

Tatsfield Receiving Station.

A few weeks ago I said that the new B.B.C. receiving station at Tatsfield might be ready this month, but now learn that it will not be brought into service until the middle of September, when all the gear at present used at Keston will be transferred to Tatsfield—broomstick aerial and all.

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Also Brookman's Park.

I should not be surprised if the regional station at Brookman's Park is radiating a regular service about the same time, and it will probably have a fairly smooth passage for two or three months until the twin-wave transmitter is brought into service, when troubles may arise for a time. So complicated has become the aerial system of suburban villadom that some of us are likely to be more or less incommoded by a next-door neighbour who is not content to settle down to one or other of the programmes for any length of time, but restlessly switches from one to the other every two minutes.

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The Footpath Story.

While on the subject of Brookman's Park, I understand that a lot of ink has been spilt unnecessarily on the subject of the alleged closing of a certain footpath near the new station. The facts of the case appear to be that the B.B.C. is making a new concreted path for the benefit of foot passengers, but the old short cut remains open to those who wish to save about four yards and do not object to mud on wet days.

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The S.O.S. Season.

Some amusing stories are going around about the sudden increase in S.O.S. broadcasts, and provincial journals have been indulging in flights of imagination. One writer, referring to this subject, cites a case of a "straying uncle" who was "tracked down to the Norfolk Broads in less than half an hour" and "returned in time to assist at a family wedding, resigned but a little sad."

In case listeners should think that any wandering uncle can be found in this way it may be as well to state that the only circumstances in which S.O.S. calls are undertaken by the B.B.C. are :—

(1) Missing persons—only broadcast at the request of the police.

(2) Messages to trace relatives of persons dangerously ill—only broadcast when illness has been confirmed by the medical authority attending the case and after all other means of communication have failed.

These hard facts rather mercilessly destroy the romance of the "missing uncle."

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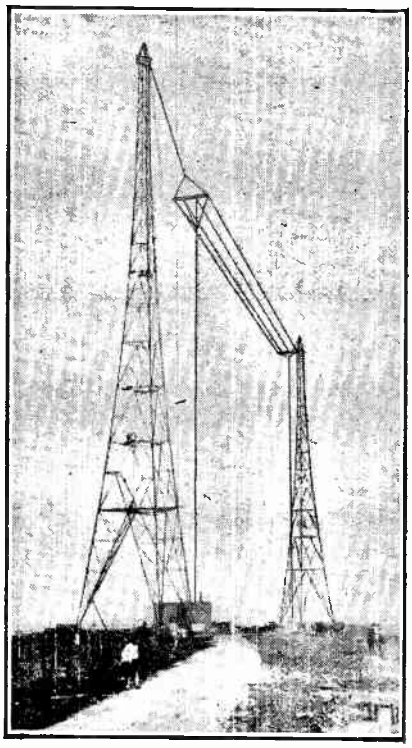
Western Regional Station.

Our Celtic compatriots of the Principality of Wales are already impatiently demanding a regional station for themselves, but I fear they must await their turn, and even then will probably have to share the Western station with their neighbours in Somerset, Devon and Cornwall. I understand that this is fourth on the list of projected regional stations. The original order proposed was, Northern England, Southern England, Scotland and the West, arranged as far as possible to satisfy the needs of the greatest number of listeners in the shortest possible time, but as those in the South suffered more from interruption by ships' traffic in the Channel the southern station was considered more urgent than that in the North of England, and was given precedence.



The masts and aerial system of the Danish broadcasting station at Kalundborg, from which the Copenhagen programmes are broadcast on a wavelength of 1,153 metres.

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The Northern Station, a Correction.

A correspondent in the *Huddersfield Examiner* takes me to task and corrects the pronunciation, given in these notes on August 7th, for Slaithwaite which, he says, should be "Slawit" and not "Slewitt." I accept the correction with thanks, the more so as his letter drew from another correspondent the story of a Colne Valley manufacturer who was endeavouring to impress on an incredulous fellow-traveller from London to Huddersfield the correct pronunciation of the locality. "Well," said he, "when we get there I will ask the porter, and you will hear for yourself." On arriving he called to the porter, saying, "Hey, porter, what station is this?" The porter replied, with a merry twinkle in his eye and to the discomfiture of the questioner, "Why, damn thee Joss, tha knows!"

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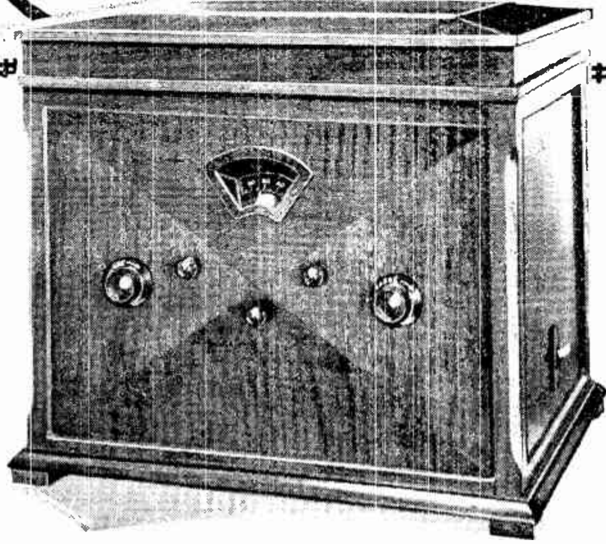
Talks for the Coming Season.

One or two new features will appear in the Talks which the B.B.C. is now arranging for the months of September to December. The tendency of the times under the general title of "Points of View" should lead to some witty comments by such eminent speakers as Dean Inge, Sir Oliver Lodge, Mr. H. G. Wells, Prof. Haldane, and Mr. G. Lowe Dickinson, the author of "A Modern Symposium."

Another series, on the lines of "My Day's Work" which was broadcast some time ago, will be entitled "While London Sleeps." These are to be given by night workers such as a journalist, a river policeman, a Covent Garden porter, and a coffee-stall proprietor. A series of portraits of personalities, real and imaginary, called "Miniature Biographies" are also contemplated, the contributors including André Mourois, Virginia Woolf, and Harold Nicolson.

Broadcast Receivers RI ALL-ELECTRIC S.G. THREE



Without an Aerial— An Ideal Set for the Flat Dweller.

With an Aerial— A Sensitive Long-range Receiver.

WHEN indirectly heated A.C. valves, and, in particular, the AC/S screen-grid valves, made their first appearance it was realised that their effect on domestic receiver design would be nothing less than revolutionary. In the first place, they offer a complete solution of the problem of battery maintenance, and, secondly, their amplifying efficiency is such that a single stage, either of H.F. or L.F., is more than equal to the two-stage H.F. and L.F. amplifiers hitherto found to be necessary for long-distance or frame-aerial reception.

Messrs. Radio Instruments, Ltd., have not only realised the potentialities of these new valves, but have already produced a complete design for the coming season in which the many problems peculiar to these valves have been successfully solved.

Compactness and Elaborate Screening.

The All-electric Screened Grid Three is really a dual-purpose receiver. It can be used without an aerial for the B.B.C. transmissions, and, as such, may be regarded as an ideal instrument for the flat dweller. Provision is made, however, for the attachment of an outside aerial, and when this is done the receiver is at once converted into an instrument of exceptional power and range. Having regard to the fact that the equipment includes a battery eliminator the dimensions of the cabinet are extraordinarily compact. Measuring only 12¾in. × 16¾in. × 15in. the set can be transported from room to room and used wherever a lighting or power point is available.

Compactness, however, calls for a careful layout of components, and in the R.I. set there is an elaborate system of screening which effectively suppresses any tendency to instability. The whole of the detector stage is enclosed in a copper box surmounted by a detachable aluminium cover plate. The L.F. valve, though not the output transformer, is also housed in this compartment, both valves being removable through holes in the aluminium plate. The aerial circuit and screen-grid valve are mounted outside the copper screening box, but are sheltered by the aluminium top plate which covers the whole area of the inside of the set. The AC/S valve projects through a hole cut in the top plate and is completely enclosed by a detachable flanged cover. The aluminium cover plate is held down by quickly detachable screws giving easy access to the interior of the screening box. Valves can be changed, however, without disturbing any part of the screening other than the flanged cover over the AC/S valve.

It is interesting to note that no attempt has been made to avoid capacity coupling between the aerial and loud speaker circuits. Indeed, coupling has been deliberately introduced in order to take advantage of the loud speaker leads as a short antenna when working without an outdoor aerial. That this arrangement does not produce instability is a tribute to the manner in which H.F. currents have been kept under control after the detector stage.

The simple but effective parallel-feed tuned grid circuit is used to couple the H.F. valve to the detector. The H.F. choke used in the anode circuit of the screen-grid valve is the R.I. Dual Astatic Choke which was specially developed for use in this type of circuit. It has the special merit of being free from absorption bands on the lower broadcast wavelengths.

The tuning condensers of the aerial and H.F. circuits are mechanically coupled, giving one main tuning control. A small compensating condenser is provided as an auxiliary control to bring the two circuits exactly

R.I. All-electric S.G. Three.—

in step at any part of the tuning range. Considerable attention has been given to the question of aerial coupling, and a method has been developed which enables any aerial or no aerial at all to be used without throwing the difference between the tuned circuits outside the range of correction of the compensating condenser.

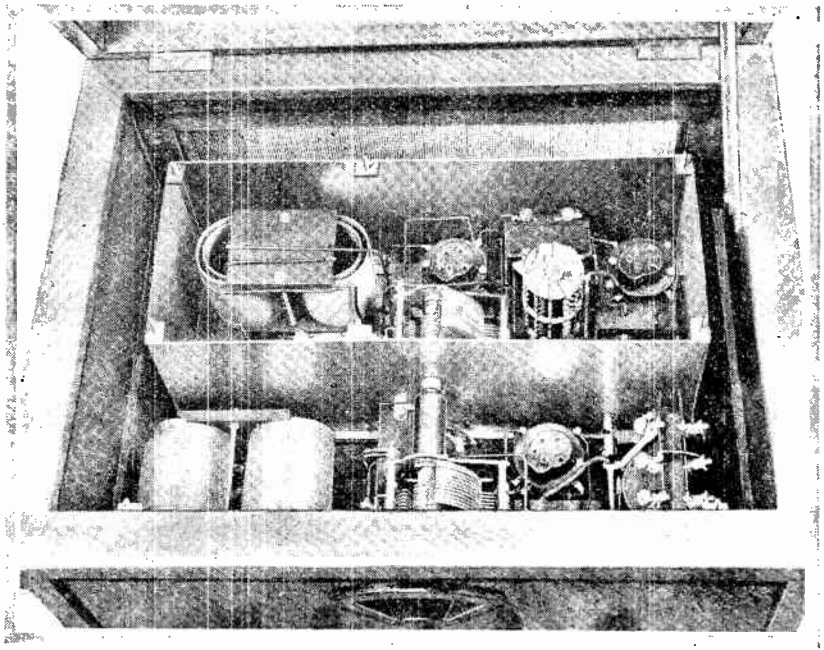
Leaky grid detection is employed, and reaction is applied to the tuned grid circuit through the usual combination of magnetic and capacity coupling. The detector is an AC/G valve, and is coupled to the AC/R output valve through an R.I. "Hypermu" transformer. The loud speaker is fed through an output transformer.

Effective Ripple Filter.

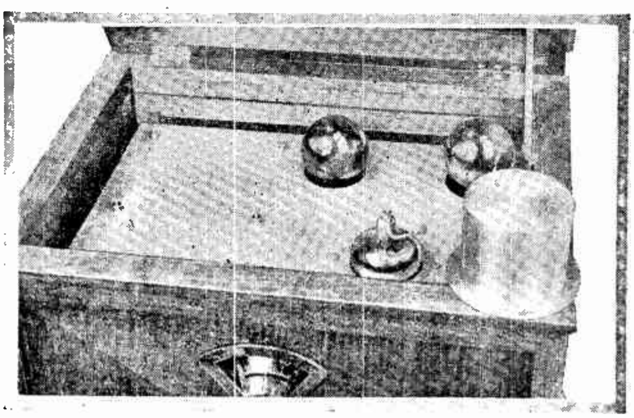
There is abundant proof that considerable time has been devoted to the development of this circuit. As evidence in support of this we would mention that grid bias is derived from the H.T. circuit by means of resistances connected between the valve cathodes. This somewhat difficult problem has been successfully solved, and the set performs with a negligible trace of hum, quite inaudible during reception. The elimination of the grid bias battery greatly simplifies the maintenance problem and limits replacements to the valves, which should function without attention for years.

In connection with the mains unit itself, it is only necessary to mention that the smoothing condensers are much above the usual size. Regulation porcelain fuses are fitted in each main lead, and a quick-break porcelain switch is fitted in the right-hand side of the cabinet. Adequate ventilation is provided by the perforated back of the cabinet. The rectifier is a half-wave SP41U valve.

In spite of the apparent multiplicity of controls (there are in all five knobs on the front panel) tuning is not a difficult process. Once the function of the controls has been mastered from the instructions their manipulation becomes instinctive. The reaction control is smooth and free from backlash, and maintains its setting over large sections of the dial both on long and short waves. The main tuning control has just the right reduction gearing, and the compensating condenser covers all settings of the main tuning control irrespective of the type of aerial employed.



Interior of the screening box with aluminium top plate removed.



The valves are readily accessible, the H.F. valve being screened by a detachable metal cover.

The high quality of reproduction and low level of residual mains hum create at once a favourable impression on first switching on the set. No doubt the use of only a single stage of L.F. amplification contributes largely to the high standard of quality obtained. The volume available is sufficient to work any of the more efficient moving-coil loud speakers, and, in order to do justice to the quality to be obtained from this receiver, a loud speaker of this type is to be recommended.

Tests of range and selectivity were carried out 20 miles north of London, the receiver being first of all tried out without any external aerial system. No difficulty was experienced in tuning-in 2LO, 5GB and two foreign transmissions at good loud speaker strength on the lower waveband, while at least eight other stations were also picked up, though at a somewhat lower volume level. On long waves, Radio Paris, Königswusterhausen, 5XX, Eiffel Tower and Hilversum were well received, and no difficulty was experienced in separating the first three of these stations. In our opinion the selectivity without an aerial will be more than sufficient to give adequate separation of the alternative programmes from Brookmans Park when that station comes into operation.

R.I. All-electric S.G. Three.—

When an aerial is connected to the set the selectivity suffers to a certain extent, probably on account of the special aerial circuit connections which have been adopted. Whatever the cause, the background from Daventry 5XX, with a 40ft. aerial, extended 20 degrees on either side of its normal setting, and involved both Königswusterhausen and Radio Paris. On the short waves, 5GB spread 8 to 10 degrees, and 2LO six degrees, but the range was phenomenal. No attempt was made to count the stations received on the lower waveband, and it is no exaggeration to say that it was impossible to tune to any part of the dial without encountering a station. With an efficient outdoor aerial there is more sensitivity than the average man requires, and some of this can be well spared in the interest of selectivity. The obvious solution is to reduce the length of aerial until a compromise is reached which satisfies local conditions.

It is, however, as a self-contained receiver, without external aerial or earth, that the All-electric Screened Grid Three earns special commendation. The quality is good, the set can be moved from room to room, and there are no batteries to maintain, while the sensitivity and selectivity are sufficient to guarantee several alternative programmes at all times.

The makers are Messrs. Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, London, W.C.1, and the price of the receiver, inclusive of all valves and royalties, is £30.

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.

AMATEUR STATUS.

Sir,—May I please be allowed to join myself with the expressions of opinion of "An Observer" appearing in this week's *Wireless World*?

I, as one of the old officials of the Incorporated Radio Society of Great Britain, feel that the amateur has only himself to praise or blame for his present position.

Anybody listening to many amateurs' transmitters cannot fail to be impressed with the fact that many of them are of the "change the needle o.m." type. Others are obviously merely sending calls in the hopes of collecting those foolish QSL cards. The cards in question are harmless enough, but when the collector is known to have applied for and obtained his licence on the grounds of experiment, it is small wonder that the status of the amateur is harmed by this practice.

Another point is that some of them do not even observe the regulations under which they hold the licence. A case in point is that of the transmitter heard less than four weeks ago, who said over the ether that he had not a wavemeter. As a matter of fact, he was off the amateur band of wavelengths and apparently did not know it, and had not the means of ascertaining his position. His correspondent did not enlighten him, so presumably he also was working by guesswork.

The recently published letter of Mr. Bevan Swift makes clear the part taken by the amateur or his representatives in concluding the agreement under which transmitting licences are now granted. I remember full well that the R.S.G.B. got all that could be had from the Postmaster-General. I also recollect that that Department was very attentive and courteous in its dealings with the R.S.G.B. It seems clear that no further facilities could be obtained without interfering with other and perhaps more important services. If the amateur treats his hard-earned concessions so lightly he can hardly expect to improve his position in the future.

To get back to the original point under discussion, it seems that the R.S.G.B. is being criticised by a few who, for various reasons, are not satisfied with their facilities. To do this in the public Press is an admission of a lack of *esprit de corps* which is deplorable. If the amateur hopes to improve his status and gain additional facilities, the pleas of the QSL collectors and those who want radio purely as a "lark" must be disregarded. The amateur has in the past done splendid work on the rocky path of pioneering. The pioneer days are over and we know to whom the credit for good work is due. Increased knowledge and everyday application of high frequency work makes the way of the amateur more exact and demands more of him than it used to do. If he wishes the word amateur to mean the same as it did he must keep pace with the times.

There is no reason why amateurs should not still consist of a body of enthusiastic, keen and jolly companions with wireless as the binding material, but to me it seems that public outpouring of criticism against the parent society and incidentally the oldest wireless society in the world, cannot assist him to attain this end.

ASHTON J. COOPER.

Ilford, Essex.

Sir,—May I be permitted to comment upon the question of amateur status? Your leading article in July 24th issue seems to imply that the Radio Society of Great Britain should still be considered as the premier organisation for the amateur. This raises a rather awkward situation. The Association of British Radio Societies, as Mr. Gill, the secretary, and Mr. Hartley said in their correspondence to you, published on July 17th, came into being due to lack of policy of the R.S.G.B., since which time the Association has acquired a very large membership, and without taking too much credit for the Association, I submit that they have done many things for the amateur, and taken up the cudgels on the amateurs' behalf very effectively with the authorities. At the same time I do appreciate the possibility of amalgamation and unity in the organisations existing for the benefit of the amateur.

If the R.S.G.B. would realise that the majority of their membership, and, if I may say so, the stout props of their organisation, are in the provinces, and will decentralise sufficiently to give the lie to the feeling that the R.S.G.B. is still the London Wireless Society, there would be no question of opposition. I say if they would do this guardedly, because, candidly, I think it impossible. They also think this, and came to the conclusion some seven years ago when they instigated the grouping system whereby local organisations banded together, and were self-governed, but were to rely upon the parent organisation for advice and help.

You have received letters from various people pointing out that this advice and help was not forthcoming; in fact, opposition was created. May I take you back to the time the Manchester Radio Scientific Society established an experimental station? Several genuine experiments were carried out with microphone and amplifiers. These experiments were cut short due to the interference of the P.M.G., and although the R.S.G.B. were advised of the position they flatly refused to give any assistance, and I believe an important member of the R.S.G.B. was more or less responsible for the P.M.G. inflicting impossible restrictions on the Society in question.

The Association of British Radio Societies does intend to contest every injustice inflicted on the amateur movement, and is trying its best to live up to its national title, and is ready at any time to sink its own individuality, I am sure, into any organisation which can be created for the benefit of the amateur in general, but as it would appear that the A.B.R.S. have a greater membership than the R.S.G.B. it does not appear reasonable to expect the A.B.R.S. to give all up to an organisation which has already proved and admitted failure to provide for the amateur movement.

Might I suggest that, through your paper on some suitable occasion, such as I think, the Manchester Wireless Exhibition, a conference is organised at which the whole of these matters may be thrashed out. For your information I may tell you that the annual general meeting of the A.B.R.S. is being arranged to take place during the Manchester Wireless Exhibition, and a programme of events such as the annual dinner, visits to various works, and places of interest are being arranged. It occurs to me that, with the aid of your journal, this might be made the occasion for a national conference, attended by all the organisations with the power to agree to any scheme most suitable to the majority. The Association of British Radio Societies, I feel sure, will be only too pleased to co-operate in any scheme for the benefit of the whole.

Manchester. J. E. KEMP, Chairman,
The Association of British Radio Societies.

Sir,—I hope that the subject of amateur status, so ably championed in your editorial columns, will provide thought for British transmitters, and that some effort will be made to free us from many of the restrictions now in force.

I am sorry to see that the A.B.R.S. is taking advantage of this opportunity to do some propaganda work for their organisation, and, what is not in the amateur spirit, some propaganda against the R.S.G.B.

I have been an active transmitter since 1925, but such is my ignorance that I had never previously heard of the A.B.R.S., and, judging from the spirit of their official letter, I am not likely to join.

"Fed-up G Ham" sums the position up very nicely, but I cannot allow Mr. Jamison's letter to pass without a comment. He does not tell the whole story of his relations with the R.S.G.B. Sufficient is it to say that Mr. Jamison appealed to the Radio Transmitters' Union (N. Ireland) for support in his dealings with the R.S.G.B., and his fellow transmitters, after considering the case, did not give their support. Mr. Jamison has resigned from the R.T.U.

If amateurs are to improve their status they will need to be a united body and speak with one voice. They are too few to have several strong societies, apart altogether from the undesirability of such a condition in amateur radio.

The R.S.G.B. is not perfect; but, in my opinion, it has done great work for British amateur transmitters, and is the recognised national Society. As such, it is the obvious medium for any organised effort to improve the amateur status, and I have always had consideration and courtesy from the executive members, of whom I have a very high regard.

In conclusion, may I express my appreciation of the way *The Wireless World* is assisting the amateur?

T. P. ALLEN, M.Sc.
Belfast. Radio GI6YW.

WHAT THE A.R.R.L. THINKS.

Sir,—Just a line to offer you our congratulations for your editorial on "Amateur Status" in the issue of July 10th. We think it very splendid indeed.

A. L. BUDLONG,
Asst. to the Secretary.
The American Radio Relay League,
Hartford, Conn., U.S.A.

ELECTRONIC OR ELECTROLYTIC?

Sir,—We note in a recent letter that readers are invited to discuss the meaning of electronic and electrolytic action, and that the Westinghouse metal rectifier is referred to in connection with this.

As the manufacturers of the Westinghouse metal rectifier we would like to give our views on the subject.

Your correspondent states that "an electrolytic action is surely the evidence of an electron flow." This is not in agreement with the usual views, which are that electrolytic conduction is carried out by the positive and negative charges on the dissociated ions of the electrolyte travelling through it in opposite directions from one electrode to the other. The medium between the electrodes must therefore be a chemical compound which readily dissociates into electro positive and electro negative ions, the electric charges on which depend on the relative numbers of protons and electrons forming them, i.e., the arrangement of their chemically combined electrons.

Electronic conduction on the other hand means that the passage of electric current is simply a flow of free or uncombined electrons. The difference between a conductor (metals in general) and a non-conductor is that the first has in its molecules free electrons, which do not affect it in a chemical sense, and which can readily pass from one molecule to the next and so form a flow of electric current.

In the special case of the thermionic valve there is no conducting medium in the space between the electrodes, but by heating one of them and applying a P.D. across them the free electrons in the heated electrode will leave its surface and pass across to the other, thereby forming a flow of electric current.

The same reasoning appears to apply to the Westinghouse metal rectifier, with the exception that no heating is necessary, and accordingly the claim of electronic action as opposed to electrolytic action would seem to be fully justified and in no sense confusing.

THE WESTINGHOUSE BRAKE AND SAXBY SIGNAL CO., LTD.
I. H. PETER, General Manager.

Sir,—A letter in *The Wireless World* for August 7th from Mr. L. Clarke contains a statement which requires some modification.

It was there stated that an electrolytic action was evidence of an electron flow. Such is certainly not the case. Electrolytic action is evidence of ionic flow. Free electrons are not involved in the changes inside the cell during, say, the electrolysis of copper sulphate. However, in metallic conduction, that the phenomenon is due to free electrons and not to ions is proved by the absence of diffusion of the conductors at the junction of two dissimilar metals in a circuit carrying a current. When the Westinghouse rectifier is said to be electronic in action, what is meant is that there is no ionic flow across the oxide-copper junction and therefore no diffusion of the oxide into the copper or of the copper into the oxide.

Rectification would then be due to the fact that electrons either could pass in one direction only, as in the thermionic valve, or could pass in one direction more easily than in the opposite. However, I should like to know how it was shown that the action is electronic rather than electrolytic; perhaps some of your readers can supply me with the references.

As far as conduction in crystals goes, there is some evidence to show that a conversion of ions does occur in a few cases across the crystal-metal junction.

F. LLEWELLYN JONES.
Glamorgan.

TRANSMISSION QUALITY.

Sir,—There is a certain portion of the activities of the B.B.C. the excellence of which is taken too much for granted. People talk about the wonderful reproduction of their sets now that they have installed the latest thing in receiving sets and loud speakers. But it never seems to occur to such people that their set is merely a link in the chain. For if the transmissions of the B.B.C. were not so very nearly perfect it would be quite impossible to reproduce good speech and music, however good the amplifier and loud speaker. This fact hardly seems to be realised at all by a great many people, and I think it is a fact for which the B.B.C., who have spent so much time and trouble improving their apparatus, should get due praise.

AN APPRECIATIVE LISTENER.
London. W.2.

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.

Fluctuating Eliminator Output.

I gather that the terminal voltages of an eliminator are always more or less dependent on the current consumed by the valves of the receiver. Should it not be possible so to arrange matters that the voltage delivered is practically independent of current consumption? If so, I should be glad of a hint as to how this state of affairs might be realised. M. V.

It is a fact that the voltage output of all eliminators is more or less dependent on load; in fact, in some of the best designs, where separate feeds are provided for the various valves through series resistances, voltage fluctuations are greater than in the case of comparatively simple instruments with a potential divider.

An eliminator, either for A.C. or D.C. mains, can be designed in such a way that its voltage output is almost unaffected by the load within practical limits, but such an instrument would be unduly expensive, and, moreover, it would be extravagant. This is because the only practical way of satisfying your requirements is to feed each terminal through a potentiometer of such a low resistance that it consumes a current many times greater than that taken by the valve (or valves) fed from it. As you are probably aware, potentiometer feed for anode bend detectors and screening grids has been advocated by writers in this journal; when dealing with low consumption circuits, it is easy to ensure that the potentiometer will consume much more current than the load without making the device unduly extravagant, but this is impracticable when arranging to feed, say, a super-power valve, or even an ordinary power valve.

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Actual Anode Voltage.

Will you please describe a simple method of measuring the actual voltage on the anode of the output valve of my set? I wish to apply the maximum voltage permitted by the makers' instructions (150 volts). I am sending you a circuit diagram of the receiver; will you please mark on it the connections of the measuring instrument? It should perhaps be added that I have a combined H.T.-L.T. meter rated at 200 ohms per volt. A. M.

We see from your circuit that the output valve has a milliammeter permanently connected in its anode circuit, and that this valve is provided with a separate filament rheostat. This simplifies the task of taking an actual voltage measurement. All you have to do is to connect a voltmeter directly between anode and negative filament of the valve in the manner shown in Fig. 1. Previous to doing this, you should make a note of the current indicated by the plate milliammeter under normal working conditions with full filament brilliancy. When the voltmeter is connected, it will be observed that the milliammeter reading will increase slightly, due to the presence of a resistance (that of the voltmeter) in parallel with the valve. The next step is to decrease filament emission by operating the rheostat until the milliammeter shows its original and normal reading, when the pressure indicated by the voltmeter will be that actually on the anode under working conditions—with the voltmeter removed, of course.

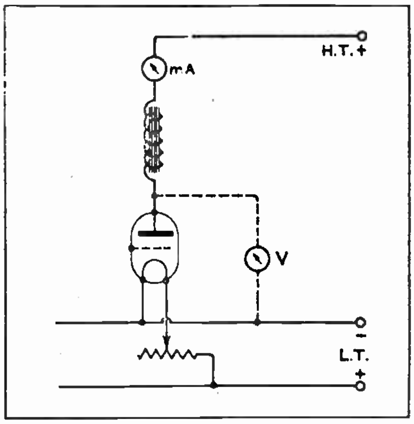

Fig. 1.—Measuring the voltage actually applied to an anode.

In cases where a filament rheostat for the output valve is not fitted, a variable resistance may be temporarily connected in the lead between the set and the positive L.T. accumulator terminal.

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A Partial Cure.

Since installing an eliminator for my receiver I have been troubled a good deal with motor-boating and L.F. oscillation. I am told that the addition of a choke filter output arrangement will effect a cure. Do you agree? C. N. L.

This statement is rather too sweeping; although there can be no doubt that a properly arranged choke filter device will reduce the tendency towards L.F. oscillation it cannot be assumed that it will provide a cure in every case.

We think, however, that you would be well advised to try it, but you must make sure that the circuit adopted is that in which one side of the loud speaker is connected to "earth." If the trouble is not cured, we suggest that you write again, giving details of your set.

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Poor H.F. Amplification.

(Referring to previous letter) . . . . You say that my trouble is almost certainly associated with the H.F. stage; I find that when the H.F. valve is switched off, signals from the local station which are normally quite good are almost completely eliminated. In fact, as far as reception of this station is concerned, the valve seems to work quite well. Do you think that the fact that its inclusion makes such a great difference to signal strength is a proof that the valve and its associated circuits are free from blame? R. S. G.

We observe from your address that you live less than fifteen miles from the London transmitting station; at this distance it is quite impossible to form an opinion as to the effectiveness of an H.F. stage when listening to the local signals. In any case, your test is by no means conclusive, because when the valve filament is switched off, the detector grid circuit is more or less isolated from the aerial, being linked to it only by stray couplings.

The near-by station will provide a more useful source of testing signals if you use but a few feet of aerial wire during your efforts to localise the trouble.

RULES.

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

(2.) 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.

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

(4.) Practical wiring plans cannot be supplied or considered.

(5.) Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.

(6.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Testing a Two-stage H.F. Amplifier.

The performance of my two-stage transformer-coupled H.F. amplifier is far from satisfactory. After having improved the screening and added decoupling devices, complete stability has been attained, but sensitivity is much less than it should be; judging by previous experience, I should rate it as no better than that of a good single-stage amplifier. Will you please give me a suggestion as to how to proceed in making a stage-by-stage test, preferably without dismantling much of the apparatus, as some of the connections in the screening boxes are not too accessible? E. A. W.

Provided a logical method of procedure is adopted, there is not much difficulty in making a thorough test of two H.F. stages, and you should find it easy enough to trace the exact cause of the trouble. As a first step, we recommend that you should test the second H.F. stage and the detector; this can very simply be done by disconnecting the first H.F. of the anode from its coupling transformer, and in its place joining an aerial to the primary winding. If the aerial is of full size, a small condenser of about 0.0001 mfd. should be interposed.

Under these conditions the set will be functioning as a single H.F.-det. combination, and the reception of good signals will indicate that detector and H.F. valves, and also the second H.F. transformer, are functioning properly. It will also be suggested (but not definitely proved) that the first H.F. transformer is correct. While conducting this test the normal aerial-grid tuned circuit will not be in operation, and its variable condenser should be set at minimum capacity, or, at any rate, "off tune."

Before proceeding with further tests it would be wise to interchange the H.F. valves, noting whether signal strength is the same when the valve normally used in the first position is transferred to the second socket.

As a next step, after having decided that the second stage is working well, the aerial should be put back to its normal terminal, and it should be observed whether, with both H.F. valves operating, signals are of greatly increased strength. If they are not, it may safely be assumed that the fault is located in the input aerial-grid coupling, the connections to the first valve (but not the valve itself), or, just possibly, in the primary winding of the H.F. transformer.

To make a comparative test of the first H.F. stage as compared with the second, it will be necessary to break the second and third grid circuits at the points marked X in Fig. 2, and to add bridging connections as shown in dotted lines. With this form of connection the second H.F. valve is completely eliminated, and a test can be made of the aerial coupling arrangements, the first H.F. valve, the first H.F. transformer, and the detector. It should be added that this last test is generally unnecessary if the procedure detailed above has been carried out, and that it may occasionally give misleading results unless the necessarily long detector grid circuit leads are carefully disposed.

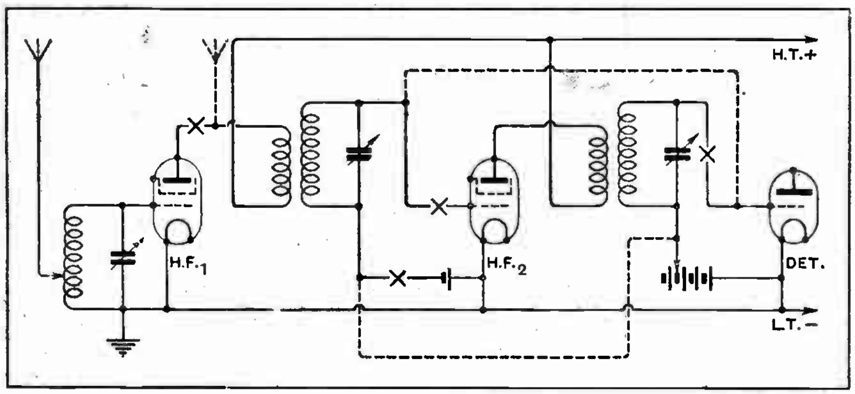

Fig. 2.—Stage-by-stage tests of a 2-valve H.F. amplifier.

H.F. Transformer Design.

Guided by your recent articles on the subject of H.F. transformer design, I have rewound the primary of my intervalve coupling in order to match the comparatively high impedance of my H.F. valve. Although amplification is distinctly improved, I find that the setting of the neutralising condenser does not hold good over the whole scale. This is not very serious, as instability is only evident on the lowest condenser settings; a more serious trouble is that selectivity is appreciably reduced. Will you make a suggestion as to how this can be improved? N. M. D.

Regarding your neutralising difficulties, it is only to be expected that it will be more difficult to obtain a balance when maximum amplification is reached, and we think that this trouble will easily be overcome by decoupling the circuits, and possibly by adding a little more screening than is customarily included in a set of this sort. We can well believe that the falling off in selectivity will be more troublesome; it should be made clear that the articles dealt with the subject from the aspect of maximum amplification, and it is a fact that the realisation of this ideal must inevitably be accompanied by some falling-off in selectivity. Unless you can make your aerial coupling arrangement more selective without impairing its effectiveness, your only course, we fear, is gradually to remove primary turns until the best compromise between long range and freedom from interference is reached.

○○○○

The Screening Grid Voltage Problem.

With a view to making an accurate measurement of the voltage applied to the screening grid of my H.F. valve from an eliminator, I have obtained a moving coil voltmeter rated at 1,000 ohms. per volt. One would imagine that a high-grade instrument of this sort should give an accurate reading, but yet it does not appear to do so. I have come to this conclusion because the set gives definitely better results when this circuit is fed, as a temporary measure, from a dry battery. Do you think that my meter is suitable for this purpose? L. W. S.

It is safe to say that no instrument of the type you are using, however good, is to be relied upon as an indicator of the actual voltage applied to the screening grid—at least, unless it is used in a very special manner. This is because the current consumption is often very low, sometimes falling below that passed even by a meter of exceptionally high resistance.

For further information on this subject and for instructions as to how accurate measurements may be made we would refer you to an article in our issue of January 16th.

○○○○

Zero Grid Rectification.

Due to the proximity of the transmitter, my "local station" set has a large reserve of amplification, and in order to reduce overloading and in an effort to improve quality, I have fitted a low-impedance detector valve (anode bend method). The negative bias for this valve was set at 9 volts, but results were not good; I have just discovered that signals are appreciably louder when the detector grid circuit is returned to negative filament—with the bias battery completely out of circuit. I cannot understand why the detector should rectify best with no bias, and should appreciate your comments. R. W. D.

In the absence of definite information as to the characteristics of your valve, we must assume that with 9 volts negative bias it is working more or less on the straight part of its grid volts/anode current curve, and consequently there is little rectification. When the valve is operated with a zero grid, considerably more rectification will be taking place, due to the effect of grid current, and we think that this explains your difficulty. It seems certain that the valve needs considerably more than 9-volts negative for proper detection.

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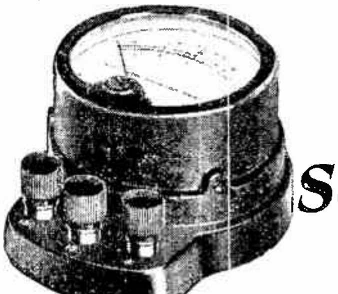

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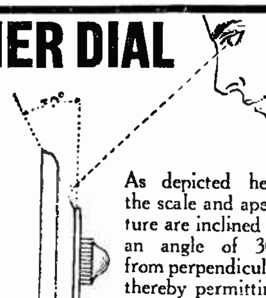

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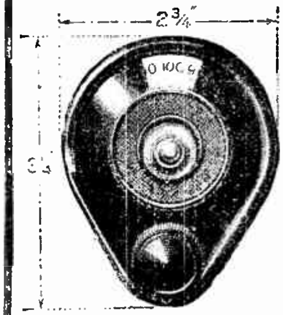

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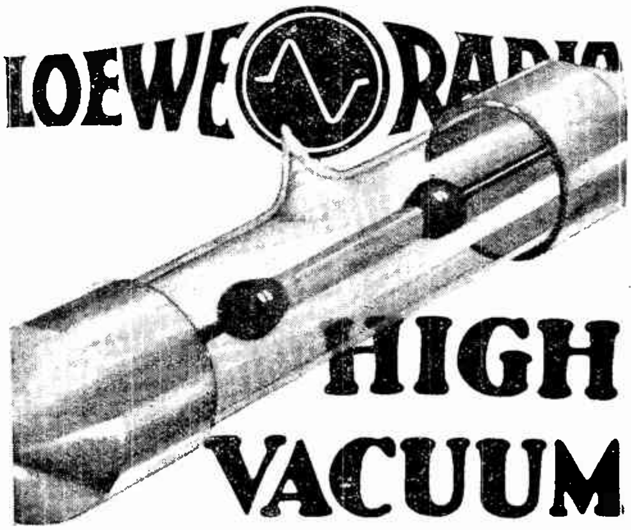

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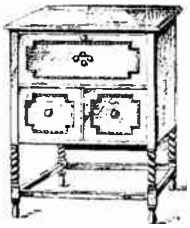

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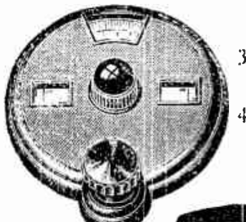

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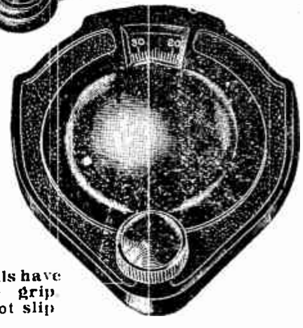

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PHILIPSON'S Safety Eliminators are Described and Illustrated in our Booklet "Radio Power." Have you had your copy?—Write to-day to

PHILIPSON and Co., Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038. 'Grams: Safety Bolton. Est. over 50 years [0318

ECKCO 1V.A.20 H.T. unit, 110v. A.C., used once only, variable 0-120 and fixed 120; £2/10.—Box 2648, c/o *The Wireless World*. [5848

JUST Out!—The new improved model Unifex H.T. A.C. eliminator kit; 30/-; giving full output of 120 volts, 15 milliamps, free from hum results.

THE New Kit includes Shielded Mains Transformer with terminals, heavy choke, 3 Hydra type condenser, tested 500 volts, D.C. Loewe vacuum resistance and clip, valve holder, panel ready drilled, and 3 sockets fitted, all the components mounted on a polished base board, and neatly boxed, with full instructions and picture diagram, ready for assembling in a few minutes; sent anywhere in the British Isles, per parcel post, c.o.d., 30/-, on the receipt of a postcard stating mains voltage, and cycle.

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THE New Model is the Finest Value in England; thousands now in use; hundreds of testimonials.

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Cabinets.—Contd.

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THE Following are the Finest Bargains Ever Offered, all of which are genuine Burndept manufacture, and you know Burndept quality; unless otherwise stated these cabinets are either slightly soiled or scratched, and every one is worth at least £3, but note our clearance prices.

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GENUINE Brand New Burndept Loud-speakers, to fit lid of above, everything complete, ready to fit in lid; 32/6.

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600-OHM Decoupling Resistances for "Wireless World" Circuits, hand made and tested in our own workshops; 1/- each, post free.—Groves Bros., St. Mary's Place, Shrewsbury. [5832

FOREIGN Listeners 4, set of three low wave coils, 32/6; highwave, 32/6; bases, 1/6 each.—Radiograph.

S.G. Multi Valve Portable Coil, 21/6; Europa portable coils, 21/- pair.—Radiograph.

S.G. Regional Coils 37/6 pair; Europa III coils, 22/6 pair.—Radiograph.

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S. PULSFORD.—Foreign Listeners' Four, complete set of coils, 62/-; bases, 1/6 each.

S. PULSFORD.—New Kilo-Mag Four, set of coils, 56/-.—S. Pulsford, 135, Hockley Hill, Birmingham. [5877

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B.T.H. Pick-up and Tone Arm, complete with Garrard motor complete, all new; £2/5.—P. Rawson, 62, Nunsfield Rd., Farfield, Buxton, Derbyshire. [5847

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BRUNSWICK Panatrope Pick-up, excellent condition; 18/6.—A. M., 3, Pinnock Terrace, Camberwell. [5893

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MAGNIFICENT 5-valve Electric Radio Gramophone Outfit, employing Rev. Noel Bonavia-Hunt's stereophonic couplers, B.T.H. turntable, Celestion pick-up, R.I. tone arm, and Baker's (steel pot) moving coil speaker in large baffle cabinet; complete outfit to operate from D.C. mains; £65.—For demonstrations apply 57, Temple Sheen Rd., East Sheen, S.W.14. [5889

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COIL Drive Speakers, Goodmans; call any date between 12.30 p.m. and 1.30 p.m. during the City luncheon hour, and hear any of our products demonstrated.—Goodmans, 27, Farringdon St., E.C.4. [0091

IF You are in London Call and See Goodmans' Coil Drive and Reed Units before purchasing elsewhere.—Goodmans, 27, Farringdon St., E.C.4. [0090

ABSOLUTELY Unsolicited Appreciations Testify to the Definite Superiority of Goodman's Products!!

OF the P.G.3 Double Acting 4-pole Balanced Reed Unit (25/- type), W.B., Old Trafford, Manchester, writes: You certainly merit congratulations on placing the P.G.3. on the market. At the last Manchester Exhibition it came under the notice of my friends and self, and there was nothing at that Exhibition which excelled the P.G.3.

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GOODMAN'S Cone Chassis Assemblies, the cone fitted to which are unique, by reason of Goodman's exclusive doping processes, can be fitted with any cone unit in 2 minutes; new model, 12/6; enthusiastic users write:—

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FINEST Suspension Leather, for fixing cones to moving coil or reed units, as supplied to principal makers; 2/- sq. ft., 1/6 10in. square; segments up to 12in. cone 9d. for 4; all post free, cash with order. Dilley, 8, Ashby Rd., Essex Rd., N.1. Clissold 0736. [5662

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WHY is the Webson B.S.7 Moving Coil Loud-speaker used as a standard in the principal laboratories of the wireless trade?

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BECAUSE the Webson B.S.7 is designed and made for the use of musical critics to whom only the finest possible reproduction is good enough.

HAVE you heard a Webson Moving Coil Speaker? If not, to do so will be a revelation.

SEND for Particulars to Star Engineering, Didsbury, Manchester. 'Phone: Didsbury 1785. or, if in London, ask Alexander Black, the Wireless Doctor 2a, Woodville Grove, London, N.16, to give you a demonstration. [5764

HANGING Corner Cabinet Speaker, 2ft. 0in. tall, polished oak, special floating cone and chassis, Blue Spot movement, powerful, fine tone, full bass, equal M.C., very handsome; photo; approval; sacrifice 2 guineas.—Box 2707, c/o *The Wireless World.* [5856

OUTPUT Valves. The ideal valve for purity output to moving coil and other large loud-speakers is an A.P. L.S.680; it dissipates 10 watts on 200 H.T. and requires only half the H.T. of the equivalent 3-electrode.—Kindly see Aneloy Products advertisement under Valves section. [5866

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Loud-speakers.—Contd.

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EPOCH by **Deferred Payments.**

EPOCH.

EPOCH.—Any responsible householder can obtain any type Epoch moving coil speaker by easy terms; no references, no interest.—Particulars from Mr. Laserson, 110, Cannon St., E.C.4. [5518

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EPOCH.

EPOCH.—**Marvellous new model moving coil speaker.**

EPOCH.—**Requires no accumulator! No mains!** No complications!

EPOCH.

EPOCH.—Does not require umpteen valves; **a crystal and one valve or a portable will work it.**

EPOCH.—The only straight line speaker.

EPOCH.—Straight line reproduction from **50** to 8,000 cycles.

EPOCH.—No resonance! No background! Clear as a bell!

EPOCH.—Sharp, **crisp attack. No drumming!** No hissing!

EPOCH.

EPOCH.—A **good soprano** does not sound like a contralto, nor as if she had a cold.

EPOCH.

EPOCH.—A **flute sounds like a flute but a violin** doesn't.

EPOCH.

EPOCH.—A piano **does** not **come** through like a broken down banjo, nor like a harpsichord or barrel organ.

EPOCH.

EPOCH.—The only range of speakers that reproduces speech as well as music with absolute accuracy.

EPOCH.—The speakers that have eliminated the defects of ordinary moving coil speakers

EPOCH.—Greatest variety on the market to suit all requirements and pockets.

EPOCH.—20 models; price from 50/-.

EPOCH.—See the new 9in. public address model.

EPOCH.—A happy model 66P.M. user asks us to state that an Epoch does not make a bad set good, but it makes a good set perfect.

EPOCH.—Testimonials by every post.

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EPOCH.

EPOCH.—One of the best known experts, whose name is a household word, after most exhaustive comparative tests, has just bought one for his private use

EPOCH.

EPOCHS are in use in many Talkies, have been adopted by scientific institutions, and are the preferred choice everywhere after comparative tests.

EPOCH is Made for Quality; the low price being only possible by quantity production and small profits.

EPOCH Speakers are very Massive, sturdy, foolproof, and made for everlasting wear.

EPOCH.—But should a speaker meet with an accident you can insert your spare diaphragm in 3 minutes (no tools whatever required), and the speaker is perfect again.

EPOCH.—With other moving coil speakers it is a complicated factory job—perhaps to be sent abroad.

EPOCH.—Dealers often push substitutes because of bigger profits; insist upon getting Epoch.

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EPOCH.—If your dealer will not take your order, the manufacturers will supply you direct.

EPOCH.—The only proper way to compare speakers is on your own set with a quick switch over; Epoch 66 welcomes such a comparison.

EPOCH.—You can have any type Epoch, subject to 7 days' approval.

EPOCH Speakers are Fully Guaranteed.

EPOCH.—British throughout.

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EPOCH.—**Send for Booklet.**

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EPOCH RADIO MANUFACTURING Co., Ltd., are the manufacturers. City Office and Service Station, 25, Laurence Pountney Lane, E.C.4 (off Cannon St.). 'Phone: Mansion House 4683. [5667

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Loud-speakers.—Contd.

BAKER'S SELHURST RADIO.

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SELHURST RADIO Moving Coil Speakers are of Proved efficiency and recognised as the best obtainable. Sold direct from address below, or from dealers in 10 countries. 14 days' approval.

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THE "Wireless World" Reader Prefers a Baker's Electro Magnet, because the highly efficient unit used is correctly designed, and by the use of special steel a high degree of magnetisation is obtained resulting in louder signals without the necessity of an elaborate amplifier requiring high voltages.

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ON Receipt of a Postcard, our new 36 page booklet will be sent at once.

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IN all Cases we are Happy to Advise You on any point concerning loud speaker reproduction

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ORIGINAL Pioneers of Moving Coil Loud-speakers, Bakers' Selhurst Radio.

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Loud-speakers.—Contd.

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BROWN Duckling Speaker, oak, complete with flex, hardly used; must sell, what offers?—11a, Shirley Rd., Addiscombe, Croydon. [5854

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DOUBLE Diaphragm Linen Loud-speakers Give Moving Coil Quality; any size up to 22in., assembled complete, 30/-; guaranteed perfect, units fitted at price extra of unit required; why risk failure assembling yourself?

POLISHED Oak Cabinets for Above Speakers, 22in. square; 27/6, all carriage paid.—Hammonds, 1, Stratford St., Nuneaton. [5899

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VALVES.—Rectifying half wave valves, 4v. 53 amps., output 30 m.a., do same work as a 15/- valve at under quarter the cost, 3/6.—Braidwood, 1, High St., Barnet. Try one! [5795

A.P. L.S.680, the ideal super output valve, which dissipates 10 watts at only 200 H.T.—half the usual voltage, "g"=3.0, mu=3.0, R_a=1,000 ohms; the valve is perfect for big amplifiers and lower power transmitters.

WE are so sure of A.P. Valves that we will send you the type required on 3 clear days' approval against cash order, and will accept risk in transit.

WRITE To-day for Full Data of the A.P. Family of Remarkable 4-electrode Valves.

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CONDENSERS, 2 mfd., 2/6; 4 mfd., 4/6; guaranteed; tested 500 volts.—Below.

CHOKES (L.F.).—Choke coils, excellent for smoothing, up to 20 milliamps, 2/-; special heavy duty chokes for 100 to 200 milliamps at 8/6 and 18/- respectively; any article on approval against cash.—Huggins, Radio Engineer, Clacton-on-Sea. [5030

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EXPERIMENTER Has for Sale the Following Components:—Pye chokes, 32II, 7/6; G.E.C. L.F.s, 2-1, 4-1, 10/- each; Igranic L.F.s, 3-1, 10/- each; Cyldon Bebe 0.0001, 4/-; Dubilier 0.0005 drum dial, 9/-; Polar reaction, 0.0001, 3/-; Gambrell neutrovernier, 2/6; Benzamin V.H.s, 1/- each; valves: P.M.3 5/-, P.M.4 6/-, P.M.24 pentode 12/6; all new and guaranteed.—Box 2499, c/o *The Wireless World*. [5740

VALVES, 2/6 each, good order; aerial coupler, 5/- (new); cone speaker, 15/-; transformer, 3/6; field telephone, 5/-; 20 mA. Sifam M.C., 17/6; portable 2-range voltmeter, recently overhauled 19/-, 25/-; other goods cheap; S.A.E.; about 200 wireless journals, 5/-.—Moorcroft, Hathersage. [5846

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Apply the same rule to your H.T. Battery and you will find the same result.

There are many H.T. Batteries cheaper than the Hellesen in first cost, but there is none from which you get so many milliampere-hours' service per penny of cost.

It pays you every time to get a Hellesen, particularly if you get a Treble Capacity, which costs less than twice the price of a Standard Capacity.

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Standard Capacity.

"Wiray" 9 volt Grid Bias Type	**2/-**
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MARCONI H.T. Unit, A.C.2, 50-100 cycles, £5/2/6; Ideal transformer, 4-1, 15/-; Colvern dual range coils for Six-Sixty mystery circuit, 17/6; J.B. S.L.F. condensers, 0.0005 and 0.00035, 5/- each; Ormond dials, D.I., 2/6 each; Titan coil (W. and W.), 10/-; D.E.5A, 7/6; P.M.5X and D.E.H.610, 6/- each; Igranic micro condenser, 2/6; Bulgin 3-point switches, 1/-; all above in new condition.—Trickett, 4, Woodlands Av., Leigh, Lancs. [5870

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NAMED Inseparably with Radio Part Exchange, wherever the English language is spoken.

THERE are those whose æsthetic tastes revolt when confronted by cheap production, whose mentality allows of no pretence, to whom rash promises are a vulgarity and colourful offers a bore; who require £1 worth of value for every £1 expenditure, and know full well that no living being can give them more.

TO Them, in the radio field, Appleby's appeal; in part exchange exists the most economical method of purchase.

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WE Supply Practically all the Leading Lines of Radio Apparatus at current list prices, and make no carriage charges except on accumulators and batteries and exceptionally bulky articles.

IF You Wish, we will take in part exchange any branded receiver, component or loud-speaker, for which you have no further use, providing such is reasonably modern and in workable condition.

TO Make Fair Offers, we must see the material; on receipt of a parcel, which must contain a list of contents and name of sender, we will send our offer, which is as an allowance from an order for new requirements totalling not less than twice the allowance—but it is fair. In the unlikely event of no agreement being reached, we will return your material carriage paid. We cannot execute part exchange orders of less than 10/- nett cash value, that is, after part exchange allowance has been deducted.

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POINT Two.—We must see the material. Making offers for material we have not seen proves inadequate, indefinite and misleading. It helps no one and progresses nowhere. Upon reflection, this is obvious, as the value of an article greatly depends on its condition and production age. The likelihood of receiving an inadequate offer for material sent to us can be determined by the fact that our rejected offers are, and always have been, below 1%.

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WE do not require you to purchase to the value of twice the allowance immediately. If you require a lesser value half the cost is payable in cash and the balance of credit due will await use at your convenience. Virtually, the system is a radio bank. Material may be deposited against a credit note, and no purchase made for several months. For those whose affairs take them periodically abroad this is particularly useful.

POINT Four.—Appleby's part exchange service is conducted in premises separate for the purpose, employing British labour of proved integrity, British capital and British behaviour. It is the original part exchange service—and a known quantity.

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A.F.5C, O.P.4C, O.P.3C, 12/6 each; 2 R.I. chokes, 7/6 each; volume control, 3/-; 6v. 80 Exide, 12/6; polar .0005 S.M. Ideal, 6/-; 5 T.C.C. 2 mfd. condensers, 2/- each; Universal clarostat, 3/6; Cyldon Bebe .0001, 2/-; 5 Gripso switches, 9d. each; D.E.5A, 5/-; D.E.H.610, 3/-; Cossor 610 R.C., 2/6; Lotus remote control, 10/-; H.F. choke, 3/-.—Box 2727, c/o *The Wireless World*. [5912

TWO R.I. Retroactive Inductances, 15/- each; Ferranti O.P.4C, 15/-, new; Ferranti 25 to 1 output, 12/6; Faradex double choke, 17/6, new; Pye 32-henry choke, 5/-; 2 Ormond slow motion dials (black), large type, 5/- 2.—Box 2725, c/o *The Wireless World*. [5907

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HIGHLY Sensitive Microphones for Transmitting Speech and Music Over a Distance, through loud-speaker or headphones, splendid instruments for making Detectaphone, deaf aid, loud-speaking telephone, announcements through loud-speaker, amplifier for crystal or valve set, experiments.—Below.

EXCLUSIVELY Super-Microphones were Used by Mr. Barnes-Jones in his wonderful invention of the Fog-Compass described in the "Times" and other papers of July 16th, 1929; each Super-Microphone guaranteed more sensitive than any other type known; fitted with a 3ft. silk connecting cord, 6/6; microphone transformer for same, 2/-; small 10 ohms earpiece for use with Super-Microphone in place of transformer, 6/-.—Below.

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BLUE Spot 66K Unit, with 7½in. chassis and cone, 22/6; Ferranti O.P.3C push-pull output transformer, 16/-; Watmel pick-up carrier, 5/-; P.M.5B, 4/-; P.M.5X, 4/-; 2 P.M.256, 5/- each; etc. —Gordan, 74, Delancey St., Regent's Park. [5891

BAKER Moving Coil Speaker, complete, 6-volt type, in perfect condition, price £2/10; Sterling Mellowvox speaker, also in perfect condition, 12/6; R.I.-Varley straight line frequency transformer, 12/6. —'Phone: Mitcham 3805; or write 3, Raleigh Gardens, Mitcham. [5890

IGRANIC .0005 Dual Condenser, 10/-; 2 Simplicon .0005 log. condensers, 4/- each; 2 Marconi S.M. dials (cost 9/-), 4/6 each; Igranic H.F. choke, 3/-; R.I. R.C.C. unit, type A, 7/6, all brand new; 2 Utility 3P.D.T. switches, 1/6 each; Formo .00035 log., 2/6; Ferranti 2 mfd. condensers, 2/-; Xlloss 1 and 4, with C.T. bases, 2/6 each; P.M.256, 4/-; L.S.5A, 10/-, perfect.—Latch, "Carrigart," Whitchurch, Glamorgan. [5886

WIRELESS Transmitting Sets for Morse Telegraphy or Distant Control of Models, etc., 1in. spark coil, condenser, spark gap, helix, etc., very compact, complete and ready for use, 12/6; high note buzzer with heavy Morse key, very high quality, 7/6.—Below.

ELECTRIC Motors, 1/16h.p. to 1/8h.p., 110v. and 220v. D.C., silent running, carbon brushes, in perfect condition and working order, suitable for gramophones, television, or any small power uses, 10/-; a few with overheated windings, if rewound make good dynamos for H.T. accumulators, 6/-.—Below.

COMPLETE Portable Telephones, ready for use, high class instruments, 17/6; hand telephones, 4/6; 1,000 ohm choke coils, 1/-; Dewar switches, 1/-; large earphones, 1/3; Morse keys, 4/-.—Below.

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DYNAMOS, shunt wound, for charging or lighting, 50v. 4 amp., ring oiler bearings, carbon brushes, 35/-; 100v. 3 amp. ditto, 50/-; 110v. 3 amp., ball bearing, carbon brushes, 55/-; 110v. 2 amp. ditto, 45/-. —Below.

ELECTRIC Motors, all ball bearing and carbon brushes, ¼h.p. to 1h.p. 110v. 30/-; ½h.p. 220v., 45/-; 6-volt car starter motors, 10/-; 12-volt ditto, 12/6; 110v. motor direct coupled to air blower, mounted on iron bedplate, ⅓h.p. motor, 45/-.—Below.

STARTERS, please state requirements; starter regulators, make good field rheostats for dynamos, to carry 2 amps. 7/6, to carry 5 amps. 10/-, to carry 8 amps. 12/6.—Below.

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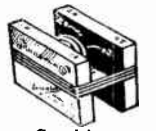

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YOUR Old Apparatus Taken in Part Payment for Latest Type; see our advert. in column Receivers for Sale.—Scientific Development Co., 51, Fishergate, Preston. [0229

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PARTS for Osram Music Magnet, at lowest price.—Box 2711, c/o *The Wireless World.* [5873

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L.F. Transformer, V condensers, cone unit, 2-volt valves, grid leak and condenser.—Jones, Bodlondeb, Legacy, Wrexham. [5887

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ADVERTISER, visiting Berlin and radio exhibition, will undertake commissions.—Box 2661, c/o *The Wireless World.* [5851

AMBITIOUS Men Wanted as Agents (all districts), for nationally advertised wireless and gramophone company planning vast new sales developments, must be capable of demonstrations and installations; generous commissions; unbounded opportunities for really enterprising men; whole or part time.—Write Box 2726, c/o *The Wireless World.* [5908

Agencies.—Contd.

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TESTERS Required by Portable Set Manufacturer in N.W. London District, previous experience an advantage, excellent prospects for suitable men.—Apply, giving age, experience and salary required, Box M., c/o Parrs, 121, Kingsway, W.C.2. [5868

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TECHNICAL Assistant Required, with experience in the manufacture and testing of thermionic valves; North London district.—State full particulars, salary expected, etc., to Box 2721, c/o *The Wireless World.* [5903

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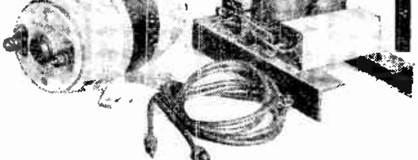

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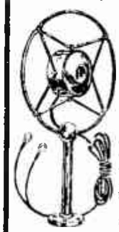

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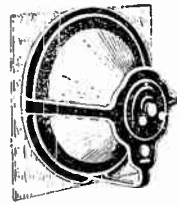

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The Wireless World

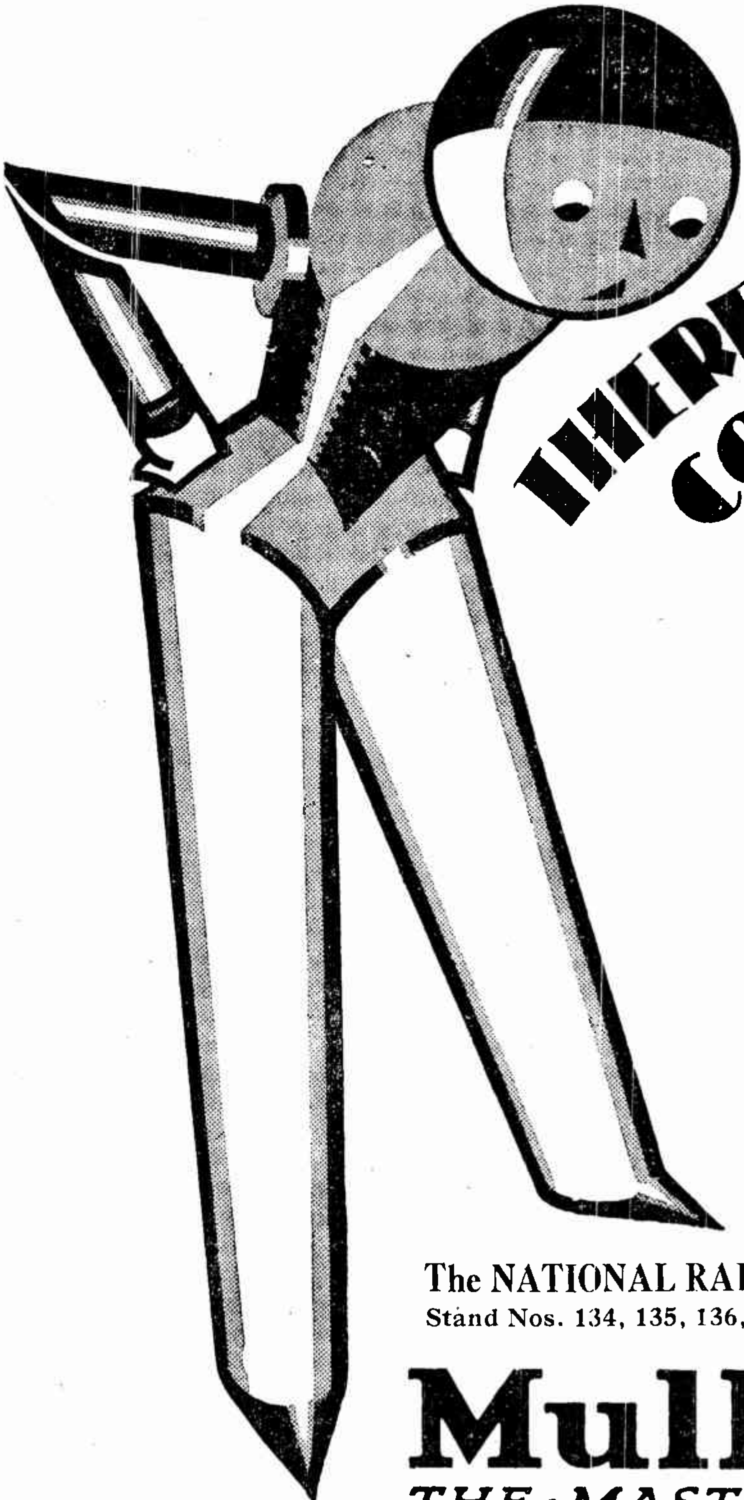
AND RADIO REVIEW

3D

The Paper for Every Wireless Amateur

Wednesday, August 28th, 1929.

No. 522. Vol. XXV. No. 9.



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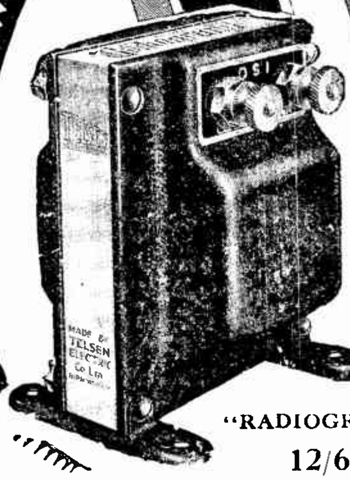

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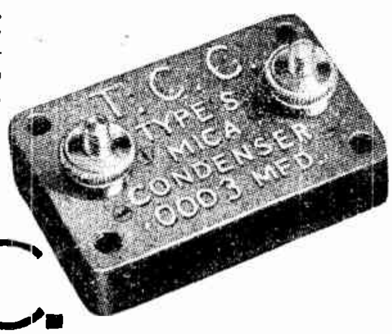

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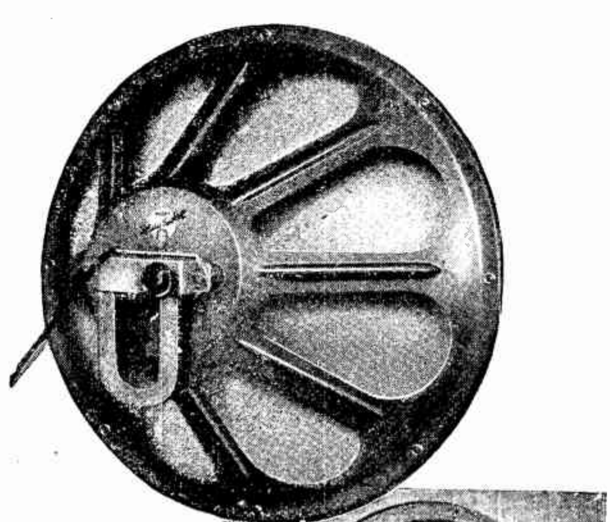

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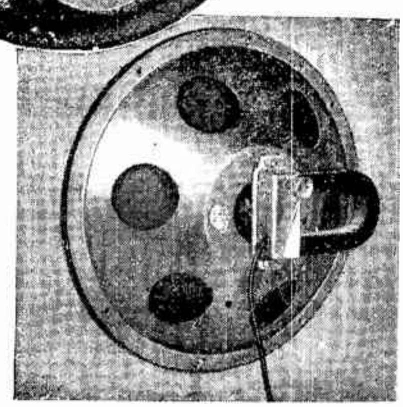

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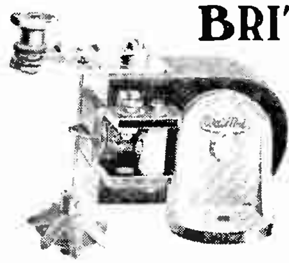

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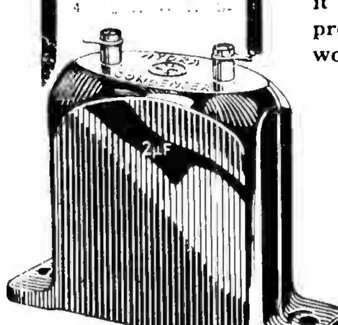

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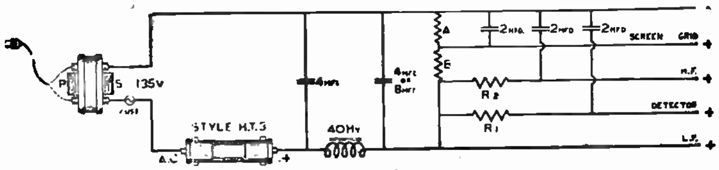

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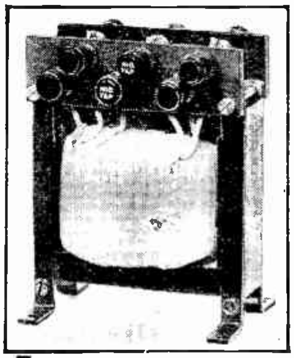

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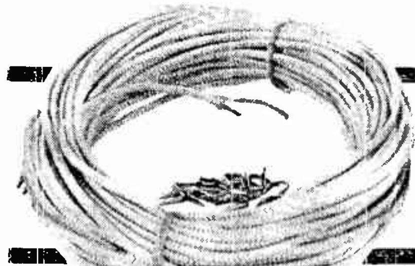

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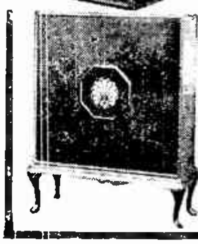

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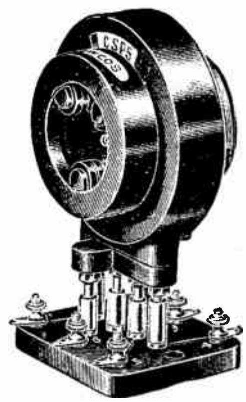

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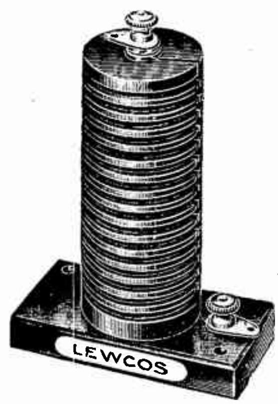

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The Wireless World

AND RADIO REVIEW

(17th 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.

THE B.B.C. "HUSH-HUSH" STATION.

BROOKMAN'S PARK, the firstfruits of Captain Eckersley's regional scheme, is now ready for service, and its inauguration should be, for British broadcasting, the most important event since the establishment of the B.B.C. The regional scheme has now been a topic of conversation for some two years since the plan was first put up by Captain Eckersley, and it can be said that it constitutes the first definite step in the establishment of a permanent scheme to provide alternative programmes throughout the country. Seeing, then, that the inauguration of transmissions from this station is an event of prime importance, why is it that the B.B.C., in its behaviour with regard to the station, is acting as if the station were something to be ashamed of, and to be brought into existence with as little commotion and as much secrecy as the B.B.C. can ensure? No definite date is given, we are told, for the station to commence work, but it is hinted that the station will gradually slide into use so that the public will all at once wake up to the realisation that a second station is providing regular alternative programmes for the inhabitants of the London area.

Why all this secrecy and caution in putting the station into operation? If the engineering staff were scared lest the station should prove a failure, then we might understand this reticence, but, knowing the staff, we have no reason whatever for doubting that the station of their design will be efficient as a transmitter.

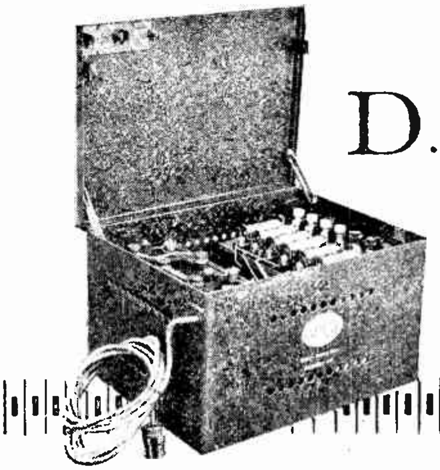
Confidence of the Public.

We know that criticism of the regional scheme has been very general, but we had come to the conclusion that the B.B.C. had been able to live down the criticism and had by now restored the confidence of the public in the potentialities of the scheme. So far as we ourselves were concerned, we were content, in view of the assurances which the B.B.C. had given, to wait for the station to begin operation rather than to continue any criticism of a pessimistic nature. Our only criticism had been because we believed that selectivity in excess of that provided by the circuits of practically all crystal sets and a very large proportion of the valve receivers at present in use, would be required within a large radius of the station in order to avoid the "swamping" effect of the high power of the two transmissions.

We would have thought that the inauguration of Brookman's Park as the first station of the regional scheme would have been the occasion for extreme jubilation on the part of the B.B.C., the listeners, and the wireless industry. We should have expected that the opening of the station would have provided a first-class opportunity for publicity for broadcasting generally, and that the inauguration would have been a ceremonial affair in keeping with the importance and dignity of the occasion.

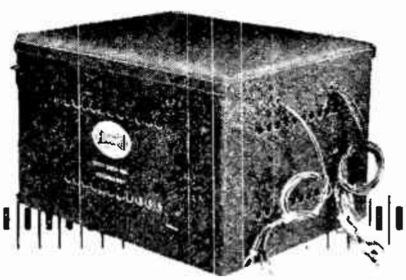
Make the most of it.

It is not now too late for the B.B.C. to revise its plans for the opening of Brookman's Park, and we would urge the Corporation to consider the advisability of abandoning the "Hush-Hush" policy with regard to the commencement of the Brookman's Park transmissions, and letting the occasion be one where no stone will be left unturned in ensuring the utmost publicity possible for British broadcasting. The opening ceremony would then take place just prior to the National Radio Show at Olympia, and assist very largely in focusing public attention on broadcasting and its value to the community at a most opportune moment.



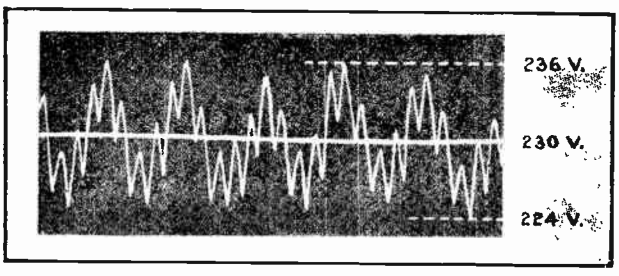
HUM PROOF D.C. ELIMINATOR

A High Tension Unit with a Double Filter for Feeding 3-, 4- or 5-Valve Sets from the "Roughest" of Mains.



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

ALTHOUGH the conversion of supply mains from direct to alternating current proceeds apace there are still a large number of districts where the change has not yet been made, and where a comprehensive D.C. eliminator which can immediately be modified for A.C. would be welcome. An examination of the title illustration will show that the eliminator about to be described is contained within a metal safety box so designed that opening the lid causes all connection with the mains to be severed and all metal parts to become "dead." On the right is the filter itself, and on the left the L.T. accumulator for the receiver can be placed provided that its overall dimensions do not exceed 8in. × 4½in. × 7in. high. Where the mains have a positive earth connection the accumulator terminals, and probably a film of acid around them, will have a difference of potential to earth of some 200 volts; it is thus a great advantage, in order to prevent shock, only to have access to this component after it is automatically disconnected from the mains. The space taken by the accumulator can be used for the transformer and rectifying equipment, using practically the same filter if the eliminator be subsequently wanted for A.C. mains.



[Courtesy Messrs. Ferranti.

Fig. 1.—Typical waveform of D.C. supply mains. The peaks of the superimposed ripple in the case of a 230-volt supply might cause a rise to 236 volts and a fall to 224 volts as shown.

Before proceeding to describe the H.T. unit in detail it would be as well to discuss the nature of a typical D.C. supply system for the *raison d'être* of each component part of the filter. In Fig. 1 is seen an oscillogram of a typical 230-volt supply. At the peaks the instantaneous voltage has risen to 236 and dropped to 224, and the superimposed ripple waveform is most irregular. The disturbances are not only a function of the speed of the generator and the number of commutator bars, but also may be due to switching on of heterogeneous gear along the line. If a filter can be designed so that the ratio of output to input ripple voltage is under 0.2 from 40 cycles upwards it would appear from experiment that the very "worst" mains, including most mercury arc systems, can be smoothed to a hum-free anode supply. It is because of the extremely wide frequency band of disturbance which is in direct connection with the filter that the D.C. unit chiefly differs from that for A.C. where the transformer isolates the input.

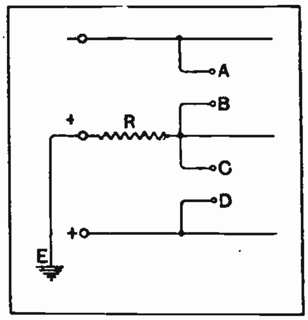


Fig. 2.—The three-wire supply system. The consumer will either be connected to A and B or C and D. Owing to the small resistance R, the neutral lead at the consumer's end may have a difference of potential to earth.

The distribution of D.C. is usually effected by the three-wire system, as shown in Fig. 2. The central neutral conductor is earthed at the generating station, and consumers will either obtain their supply by being connected to A and B or C and D. In one case the negative lead A would have a potential difference to earth of some 200 volts, while in the other case the positive lead D would have a similar potential difference. Since the neutral conductor must have a small resistance R, the many hundreds of amperes passing through it will cause B and C to have a small voltage above the true earth point E.

Earth Condenser Considerations.

If we are connected to A and B, the usual earthing of the negative filament in a receiver connected to the mains will mean a complete short-circuit of the supply,

Hum Proof D.C. Eliminator.—

If we happen to be connected to C and D, earthing our negative filament will entail a flow of current from the neutral conductor to earth, which is forbidden under the terms of the agreement with the supply company. It is thus clear that an earth condenser (see C_9, Fig. 5) *must* be included in a D.C. eliminator. With the three-wire system it is possible for a momentary fault to arise at the generating station whereby the plates of the earth condenser may have a potential difference of twice that of the supply mains; the test voltage for this component should therefore not be less than 500.

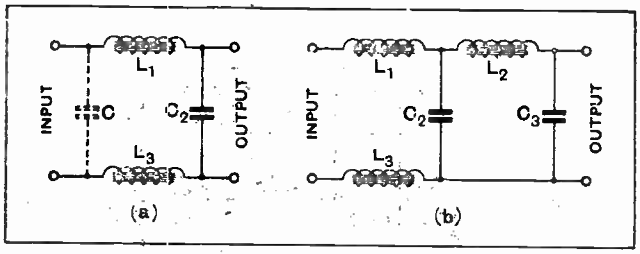


Fig. 3.—(a) A simple filter for D.C. mains. The choke L_3 can often be dispensed with when dealing with a negative neutral. Owing to the capacity of the mains a condenser C (in dotted lines) in the position shown would be useless. (b) A more ambitious double filter necessary when the mains are "rough" and especially useful where mercury arc rectification is used.

With a positive neutral conductor (A, B, Fig. 2) there is always a flow of ripple current through the negative lead, and it is for this reason that a choke of high impedance to fluctuating currents and a low resistance to D.C. (because it is in a common return wire) must be interposed. The choke (L_3) employed has an adequate inductance with heavy currents, and its D.C. resistance is only 145 ohms. When testing the eliminator on mains with a positive neutral the omission of L_3 caused quite a serious hum. It may be found that with a supply having a negative neutral L_3 is not necessary. In Fig. 3 (*a*) the simplest D.C. filter is shown; if the mains happen to be reasonably smooth the output after it has passed through the necessary voltage-dropping resistances is probably adequately free from ripple. It should be mentioned that the mains have such a large capacity that a condenser C (in dotted lines) of, say, 2 mfd. shunted across them serves no useful purpose. A more ambitious double filter which is used in the present eliminator is illustrated in Fig. 3 (*b*). Its property of smoothing such rough D.C. circuits as are produced by mercury arc rectification is incomparably better than the circuit of Fig. 3 (*a*) provided that the values of the chokes and condensers in the network are as given in Fig. 5.

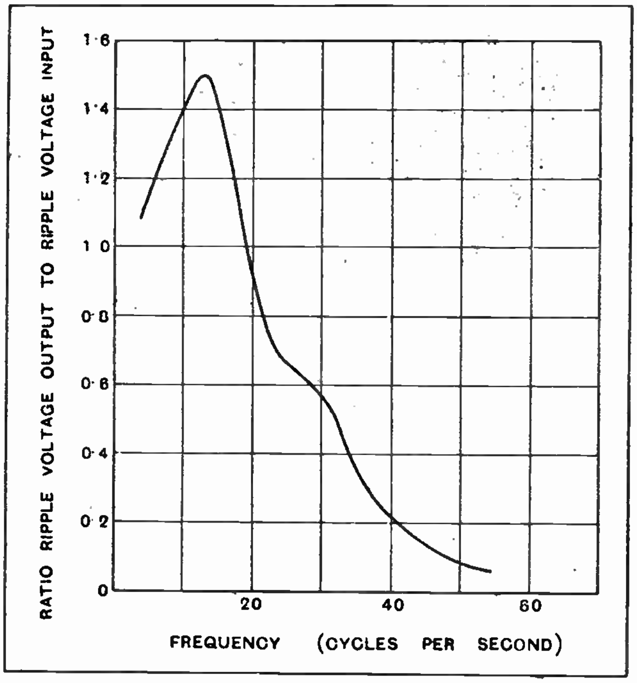
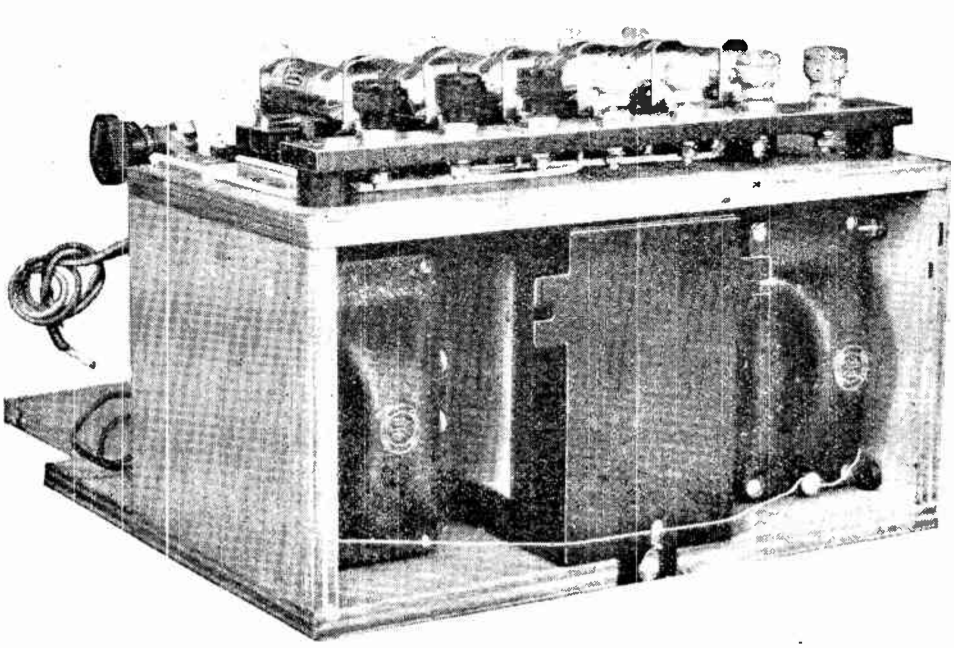


Fig. 4.—The type of curve given by the double filter of Fig. 3 (b). Provided that the peak is below 25 cycles the filter is likely to deliver an output free from ripple.

The effectiveness of the double filter to reduce the amplitude of an applied ripple voltage at various frequencies is given in a typical curve in Fig. 4. Here there is a distinct natural resonance at about 15 cycles, but, as has been



The whole unit can be lifted from the safety box. In the centre is the 19-mfd. condenser block.

Hum Proof D.C. Eliminator.—mentioned before, provided that above about 40 cycles the ripple output is reduced to less than one-fifth of the ripple input there will probably be no hum heard in the loud speaker. For further details as to the efficiency of various filters reference should be made to an interesting paper [1] by P. R. Coursey and H. Andrewes read before the Institution of Electrical Engineers.

With the exception of the earth condenser C_9 the other seven condensers are in the form of a 19-mfd. condenser block with tappings in the following order: 6, 4, 2, 2, 2, 2, 1 mfd. together with a common terminal. A composite condenser of this design confers the advantage of cheapness and compactness and involves considerably less wiring.

[1] Journal I.E.E., Vol. 65, July, 1927.

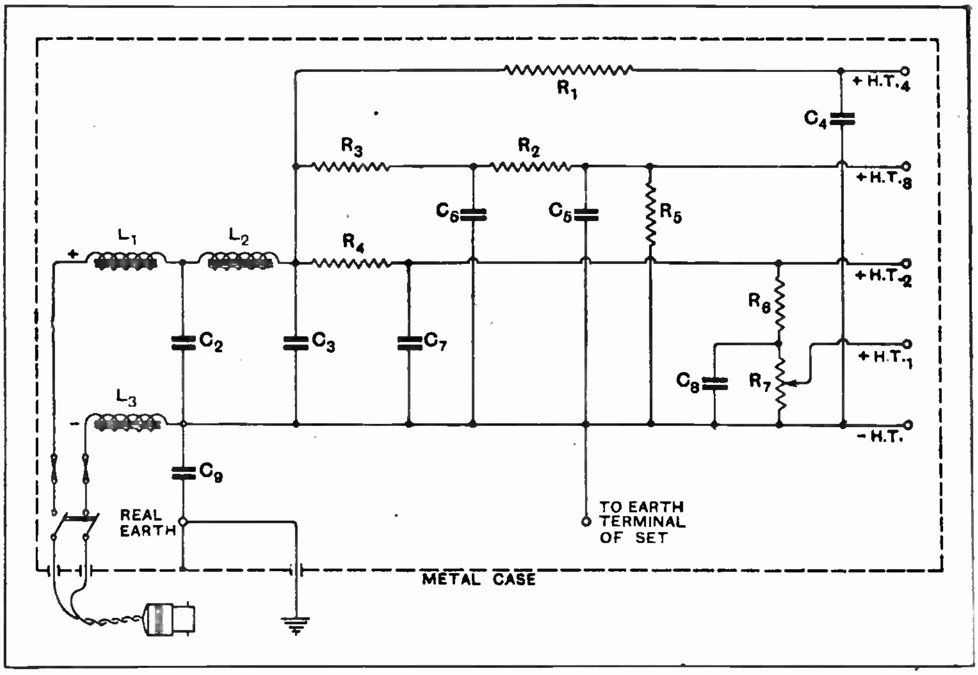
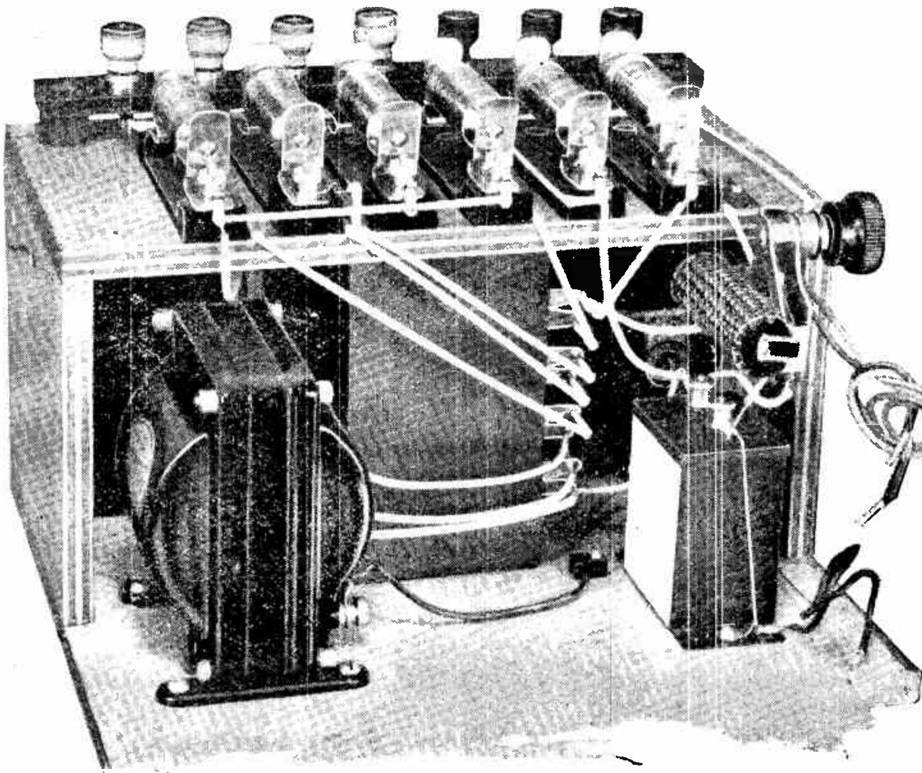


Fig. 5.—The circuit diagram. L_1, 32 henrys; L_2, 20 henrys; L_3, 6 17 henrys; C_2, 6 mfd; C_3, 4 mfd; C_4, 2 mfd; C_5, 2 mfd; C_6, 2 mfd; C_7, 2 mfd; C_8, 1 mfd; C_9, 2 mfd, 500-volt test; C_2 to C_8 (inclusive) are in the form of a tapped condenser block of 19 mfd; R_7, 25,000-ohm wire-wound potentiometer; R_6, 10,000 ohms. When using a typical screen-grid valve followed by a "D" type valve as anode bend detector and a power valve requiring about 20mA. at 150 volts, the other resistance should have the following values when the mains are 220 volts; R_1, 4,000 ohms; R_2, 10,000 ohms; R_3, 10,000 ohms; R_4, 10 000 ohms; R_5, 40 000 ohms.



On the right can be seen the earth condenser above which is the variable wire-wound potentiometer for critical screen voltage control.

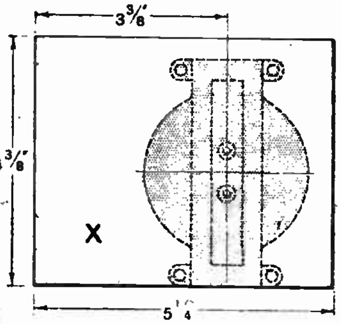
The numbers printed on the label attached to the condenser block correspond with the condenser numbers in the circuit diagram of Fig. 5, e.g., C_3 represents the condenser between 3 and "common."

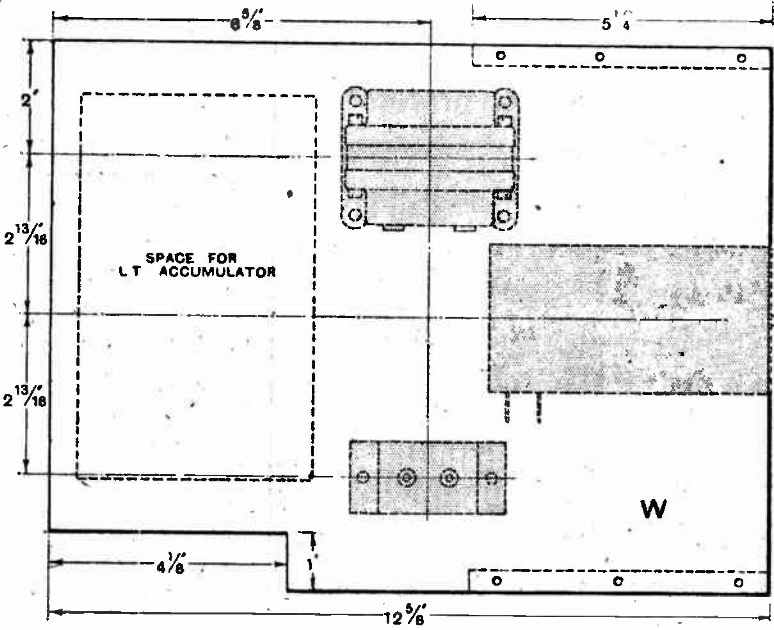
The remainder of the eliminator containing voltage-dropping resistances and condensers calls for little comment except perhaps for the critical control scheme of screen voltage (H.T. +1) for a screen-grid valve if one is employed in the receiver. As is customary a potentiometer is used—in this case a fixed clip-in resistance R_6 being connected in series with a wire-wound 25,000 ohm variable potential divider R_7. Such an arrangement is desirable since movement of the slider does not alter the total value of R_6 and R_7, and thus the regulation of the feed of H.T. +2 (also a potentiometer) is hardly changed. Whilst R_7 serves

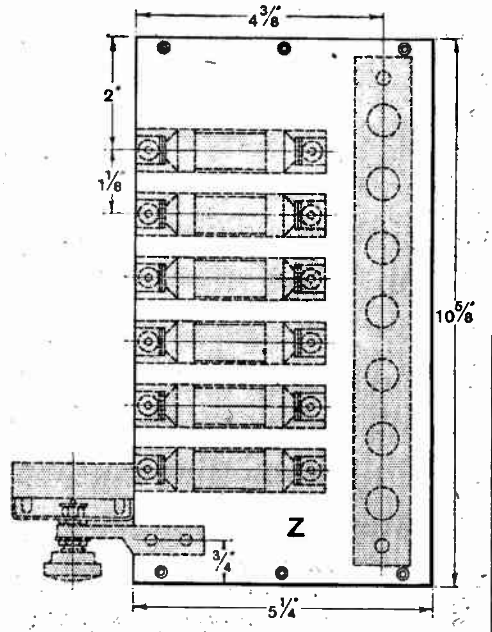
Hum Proof D.C. Eliminator.—
as a critical control of screen voltage for maximum amplification it can also be used as a very effective volume control. A small but thick ebonite knob is used on the potentiometer so that a saw-cut can be made in its head for control by a screwdriver through one of the vent holes in the safety box. This allows the chassis to be lifted out without hindrance and avoids the difficulty of a live spindle passing through the earthed metal cabinet. The potentiometer is fixed to the upper surface of the wooden superstructure by a piece of brass strip.

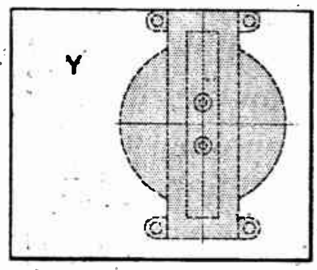
It must be remembered that with a positive neutral, the screening, aerial, loud speaker terminals, L.T. accumulator and part of the wiring may have a difference of potential of approximately 200 volts to earth. If the aerial-earth circuit of the receiver belongs to the isolated loose-coupled variety a lead must be taken from the receiver earth to the terminal marked "earth terminal of set" on the H.T. unit. If the receiver has a direct-coupled aerial circuit no such connection is required as the necessary contact has already been made through H.T. –. To prevent the possibility of shock from the

General layout of components. W is the baseboard; Z the superstructure for resistances, terminals and potentiometer while X and Y are the vertical wooden supports to the inside of each of which are attached the chokes for the positive mains lead.









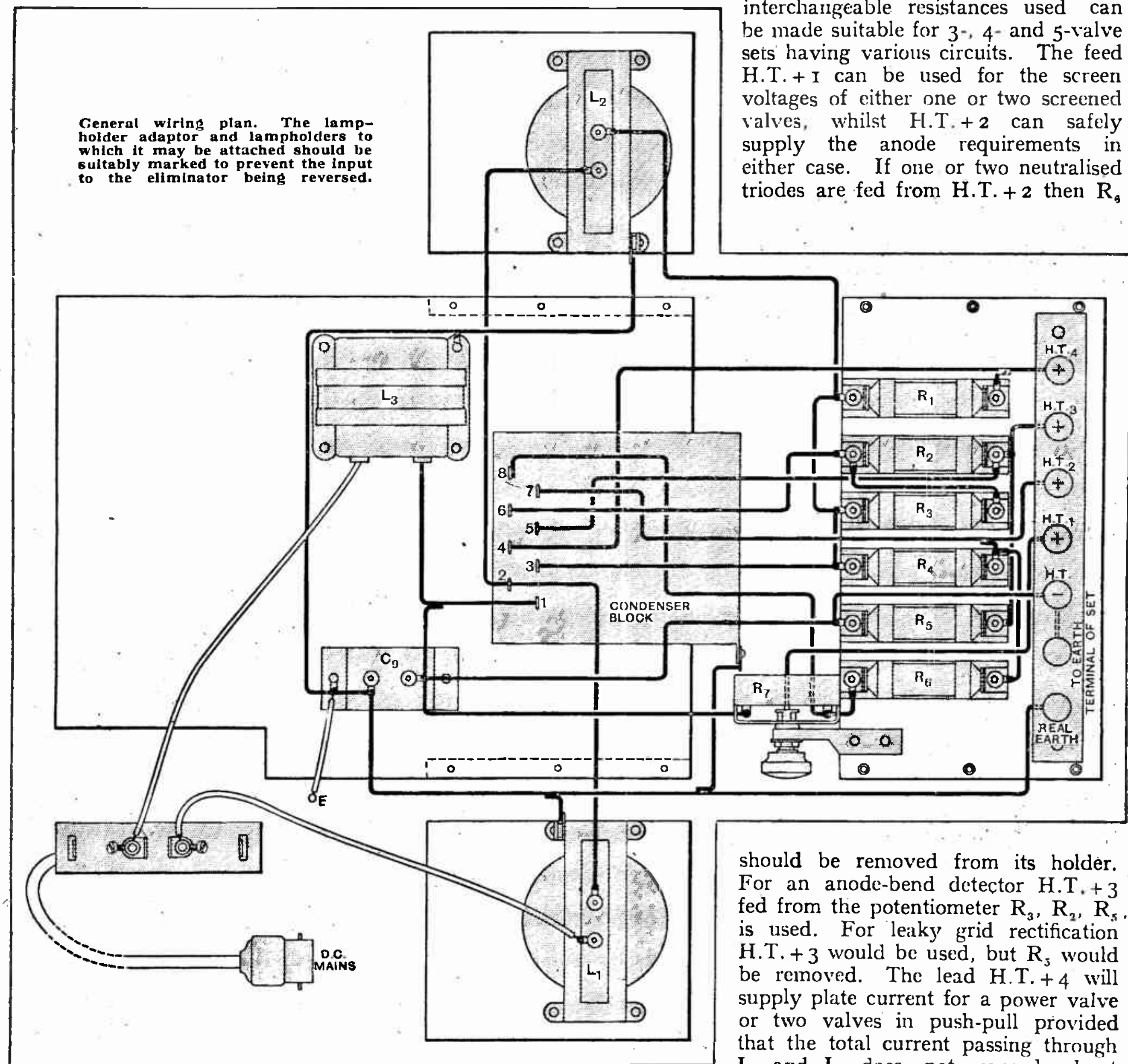
LIST OF PARTS.

1 Safety box, 13" × 10" × 7¾" (Ferranti).
1 L.F. choke, 6/17 henrys (B.2 Ferranti).
1 L.F. choke, 20 henrys (Pye).
1 L.F. choke, 32 henrys (Pye).
1 Variable high resistance wire-wound potentiometer, 0 to 25,000 ohms (Electrad-Truvolt, Rothermel).
6 Resistances and holders (Ferranti).
1 Condenser block, 19-mfd. 500-volt test (type BE.46 Dubilier) (6, 4, 2, 2, 2, 2, 1 mfd. tappings in this order).
1 Fixed condenser, 2 mfd. 500-volt D.C. test (Dubilier).
7 Terminals (Tapa).
6 Spade ends (Lisenin).
6 Wire labels ("Coltags," S. H. Collett Manufacturing Co., Ltd., 60, Pentonville Road, London, N.1).
1 Baseboard, 12½" × 9¾".
1 Lampholder adaptor.
Multi-ply wood, 20" × 5½".
Systoflex, screws, wire, etc.
Terminal strip, 1" × 9" × ¼".

Approximate cost of all parts, £7 5s.

Hum Proof D.C. Eliminator.—
aerial, a series aerial condenser, if not already embodied, should be fitted *inside* the receiver. The loud speaker can be isolated with an output transformer, or, if a choke-filter output is employed, condensers on *either* side of the speaker are necessary. To give absolute immunity from shock the receiver and eliminator should really be housed in one box the lid of which, when lifted, could be arranged to disconnect the mains. Such an elaborate scheme is hardly justified in view of the short life of the remaining D.C. systems in this country.

It should be noted that the safety box is a new model having dimensions as shown in the list of parts. It is earthed, as are also the cases of the chokes and condensers. The fuses in series with the switch in the lid of the box are rated to blow at one ampere and protect the various components in the event of serious overload or short-circuit. A terminal for "real" earth has been arranged on the terminal strip so that the earth wire to be found in the flexible cable from the safety box can be disregarded, and the projecting end together with the metal label cut off.



General wiring plan. The lampholder adaptor and lampholders to which it may be attached should be suitably marked to prevent the input to the eliminator being reversed.

The eliminator by reason of the interchangeable resistances used can be made suitable for 3-, 4- and 5-valve sets having various circuits. The feed H.T. + 1 can be used for the screen voltages of either one or two screened valves, whilst H.T. + 2 can safely supply the anode requirements in either case. If one or two neutralised triodes are fed from H.T. + 2 then R_6 should be removed from its holder. For an anode-bend detector H.T. + 3 fed from the potentiometer R_3, R_2, R_5, is used. For leaky grid rectification H.T. + 3 would be used, but R_3 would be removed. The lead H.T. + 4 will supply plate current for a power valve or two valves in push-pull provided that the total current passing through L_1 and L_2 does not exceed about 50 mA. If the full mains voltage (less a small drop due to the chokes) is required for the last stage, R_1 can be removed and a short-circuiting bar put in its place.

It will be seen that separate series feeds are arranged

Hum-proof D.C. Eliminator.—
for each valve, the only exception to this being in the case of a two-stage high-frequency amplifier where the screens and anodes can be safely fed from H.T. +1 and H.T. +2. It is, of course, assumed that a receiver incorporating such an amplifier would be well decoupled. The filtering scheme between L_2 and the receiver is so generous that separate chokes have not been found necessary in the leads H.T. +4 and H.T. +3.

Owing to the multiplicity of supply voltages and the wide range of anode currents taken by valves it is quite impossible to give any specific values for the resistances R_1 to R_5. Should the amateur possess a milliammeter it is an easy matter to see that the feed currents at H.T. +2, H.T. +3 and H.T. +4 are the same as when the valves are supplied from a battery of known voltage. Failing this, reference should be made to an article by the author entitled "Dropping Volts," in *The Wireless World* of November 28th, 1928. The resistance values given under Fig. 5 are suitable for a receiver such as the "Megavox-Three," but in this case R_3 need not be removed for leaky grid detection.

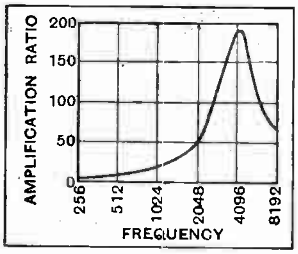
As to performance, the eliminator was tried with various *Wireless World* receivers, and was found to give an output in which no superimposed ripple could be heard even with a moving-coil speaker. A commercial kit set in which very few decoupling devices were included gave no trouble from hum or motor-boating. When the time comes for conversion to A.C. reference must be made to an article under the title "Megavox Eliminator" which appeared in the issues dated December 12th and 19th, 1928.

This eliminator is available for inspection by readers at the Editorial Offices: 116-117, Fleet Street, London, E.C.4.

IS TRANSATLANTIC CABLE TELEPHONY POSSIBLE?

Using the S.G. Valve in an Attenuation-Correcting Amplifier.

RECENT statements in the Press indicate that there is under consideration the project of laying a submarine telephone cable across the Atlantic. Such a system would have obvious advantages in its reliability, secrecy, and immunity from fading and jamming, and, if it were economically sound, and as efficient electrically as commercial land-line systems, it would not only be a great scientific achievement but an enterprise of international value.



Frequency characteristic of the screen-grid amplifier arranged to give a resonance below 7,000 cycles.

The technical difficulties involved are considerable, but in view of published information available it would appear that they have been overcome. Some unusual problems are centred around the terminal apparatus. Repeaters or amplifiers for correcting distortion are usually inserted at intervals of 70 to 120 miles in landline practice in order to augment the weakened signals and at the same time to compensate for the loss of upper frequencies. With this requirement in mind it is somewhat bewildering to imagine a distance approaching 2,000 miles to be covered without any intermediate repeating apparatus. Fantastic notions of supporting electrical equipment on buoys or sinking it to the sea bed are quite impracticable. The landline with its repeaters is in many respects analogous to a bridge with a number of piers at intervals, whilst the Atlantic cable is like a mighty suspension bridge supported only at its extremities and requiring colossal piers. In a similar manner the cable requires super-amplifiers.

Enormous Amplification of the Upper Frequencies.

Now many readers have undoubtedly had the experience of listening to broadcasting relayed over poor landlines which have absorbed, owing to their high capacity, the upper frequency currents of the telephonic range. This upper frequency attenuation is much more acute with a long submarine cable, and the problem of reproducing the original signals consists in amplifying the highest frequency of the commercial speech range many thousand times as much as the lowest frequency, the amplification naturally being progressive. This difficult problem has been solved by using the principle of a combination of screen-grid valve and a special transformer having a resonance frequency below 7,000 cycles, the characteristic of the combination being shown in the accompanying diagram. Several units are placed in cascade in the receiving amplifier for the proposed cable, and the output to the landline is controlled by varying the voltage applied to the last stages, which give uniform amplification with frequency.

Data for an actual receiving amplifier show a measured voltage amplification of five million at a frequency of 2,000, which amplification is 40,000 times as great as the value at the lowest frequency considered. An interesting comparison is afforded by the fact that repeaters used on two- and four-wire systems of landlines have voltage amplifications of 30 and 900 respectively at 2,000 cycles.

Input Correction.

The novel amplifying-correcting principle is also employed in the transmitter or outgoing end of the cable. The output from the subscriber's microphone, after reaching the terminal station of the cable, passes into the screen grid valve-transformer stages of the transmitter to boost the upper frequencies beyond their original value, thence to the transmitting valves, and finally to the cable. This "shaped" input to the cable has specific advantages. The total voltage amplification of the receiver and transmitter probably approaches 100 million, which figure has never before been realised in submarine cable engineering.

This interesting information has been extracted from a patent specification granted to Dr. N. W. McLachlan and Mr. W. S. Smith. We look forward with assurance to the day when trans-atlantic cable telephony is inaugurated.

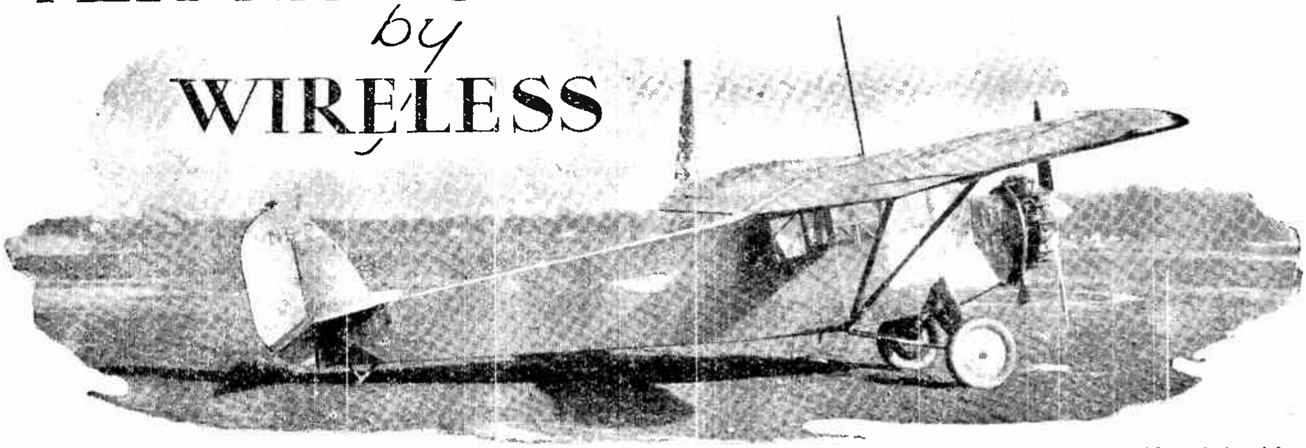
In Next Week's Issue will appear a description of

The Wireless World

RECORD III.

With A.C. Valves and a balanced screen-grid H.F. Amplifier, the set gives the highest stage magnification yet attained.

AIR NAVIGATION by WIRELESS



U.S. airplane with vertical aerial.

The Work of the Radio Beacons.

ALTHOUGH services for the transportation of passengers by air are expanding rapidly, they are at present far from attaining that reliability which is so essential in a public service. The greatest obstacle to air passenger traffic arises from the hazards of the weather. Airways and airports are now being provided in abundance in this country and abroad, aircraft of adequate strength are more and more available, every provision is offered for the comfort and convenience of the air traveller, and yet air traffic can still be halted when low visibility prevents the pilot from seeing his landmarks or lights on the ground. Deprived of all landmarks and under intense strain to maintain equilibrium, the aviator is then compelled to abandon dependence on his senses and to navigate according to the information conveyed to him by his instruments. A pilot can continue flying safely in fog by means of devices such as the altimeter, turn indicator and compass, but it is only by the help of radio that he can be certain to keep on a given course and find an invisible aerodrome.

A radio beacon system[1] is in process of erection on the airways of the United States for the purpose of marking out the airway routes so that the pilot can, regardless of fog, keep accurately on his course and receive a definite intimation when he has reached the landing field.

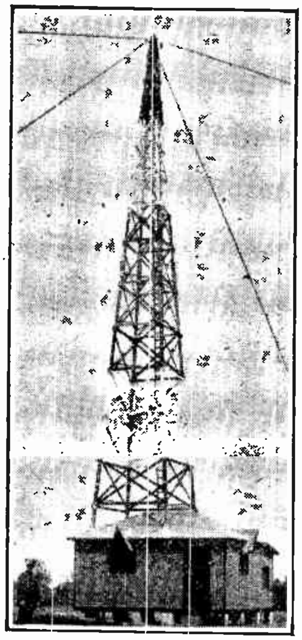
THE RADIO BEACON INDICATOR is the topmost instrument seen in this view of the cockpit. The two white spots mark the extremities of reeds which vibrate vertically when the radio beacon is tuned in.

The radio beacon is a special kind of transmitter located near to the landing ground of an airport. The ordinary simple antenna is replaced by two loop aerials spaced at an angle to each other and rigidly fixed in space. The two loops are excited by a common high-frequency supply, but the individual aerial currents are modulated at a different low frequency. The current in one loop is modulated by an audio-frequency of 65 cycles and the other 85 cycles per second. Each of the aerials emits a directional wireless beam, so that an aeroplane flying along a line equidistant between the two beams will receive two signals of equal intensity, one from each beam. Should the aeroplane deviate from this line, which represents the direct route to the landing ground, it receives a stronger signal from one beam than from the other.

An ingenious indicator on the instrument board of the aeroplane shows when the

[1] J. H. Dellinger, Journal American I.E.E., Feb., 1929.

Air Navigation by Wireless.—
signals from the two beams are being received with equal intensity. The low-frequency modulation of the incoming waves cause two small reeds to vibrate. One reed, on the pilot's right, is tuned to 65 cycles per second, while the other, on his left, is tuned to 85 cycles per second. The tips of the reeds are painted white against a dark background, so that when vibrating each appears as a vertical white line. If the two white lines are of equal length, i.e., the reeds are vibrating at the same intensity, the pilot is on his correct course. If the one on his right becomes longer than that on his left the aeroplane has drifted off the course to the right, and *vice versa*. Thus, if the pilot deviates from the regular course, either accidentally or to avoid a stormy area, the radio beacon makes this apparent, and shows the way back. The great advantage of the radio beacon system over other kinds of homing devices, such as compasses, is that if the machine is blown off its original course by side winds the destination point can still be located. The radio beacon creates an invisible thread along which the aeroplane travels as unerringly as a train on rails.



The new radio beacon and operating hut at Mitchell Field, N.Y.

Arriving at the Aerodrome.

In foggy weather, however, the pilot's troubles are not ended when he has succeeded in keeping his machine in the invisible " permanent way." Sooner or later he will come to the " buffer stops " at the end of the journey, and his task is then to make a blindfold landing. He must be told, therefore, of the moment when he passes over the radio beacon. The indicator is intended to provide this information. As he flies over the beacon there is a sudden relaxing of the reeds, due to a region of zero signal strength immediately above the transmission tower, and he is able to locate the landing ground to within 100 feet. This arrangement works well in theory, but in practice it cannot be said that the problem of landing in fog has been completely solved.

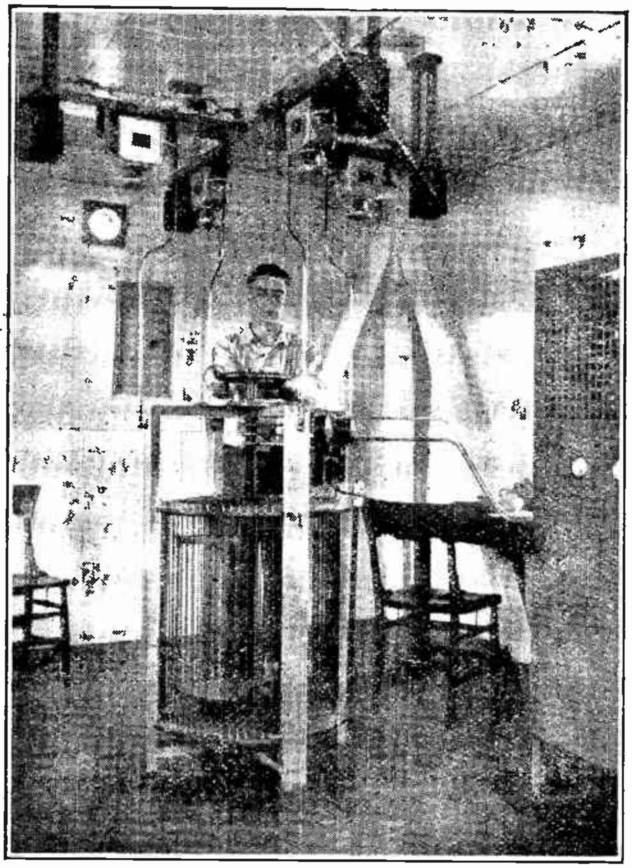
A costly but more reliable method of guiding aeroplanes to their landing ground in fog is employed in this country and France and is known as the " leader cable " system. A straight side of a buried loop of cable, oval in shape and measuring possibly as much as 6 x 2 miles, runs through the aerodrome. Adjacent to this straight side and encircling the portion of the aerodrome which is free for landing purposes is a second and smaller buried loop. The pilot gradually descends in circles, following the track of the larger loop by means of his induction operated equipment. With each revolution he picks up a signal from the smaller loop, indicating that he is above his landing place. When sufficiently low he is then able to plunge through the fog and make a safe landing.

The Capacity Altimeter.

This method presupposes the installation on the aeroplane of a reliable altimeter. In this department, too, radio principles are applied with considerable success. The capacity altimeter determines the distance from the ground by means of two condenser plates on the 'plane. As the ground is approached the electrical capacity change affords an indication of height, though, unfortunately, the changes in capacity are too minute to be observed at heights above 100 feet. Dr. E. F. W. Alexanderson, the well-known American research worker, has recently experimented with an altimeter in which use is made of the direct reflection of radio waves between aeroplane and ground.

The whole receiving system as used on the U.S. airways comprises a 10-foot vertical rod aerial, a small indicator unit on the instrument board weighing one pound, a receiving set weighing less than 10lb., which may also be used to pick up radio telephone signals, and a 10lb. battery.

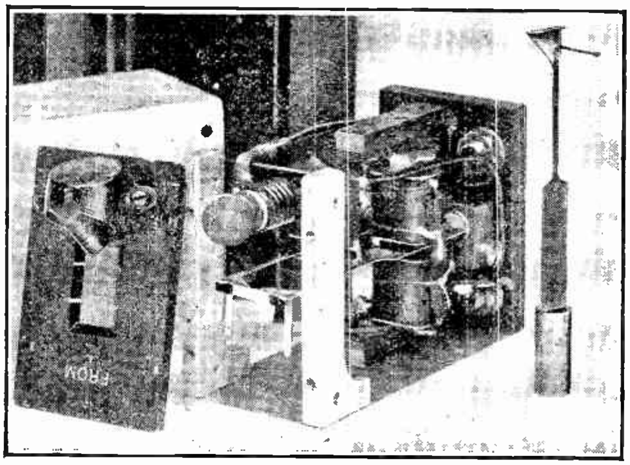
Besides being sensitive, the receiver is highly selective,



Setting the "goniometer" at the Mitchell Field beacon. The lead-in conductors are connected to aerials at the four points of the compass.

Air Navigation by Wireless.—
with interstage shielding as well as shielding against interference from the magneto. The vibrating reeds assist, of course, in securing selectivity. Remote control tuning is employed, so that the set may be placed in any part of the machine.

The abandonment of the trailing wire aerial has come as a welcome relief to airmen. Not only was it a source of anxiety due to the risk of entanglement with objects on the ground, but it played strange directional tricks



The aerial beacon indicator dismantled to show the principle of operation.

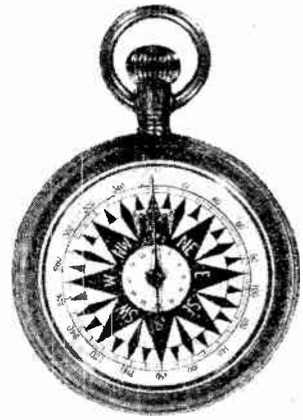
at night and at times when high winds prevailed. A great virtue of the vertical pole aerial is that it is non-directive.

The radio beacons are designed to operate over the wavelength band of 925 to 1,050 metres.

While a beacon system can mark out the airway routes, it can give no help to the flier on an independent course. Two methods of adapting radio to this navigational need are in use.

In the first, radio direction finding stations are maintained at various air ports, and each aeroplane carries both a transmitting and receiving set. Upon request by the pilot, two or more of the direction finding stations determine the direction of travel of wireless waves from the 'plane. Combining their determinations, they calculate the aeroplane's position and send this information by radio to the pilot.

The second method of helping the independent flier is the rotating radio beacon. This is a radio transmitting station, located at an air port, which has a rotating directive aerial, causing a beam of wireless waves to sweep constantly around. A special signal indicates when the beam passes through north. A pilot listening for this beacon's signal with his receiving set can determine his direction by the time which elapses between the north signal and the instant when the beam is heard with maximum intensity. The elapsed time is determined by means of a stop-watch, which can be calibrated to read direction.



A stop-watch used for direct reading from the experimental rotating wireless beacon at Orfordness, Suffolk. The watch is started from zero when the beacon gives the "north" signal and is stopped when signals are loudest, the beacon rotating at the same speed as the watch hand.

Commercial reliability of air travel would seem to depend entirely on the use of radio. Certainly any practical scheme for a transoceanic air service would require directional radio aid, particularly for a system such as that involving a number of seadromes anchored across the ocean.

TRADE NOTES.

Change of Address.

Pertrix, Ltd., 120, Tottenham Court Road, London, W.1, announce that, owing to continued expansion of business, more commodious premises have been acquired at Britannia House, 233, Shaftesbury Avenue, London, W.C.2. The telephone number is Temple Bar 7971 (four lines).

o o o o

Cliftophone and Records, Ltd., "Radio Dept.," 95, Park Street, Southwark, London, S.E.1, have acquired new premises at Woodstock Road, Shepherd's Bush, London, W.12. The telephone number is Riverside 4611.

o o o o

New Branch Office.

Messrs Ward and Goldstone, Ltd., Frederick Road, Pendleton, Manchester, have opened a branch establishment at Upton's Yard, 49a, Briggate, Leeds. The telephone number is Leeds 26812, and the telegraphic address Multum, Leeds.

Change of Name.

The Electron Company, Ltd., 122, Charing Cross Road, London, W.C.2, has changed its name to: The Six-Sixty Radio Company, Ltd. The address remains as hitherto.

o o o o

Catalogues Received.

Messrs. Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17.—Illustrated catalogue of "Wearite" components

o o o o

Messrs Whiteley, Boneham and Co., Ltd., Nottingham Road, Mansfield, Notts.—Illustrated folder dealing with the Lodestone Moving Coil loud speaker; also cabinet cone speakers and valve holders.

Watmel Wireless Co., Ltd., Imperial Works, High Street, Edgware, Middlesex.—Descriptive folder of the Watmel balanced armature loud speaker unit; also constructor's blue-print of the 1929 "Imperial Three" receiver.

o o o o

Messrs. Claude Lyons, Ltd., 76, Old Hall Street, Liverpool.—Descriptive folder of the "B.A.T." L.T. battery eliminator for A.C. mains; also illustrated leaflet describing the "B.A.T." push-pull output "Gramo-Radio" two-stage amplifier.

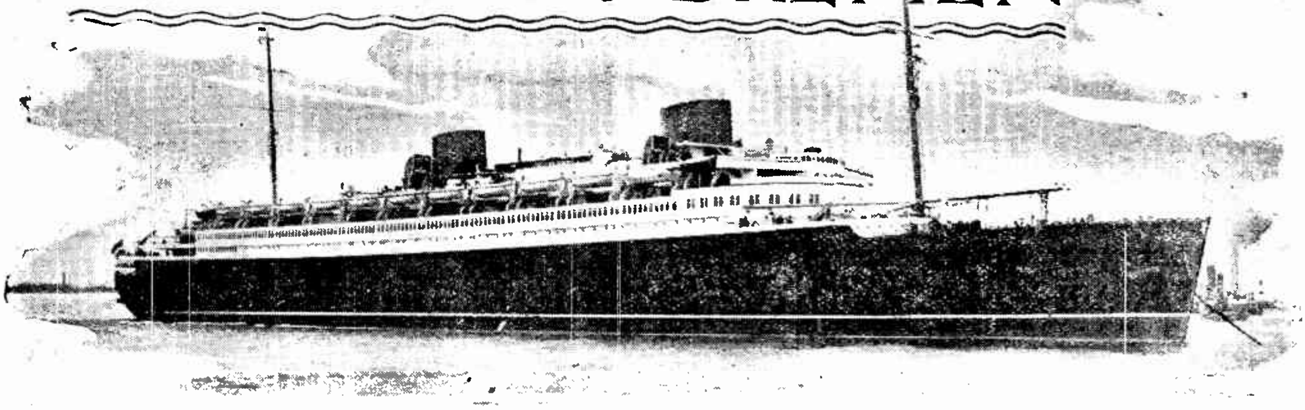
o o o o

Columbia Gramophone Co., Ltd., 102-108, Clerkenwell Road, London, E.C.1.—The Columbia Review and current monthly list of new gramophone records.

o o o o

Mullard Wireless Service Co., Ltd., Mullard House, Charing Cross Road, London, W.C.2.—Illustrated leaflet of Mullard "Pure Music Speaker" type "H."

RADIO on the "BREMEN"

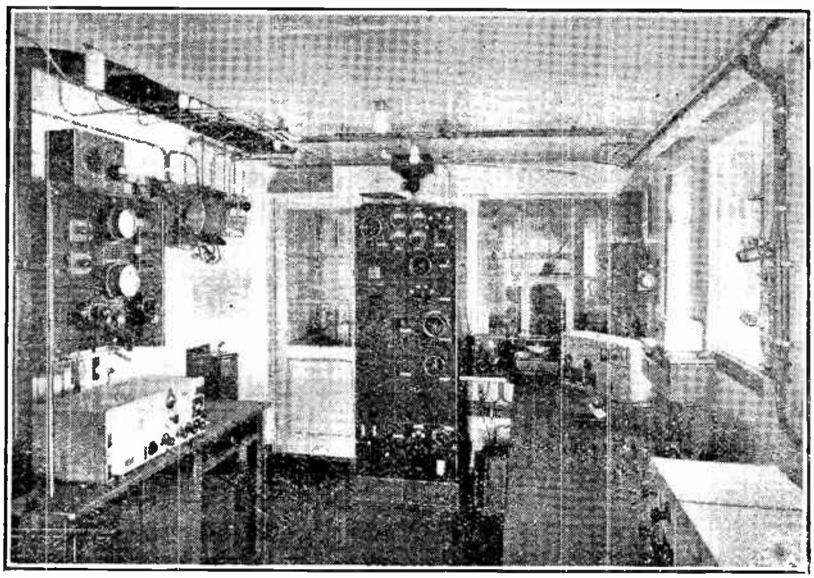


High-speed Telegraphy, Telephony and Short-wave Equipments.

THE new Norddeutche Lloyd liner *Bremen*, which has recently established a new transatlantic speed record, is equipped with the most modern type of radio apparatus. Its transmitters and receivers embody many new and interesting recent developments of the Telefunken Company.

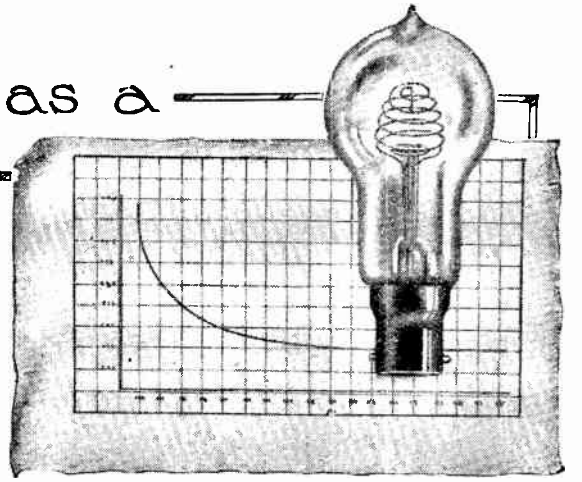
The transmitter, which is of the oscillator-driven type, is readily adapted to give continuous wave, interrupted continuous wave and telephony. Wavelengths of from 500 to 3,000 metres are provided, and the aerial energy is 3 kW. The circuit arrangement permits of exact calibration of the master oscillator, and wavelength changes are effected in less than thirty seconds. Direct current at 4,000 volts is taken from a rotary machine. In addition to the main transmitting equipment are three other transmitters. One of these is a short-wave long-distance set using 700 watts. This again includes a calibrated drive oscillator and intermediate circuit. Provision is made for telephony transmission with this short-wave set, and in order to conform to the requirements of the Washington Convention, long-distance telephony transmissions will be transferred from the main transmitter to this equipment after January 1st next. A medium-wave transmitter is also installed for handling traffic at short range, and consists of a modulated C.W. set with a wave range of 580 to 830 metres and an aerial power of about 200 watts. In addition there is the emergency equipment, which is an accumulator-driven spark set and arranged to be independent of the ship's power supply.

Various receiving sets are installed for independently working on the several wave ranges, while a complete receiver with loud speaker output is kept permanently tuned to 600 metres for the reception of distress signals. Automatic high-speed keying facilitates the handling of a large amount of traffic, which is disposed of through the German station at Norddeich and the American station at Marion. A keying speed of 250 words a minute is maintained. A staff of six operators is required to conduct the wireless service, while the radio direction-finding gear which is also installed is handled by the navigating staff. Two of the motor-driven lifeboats are equipped for transmission and reception. Power is derived from a 24-volt accumulator of 100 ampere-hour capacity and applied to an alternating current generator. Reception by both valve and crystal is provided. Collapsible masts support a small two-wire aerial. Similar radio equipment to that of the *Bremen* is being installed aboard the *Europa*, now under construction.



The *Bremen's* radio cabin. The main transmitter control is in the centre while several of the receiving sets can be seen.

The Neon Lamp as a Stabiliser



How Feed-back can be Avoided in Eliminators.

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

THERE are many wireless receiving sets in existence in which the output valve or valves are of the high voltage type, requiring anything from 300 to 500 volts on the plates, whereas the preceding valves are of the more usual type which operate with plate voltages of 150 or less. In a great many instances an extra stage employing the push-pull system with valves of the L.S.5A class has been added to an existing set for the purpose of driving a moving-coil type loud speaker.

With such a set the use of a high-tension battery eliminator is almost essential on account of the prohibitive cost of batteries with sufficiently high voltage and ampere-hour capacity. Now, it is already well known that very special precautions have to be taken when a battery eliminator is used, to prevent feed-back

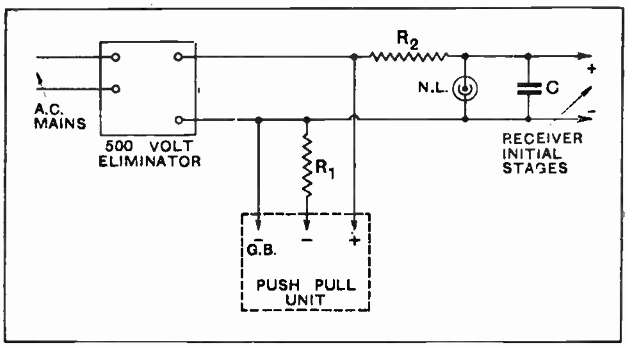


Fig. 1.—Schematic diagram showing how a neon lamp may be used for stabilising in a composite set where two widely differing values of H.T. voltage are required. N.L. is the neon lamp. C should have a value of 2 to 4 mfd.

effects due to its high internal resistance. These effects, if not counteracted, usually result in continuous oscillation at a very low frequency, the phenomenon being commonly referred to as "motor boating." This subject has been fully dealt with in previous numbers of *The Wireless World*, and methods of prevention have been explained, so that it will not be necessary to give more than a brief reference here. So far, the system of anode-feed filter circuits developed by Messrs. Ferranti has proved the most successful scheme for the prevention of "motor boating"; the plate circuits of all but the last stage are fed through series resistances with large by-pass condensers to prevent the current variations from passing through the eliminator and its filter circuits. Unless the push-pull arrangement is employed the loud speaker is connected to the last valve through the usual choke-capacity filter system.

Some time ago the writer had occasion to use a note magnifier with three stages of amplification before the push-pull output stage. The actual valves used, taken in order, were D.E.5B, D.E.5, D.E.5A, and two L.S.5A valves in push-pull, the first and second and the second and third stages being resistance-coupled. The push-pull portion was built as a separate portable unit. An eliminator was constructed to give 500 volts with an output of about 70 milliamps., the usual smoothing circuit being included. Both H.T. supply and grid bias for the L.S.5A valves were obtained from the eliminator by including a resistance in the negative H.T. lead as shown at R_1 in the schematic diagram of Fig. 1. Under working conditions the voltage on the plates was 375, with a negative grid bias of 125, making a total of 500 volts from the eliminator. The three preceding valves were to be operated with a high-tension voltage not much in excess of 150, so that it was necessary to connect a high resistance R_2 in the main H.T. lead supplying these stages.

It will be realised at once that to obtain stable operation of four stages of low-frequency amplification, where the valves were all supplied from the same eliminator, presented no easy problem. The system of separate series feed resistances and by-pass condensers proved to be inadequate in this somewhat special case. At first it appeared that the only solution would be to supply the first two stages independently from a battery, but such a scheme defeated the objects in view. It was fully realised that any small change in current through the high resistance R_2 would result in a relatively large change of voltage on the plates of valves 1, 2 and 3, and that should the filaments of these valves be inadvertently switched off before the H.T. supply the full 500 volts would build up across the various by-pass condensers in this part of the amplifier, with disastrous results, since it was designed for a working voltage of 150 only. It was obviously necessary to connect some sort of

The Neon Lamp as a Stabiliser.—

permanent load in parallel to eliminate this danger and to reduce the voltage variations due to the changes in the useful load current.

It was here that the use of a neon lamp suggested itself on account of its special properties: A neon lamp does not behave like an ordinary resistance; *a given change in the voltage applied to the lamp results in a very large change of current compared with the current change which occurs in an ordinary resistance for the same variation of voltage,* the initial current being the same in each case.

And so a neon lamp with the safety resistance removed from the cap was connected in parallel with the low-voltage part of the amplifier. The result was highly successful from the outset, and led to further experiments which proved that the inclusion of a neon lamp in this manner was of great advantage in any receiver where the eliminator voltage exceeded 150 when on load. The writer has found that oscillation and "motor boating" cease entirely *even when the anode feed resistances are omitted.* With the four-stage note magnifier referred to above no resistances were required other than the series resistance R_2 necessary to drop the voltage down to the requisite level. Fig. 1 gives a schematic diagram of the arrangement used.

D.C. Characteristics of Neon Lamp.

It will be helpful first to discuss the chief characteristics of a neon lamp in order that as simple an explanation as possible may be given as to why its inclusion has such a beneficial effect. Later actual

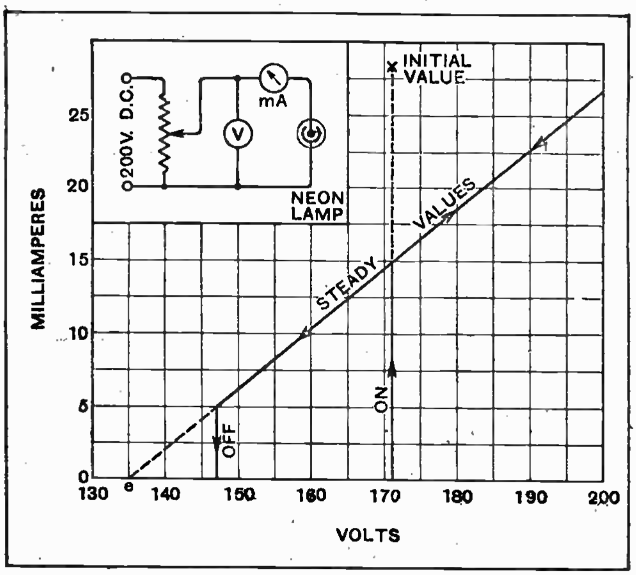


Fig. 2.—Static characteristic curve of neon lamp. The circuit arrangement for obtaining the curve is shown.

figures are given showing how pronounced the stabilising effect really is and at the same time indicating how the circuit is designed to suit any particular set of conditions.

The neon lamp in its commercial form has a steadying or ballasting resistance connected in series and mounted inside the cap in order to prevent the possibility of an arc forming between the electrodes when the lamp is switched on to the mains. For our purpose it is necessary that this resistance should be removed, or that a lamp without any ballasting resistance be purchased from the manufacturers.

When the requisite voltage is applied to the electrodes of a neon lamp the glow is formed over the entire

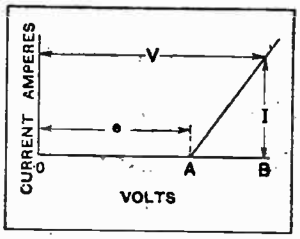


Fig. 3.—Diagram enabling the relationship between voltage and current for the neon lamp to be obtained in the form of an equation similar to that for a battery on charge.

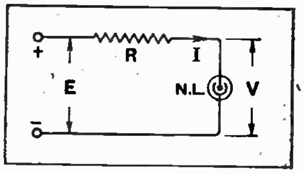


Fig. 4.—When a resistance R is connected in series with the neon lamp, the voltage V across the lamp varies only slightly when R is varied over a wide range.

surface of the cathode, or negative electrode, while the anode does not glow at all unless the voltage is excessive. It is important to note that the initial current taken by the lamp when switched on cold is very much greater than the final steady value to which the current falls after the gas in the bulb has had time to warm up. The current attains a steady value after about four or five minutes, and this may be less than half the initial value.

If the voltage applied to the lamp is gradually increased from zero it is found that no current whatever flows and no glow occurs until the voltage reaches a definite critical value, at which the current suddenly jumps up from zero to something like 30 milliamps., and then gradually drops to about half this value as the lamp heats up, the applied voltage being maintained constant at the critical value at which the current commenced.

Critical Starting Voltage of Neon Lamp.

For a particular lamp tested the glow was established when the applied E.M.F. reached 171 volts, and after about five minutes the current, with this voltage maintained, settled down to a steady value of 14.7 milliamps. The voltage was then increased in steps and the corresponding values of the current noted, the results of these observations being shown by the graph of Fig. 2. It will be seen that the graph is a straight line—a point of considerable importance, as will be seen later. On reducing the voltage again in stages it was found that the current did not cease to flow when the critical starting voltage of 171 was reached and passed, but continued to fall according to the same straight-line law until, at 147 volts, it suddenly ceased and the lamp went out. Fig. 2 gives the complete cycle of current changes for variation of voltage from zero up to 200 and back again to zero. As the lamp should not be run at voltages above about 200 without the safety resistance in the cap we see that, once the glow is established, we have a useful voltage range from about 150 to 200. If the graph is projected

The Neon Lamp as a Stabiliser.—
downwards to meet the voltage axis, as shown by the dotted line, the intersection occurs at about 135 volts, a figure which we shall have to make use of in the calculations to follow.

The fact that the current varies according to a straight-line law renders the theory and calculations relating to our particular problem so delightfully simple that we only need to use Ohm's law. The first thing we require to know is the equation showing the relation between voltage and current. If the current in amps. is plotted against voltage, as in Fig. 3, and the graph produced downwards to meet the voltage axis at A, we see at once that the current is exactly proportional to the amount by which the voltage exceeds the value OA. Let OA$=e$ volts, and let I be the current when the voltage applied to the lamp is OB$=$V, where V is greater than e.

Neon Lamp Equivalent to Floating Battery.

Then I is proportional to AB, and AB$=V-e$; that is to say, the current is proportional to the difference between the applied voltage V and a constant back E.M.F. of value e, or, in other words, $\frac{V-e}{I}$ is a constant. These are exactly the same conditions which obtain when a battery is being charged, the charging current being equal to the difference between the applied E.M.F. and the back E.M.F. divided by the resistance. Thus we can liken the neon lamp to a battery on charge and apply the usual methods of calculation. For instance, $(V-e)/I=r$, where r is the internal resistance of the equivalent battery, e is its E.M.F., and V the applied charging voltage.

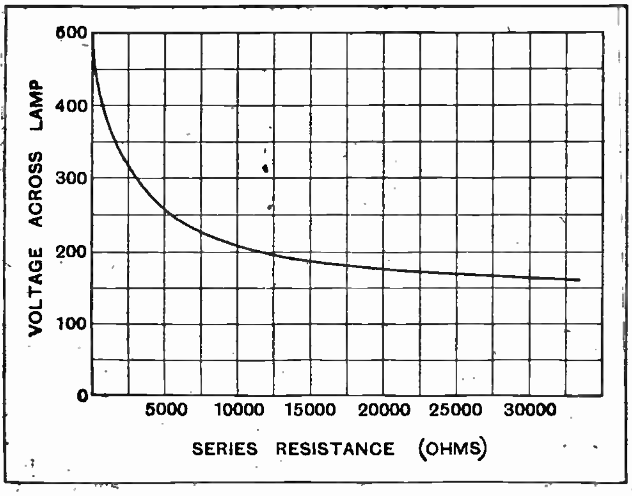


Fig. 5.—Curve showing how the voltage across the neon lamp varies as the series resistance is increased. The supply voltage was assumed constant at 500 volts.

Referring to Fig 2 again, we see that for the lamp under test, $e=135$, and that when $V=160$ volts, $I=10$ milliamps. or 0.01 amp.

Therefore $r=\frac{160-135}{0.01}=2{,}500$ ohms, and the equation showing the relation between voltage and current for this lamp becomes

$$I=\frac{V-135}{2{,}500}\text{ amps.} \qquad (1)$$

for voltages greater than 147.

Clearly then the use of the neon lamp in parallel with a variable load is equivalent to the use of a floating battery whose internal resistance is 2,500 ohms and whose E.M.F. is 135 volts, and it will have the same smoothing effect as such a battery. At first sight this resistance might appear to be too high to allow of efficient stabilising, but, of course, this depends on the relative resistance of the useful load in parallel with the lamp. For an average case of, say, 10 milliamps. at 150 volts, the load resistance is 15,000 ohms—several times greater than the equivalent battery resistance of the neon lamp. It must be remembered that the lamp itself only takes a small current in spite of its low equivalent resistance, on account of the back E.M.F. A plain resistance of 2,500 ohms in parallel with the load would certainly have the same smoothing effect, but would take such a large current that the eliminator would be overloaded and the voltage pulled down to a very low figure.

The Value of the Series Resistance.

First consider a circuit consisting of a variable resistance R in series with the neon lamp, as shown in Fig. 4. Let E be the value of a constant voltage sufficiently great to light the lamp applied to the ends of the circuit, and let V be the resulting voltage across the lamp itself. Then the voltage across R will be $(E-V)$, and by Ohm's law the current is

$$I=\frac{E-V}{R}\text{ amps}$$

or

$$\frac{E-V}{I}\text{ ohms.}$$

But by equation (1) $I=\frac{V-135}{2{,}500}$ amps.

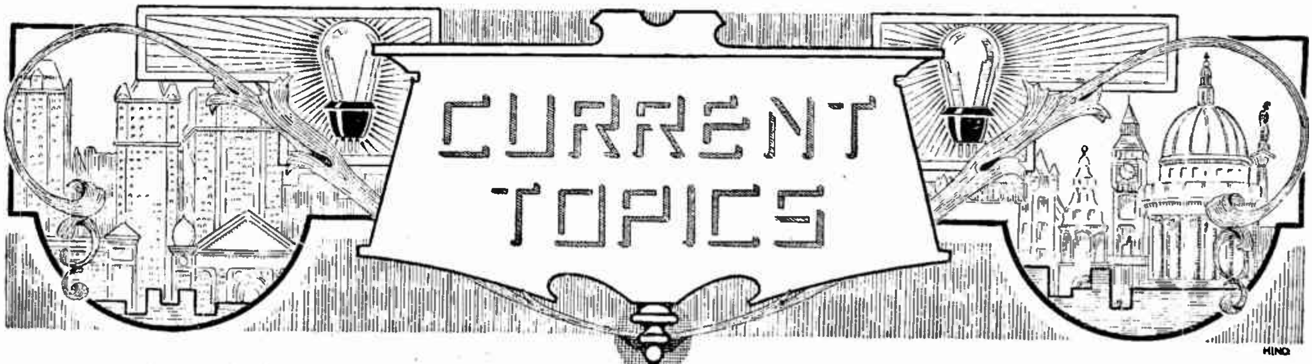
and, therefore, $R=2{,}500\frac{E-V}{V-135}$ ohms ....(2)

This enables us to determine the series resistance necessary to give any desired voltage across the lamp with a given supply voltage E. For instance, with an eliminator giving 500 volts, if we desired 190 volts across the lamp, with the valves representing the useful load switched off, the necessary series resistance would be

$$R=2{,}500\frac{500-190}{190-135}=14{,}100\text{ ohms.}$$

A number of values have been worked out in this manner for a 500-volt supply, and the voltage V obtained for various values of R is given by the curve of Fig. 5. The outstanding feature shown by the curve is that the voltage across the lamp varies only slightly for relatively large changes of resistance above 10,000 ohms. For instance, raising the series resistance from 15,000 to 30,000 ohms lowers the voltage across the lamp from 186 to 163, a matter of only just over 12 per cent. This indicates that the series resistance need not be critically adjusted to the value calculated.

(To be concluded.)



CURRENT TOPICS

Events of the Week in Brief Review.

MAZDA VALVES.

As the result of an arrangement between the Edison Swan Electric Co., Ltd., the British Thomson-Houston Co., Ltd., and Metro-Vick Supplies, Ltd., the well-known valves of these three companies (Ediswan, Mazda and Cosmos) will in future be marketed entirely by the Edison-Swan Company, who have taken over the selling organisation as from August 12th, and they will all be known as the "Mazda" valves.

At the same time we understand that the three individual companies can still supply some of their last year's types if these valves are specifically required for replacements in existing sets.

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WIRELESS SHOW IN ROUMANIA.

The first International Exhibition of Radio and Electrical Household Apparatus will be held in Bucharest from September 1st to 20th, at which it is expected that manufacturers from all countries in Europe will be represented.

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THE CURSE OF BABEL.

It is stated that the one official language to be used at the World Radio Conference to be held at The Hague will be French. This, we understand, has aroused protests, especially from America, as it is not easy to find men who combine the understanding of wireless technicalities with a fluent command of the French language. It has been suggested that use might be made of the Filene-Finlay system of translation, as at the Geneva Conferences, where delegates are provided with head telephones, connected with sundry microphones into which experts translate the speeches, sentence by sentence as they are delivered, into the required languages. The difficulty, however, would still remain of finding ready translators with the necessary technical knowledge of the intricate problems of wireless transmission and reception.

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BY LAND LINE TO AMERICA.

A rival to transatlantic wireless telephony is projected by the American Telegraph and Telephone Company, who have decided to lay a telephone cable between Frenchport, Co. Mayo, and Newfoundland, which will eventually link up London and New York by wired telephony.

PROGRESS AT BROOKMAN'S PARK.

Testing in the new regional station is in energetic progress. Unmodulated carrier waves have for some time been transmitted from its aerials, and by the time these notes are published it is probable that modulated tests will be broadcast outside the regular programme hours.

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RESERVE YOUR JUDGMENT.

Listeners who may chance to hear these preliminary tests should not, however, judge the station by them, as the power is often considerably varied, and it is unlikely that the transmitters will be called on to work to their full capacity with an output of 50 kW. to the aerial, even when employed for the regular broadcast service.

Engineers are very conservative, and like to have a little extra in reserve. It may also be found expedient to use rather more power for the shorter wavelength, as the aim of the B.B.C. is to get equal strength for both programmes at the normal outward limit of the area to be served, and the 261 metre wavelength may show signs of attenuation more rapidly than that of 356 metres.

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BELGIAN WIRELESS SALON.

The annual Brussels Radio Salon will be held this year in the Palais du Cinquantaire from October 12th to 21st.

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SHORT-WAVE SETS ON SHIPS.

Owing to the extreme ranges obtainable at comparatively low powers with short-wave sets, they are being installed on an increasing number of ships. The Marconi Company has recently produced a short-wave combined telegraph and telephone transmitter known as Type T.N.7, with which communication has been established over distances of more than 6,000 miles.

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BROADCAST COPYRIGHT IN FRANCE.

The Litigation Committee of the French Education Department has decided that university professors have a legal right to authors' royalties when their lectures are broadcast.

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ANOTHER AUTUMN SALON.

Bordeaux will hold its wireless salon this year from October 25th to November 3rd.

STOLEN GOODS.

Messrs Whittingham, Smith and Co., of Park Royal, N.W.10, ask us to state that on the night of August 15th four "Portadyne" Junior Receivers in hide cases were stolen from their works and that they would be glad to hear from any dealers or others to whom they may be offered. The serial numbers are 2178, 2181, 2185 and 2091.

We understand that the theft of portable sets is becoming a somewhat common practice, and that they are often offered on an alleged hire-purchase system to an unsuspecting buyer, who is asked to pay a deposit which, he is told, entitles him to retain the receiver for three months, after which time the first of ten monthly instalments for the balance will be collected. Needless to say, the seller never calls again for this, and the purchaser is left with a stolen receiver on his hands.

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DUBLIN WIRELESS SHOW.

The Radio Exhibition for the Irish Free State will be held at the Mansion House, Dublin, from October 26th to November 1st.

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SPANISH WIRELESS LICENCES.

The Spanish authorities have fixed the licences payable on receiving and transmitting sets at the following rates: Crystal receivers one peseta (8d.) quarterly; valve sets, 5 pesetas (3s. 4d.) quarterly; and transmitting apparatus, 5 per cent., *ad valorem*. The proceeds from these taxes will be devoted to maintaining the broadcasting services.

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DIFFICULTIES IN NORTHERN IRELAND.

Listeners in the area served by the Belfast station are not entirely enthusiastic over the change of wavelength, under the Prague Plan, from 306 metres to 242 metres. Wireless dealers are by no means plentiful in many of the outlying districts, and users of crystal sets sometimes experience difficulty in getting suitable coils to adapt their receivers to the new wavelength.

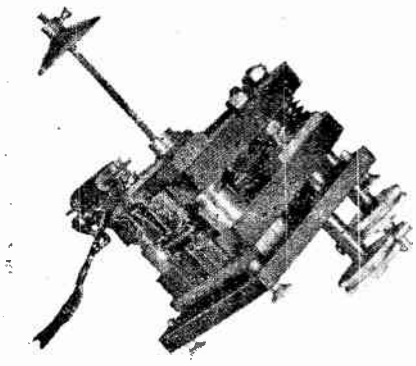
The B.B.C. will probably give demonstrations in Northern Ireland to prove that it is really easy to get Belfast with a suitably designed crystal set and generally to help those listeners who are experiencing difficulties.

A Review of Manufacturers' Recent Products.

WATES "STAR" LOUD SPEAKER UNIT.

This cone loud speaker unit is of the double-acting reed type and embodies two permanent magnets, four laminated pole-pieces and four coils. The vibrating reed, which is disposed centrally between the four poles, is fixed at one end and is provided with an adjusting screw for regulating the position of the reed in the gap.

A feature of unusual interest is the provision of an extra adjusting screw which enables the upper magnet system to be moved away from, or closer to, the lower magnet. This, in effect, alters the width of the air gap in which the armature vibrates. This double adjustment confers the decided advantage of a small gap when maximum sensitivity is required, and at the same time assuring that the reed will be centrally disposed in the gap. Likewise, when large inputs are available the gap can be opened and the position of the reed altered to meet the new conditions.



Wates "Duplex" cone loud speaker unit with double adjustment.

A practical test was made with the unit attached to a "floating" cone mounted on a three-feet square baffle board. Sensitivity is good and although the unit will deliver ample volume to fill a room of more than average size it will not accept a large input without signs of distress. A small power valve will operate this unit at sufficient volume to meet most requirements.

The response, as judged by the ear, is reasonably good over the major portion of the audible scale, but there is a tendency to over-emphasise slightly the middle register.

The sample tested was the "Duplex Model," which is offered at 36s. A cheaper type known as the "Popular Model" is available also, the price being 22s. 6d. These units are obtainable from the Shaftesbury Radio Co., 184-188, Shaftesbury Avenue, London, W.C.2.

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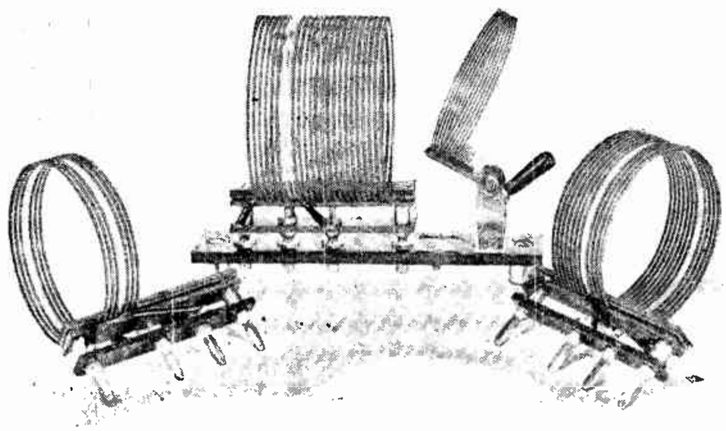
HAMMARLUND SHORT-WAVE COIL UNIT. Type S.W.T.3.

Some recent modifications have been made to the Hammarlund short-wave coil units which should make for improved efficiency. The coils are constructed as hitherto, the turns being wound and firmly attached to a specially prepared former made from material resembling celluloid.

The main point of interest, however, is in connection with the plugs on the interchangeable grid and reaction coil units. The shanks of these are square in section but of the "banana" type. Contact is made between the edges of the plugs and the inside of the sockets and, since these are relatively sharp, they tend to cut into the metal, thereby making a "clean" contact. On very short waves a "dirty" contact can be extremely troublesome and, moreover, will give rise to objectionable noises often quite sufficient to drown weak signals. Likewise, contact with the aerial coil is, for the same reason, made *via* the medium of two phosphor-bronze semicircular springs. The set illustrated is the type S.W.T.3 and consists of three interchangeable units which cover all wavelengths between 15 and 107 metres when the grid coils are tuned by a 0.00014 mfd. variable condenser.



Hammarlund short-wave coil unit, type S.W.T.3.

Hammarlund apparatus is obtainable from the Rothermel Corporation, Ltd., 24 and 26, Maddox Street, London, W.1. The price of the short-wave coil unit is 48s. 6d

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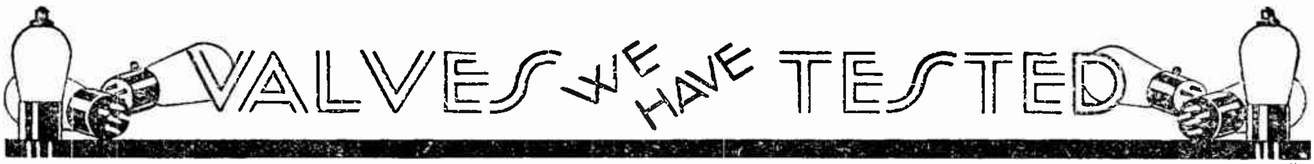
Lack of space necessitates the holding over of the publication of the test report of the B.T.H. gramophone pick-up, to which reference was made in last week's issue.



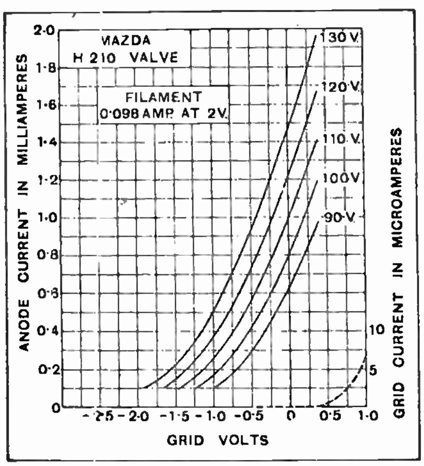
THE NEW MAZDA VALVES.

A Range of Two-volt Valves with Good Mutual Conductances.

WITHIN a few days a new range of "Mazda" valves will be placed on the market. The selling organisation for these will be the Edison, Swan Electric Co., Ltd., Mazda House, 1, Newman Street, London, W.1. The specimens dealt with in this review comprise those designed for use with a two-volt accumulator, the range consisting of seven valves in all; five triodes, a screen-grid H.F. valve, and a pentode.

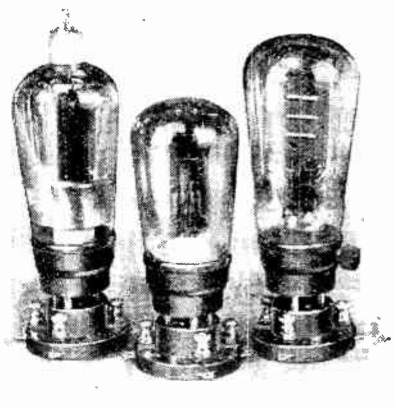
Type H 210.

This is fitted with a 0.1 amp. filament, and has been designed for use as an amplifier or detector, but, since its rated characteristics are A.C. resistance 59,000 ohms, amplification factor 47 and mutual conductance 0.8 mA. per volt, its most useful function would appear to be that of an anode bend detector followed by a resistance - capacity intervalve coupling. However, it can be used advantageously as an L.F. amplifier, using either R.C. or choke-capacity coupling.



Average values under working conditions; A.C. resistance, 50,000 ohms; amplification factor, 45; mutual inductance, 0.9 mA/volt.

A specimen was tested, and the measured characteristics were found to agree sensibly with the maker's figures. At 100 volts H.T. and zero grid bias, the A.C. resistance was found to be 51,300 ohms, the amplification factor 44.5, and the mutual conductance 0.87 mA. per volt. Since it will be used normally as an amplifier, without grid bias other than that obtained by returning the grid to the L.T. –, the values under normal working conditions will not show any appreciable change. This condition is made possible by the fact that grid current does not start to flow until the grid acquires a positive potential of approximately plus 0.4 of a volt. When used with the maximum anode potential—namely, 150 volts—a small negative bias of between 0.5 and 1.0 volt would be advisable with the aid of a potentiometer if full advantage is to be taken of the maximum permissible grid swing without causing grid current to flow.



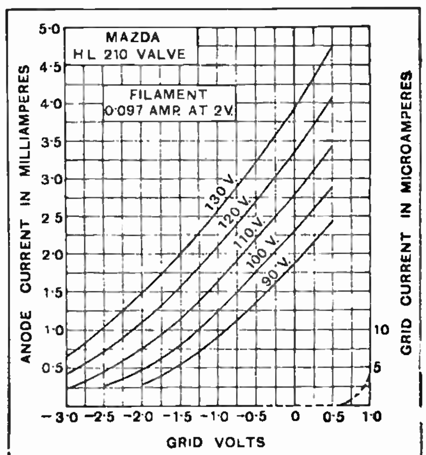
New Mazda two-volt valves. On the left is the SG215, a triode occupies the centre position, and the 230 Pen is on the right.

Type HL 210.

In a modern set the two positions most likely to enable the best to be obtained from this valve is the detector stage or first L.F. position, provided two low-frequency amplifiers are used. It will efficiently perform the service of an H.F. amplifier where a neutralised stage is employed. No alteration will be necessary to the H.F. transformer, since the rated characteristics of the valve are: A.C. resistance 21,000 ohms, amplification factor 26, and mutual conductance 1.25 mA. per volt.

Measurements obtained from a specimen of this type gave the characteristics at 100 volts H.T., and zero grid as being: A.C. resistance 20,500 ohms, amplification factor 25.8, and mutual conductance 1.26 mA. per volt. Grid current starts at plus 0.5 volt grid bias, so that with anode voltages greater than 110 a negative bias of 1.5 volts will be required when using the valve for amplifying purposes.

In the detector position it will serve equally satisfactorily as an anode bend or a leaky grid rectifier. Resistance-capacity coupling would be the best medium for linking the anode bend arrangement to the following valve, although a transformer with a large primary would be admissible if the output stage follows immediately after the detector. With grid rectification the use of a transformer is certainly permissible.



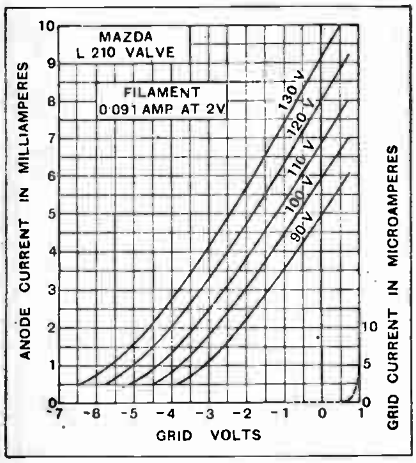
Average values under working conditions; A.C. resistance, 21,650 ohms; amplification factor, 23.6; mutual conductance, 1.09 mA/volt.

Valves we have Tested.—

Type L 210.

This may well be regarded as the general-purpose valve in the series, for the reason that, with nominal characteristics of A.C. resistance 10,000 ohms, amplification factor 15.5, and mutual conductance 1.55 mA. per volt, many diverse applications can be found for it. In particular, it will probably find greatest application as a penultimate valve in an amplifier of two or more stages used either for radio or gramophone reproduction, especially the latter.

The measured characteristics taken at 100 volts H.T. and zero grid bias were: A.C. resistance 10,130 ohms, amplification factor 15.7, and mutual conductance 1.55 mA. per volt. A use which should be given more than a passing thought is that of an anode



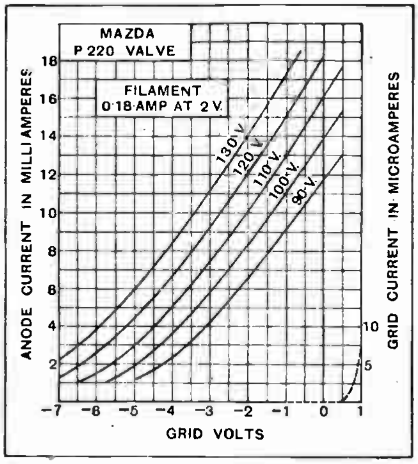
Average values under working conditions; A.C. resistance, 11,100 ohms; amplification factor, 16; mutual conductance, 1.44 mA/volt.

bend detector followed by transformer coupling to an output stage.

When employed as an amplifier with 120 volts H.T., a negative grid bias of 3 volts will be necessary. At 150 volts H.T. a grid bias of −4.5 volts will be satisfactory.

Type P 220.

The P 220 is a small power valve requiring 0.2 amp. of current at 2 volts for the filament. It will deliver sufficient undistorted power to operate sensitive loud speakers of the horn or cone variety at ample volume for small rooms or where a large output is not required.



Average values under working conditions; A.C. resistance, 5,600 ohms; amplification factor, 14; mutual conductance, 2.5 mA/volt.

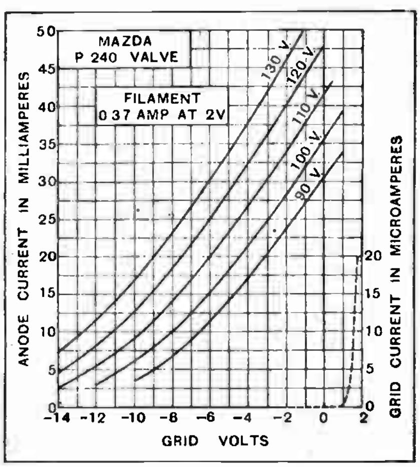
CHARACTERISTICS MEASURED AT 100 VOLTS H.T. AND ZERO GRI BIAS.

P 220.	A.C. Resistance Ohms	Amplification Factor.	Mutual Conductance.
Maker's Rating .	3,700	12.5	3.4 mA/Volt
Measured Values	4,350	13.5	3.1 mA/Volt

Type P 240.

This is the super-power output valve of the 2-volt class, and accordingly will find itself occupying the last position in an amplifier designed for fairly large power work, such as operating moving-coil loud speakers, or a number of small cone-type instruments. Its rated characteristics are: A.C. resistance 1,900 ohms, amplification factor 7.0, and mutual conductance 3.7 mA. per volt.

The sample specimen measured at 100 volts H.T. and zero grid bias

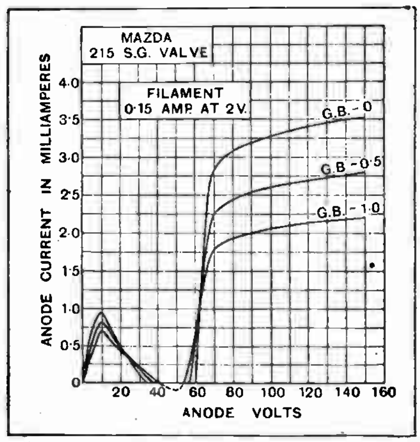


Average values under working conditions; A.C. resistance 2,100 ohms; amplification factor, 6.9; mutual conductance, 3.3 mA/volt.

gave values sensibly in agreement with these. We found the A.C. resistance to be 1,820 ohms, the amplification factor 6.6, and the mutual conductance 3.26 mA. per volt.

Type 215 SG.

This is undoubtedly the star valve in the series. It is a screen-grid H.F. amplifier, and to obtain full value from the characteristics exhibited careful design of the H.F. stage and associated circuit will be necessary. A mutual conductance of 1.1 mA. per volt has been achieved, coupled with an amplification factor of 300 and an A.C. resistance 270,000 ohms, according to the maker's rating. Measurements made with a sample 215 SG under the same conditions, namely, 120 volts H.T., 60 volts screen-potential, and zero grid bias, gave the values as: A.C. resistance 246,000 ohms, amplification factor



Average values under working conditions; A.C. resistance, 246,000 ohms; amplification factor, 293; mutual conductance, 1.19 mA/volt.

293, and mutual conductance 1.19 mA./volt.

Since the A.C. resistance is of the order of that of a well-designed and efficient tuned circuit at resonance, set designers may justifiably expect a big stage gain if adequate attention to small details in the design of the stage is followed. According to the maker's figures the effective inter-electrode capacity has been reduced to about one-third of that obtaining in the majority of similar tetrodes.

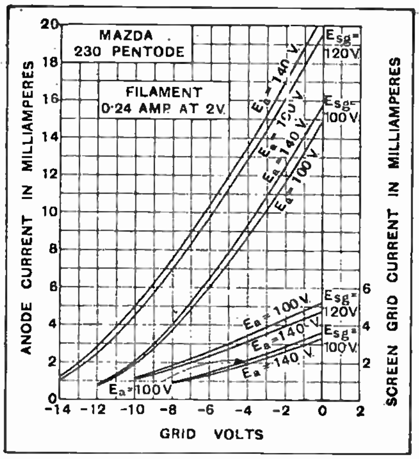
This should make for greater stability and higher amplification from a single stage than possible hitherto with battery-fed filament valves.

Valves we have Tested.—

Type 230 Pen.

This is a five-electrode power valve with a high amplification factor, but, unlike the majority of power valves, will not handle a large input. The use of an intermediate L.F. stage between the detector and the pentode output valve is not recommended. Its greatest field of usefulness will be found probably in portable sets where space is limited and low H.T. consumption essential.

Maker's figures are not yet available regarding the characteristics of the valve, but we have measured these under various conditions and find that with 100 volts on both anode and auxiliary grid, and at zero grid bias, the average values are: A.C. resistance 49,000 ohms, amplification factor 84.5, and mutual conductance 1.73 mA. per volt. These vary considerably with different values of anode potential, auxiliary grid volts, and grid bias.



Average values under working conditions with auxiliary grid potential lower than anode voltage; A.C. resistance, 80,000 ohms; amplification factor, 112; mutual conductance, 1.4 mA/volt.

It is noticed on examination of the valve that the "earthed" grid, or fifth electrode, is connected internally to the control-grid, and not to the filament as usual in valves of this type. A standard 4-pin base is fitted with the pins disposed as in the ordinary triode. The auxiliary grid is brought out to a small terminal on the side of the base.

All valves in this series are heavily "gettered," and we could not find the slightest trace of softening as evidenced by the presence of reversed grid current.

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 am glad to see that some of the complaints concerning the class of items broadcast by the B.B.C. from 5SW have been published in your esteemed journal from time to time, and am sure overseas readers will thank you for your interest.

Of course, we overseas readers and listeners realise that we are free listeners and have no right to complain. Certainly the "High and Mighty Powers that Be" could give us a very disconcerting reply. However, it is understood that 5SW is an Empire Station for world-wide transmissions.

The present policy of 5SW is very unsatisfactory to the Empire, and other listeners. Here in Egypt, as undoubtedly elsewhere, there are many foreign listeners who would be far more interested in the British Empire if 5SW made its programme more interesting and more musical. Does this awful drama stuff amuse anyone? I think there is quite enough trouble in our daily rounds without adding to it by sitting down to listen to such things as "Ah! after five years of prison I am at last f-r-r-ee!" How many people want pianoforte lessons per radio? How many are content to listen to lectures? Let us be gay, cheer us up, amuse us, and we commence the next day with a brighter outlook and a kindly thought.

It is a great pity that there are no transmissions on Saturdays and Sundays. They are the best times for busy overseas listeners.

If I lived at Home I would approach the wireless clubs. Through them and their politicians the B.B.C. could be controlled by listeners. Another suggestion is that the B.B.C. have a committee of listeners, formed from delegates of the wireless clubs, to consult on programmes. Correspondence can also be a fair census of what is required.

Incidentally, our politicians would be serving our Mother Country far better if they "washed their linen" at home, instead of getting on the air and telling foreign listeners what fools, bunglers and prevaricators are the other political parties does not improve our prestige. Overseas listeners cannot vote. Their only interest in Home politics is the result, and we were not allowed to have the result broadcast to us!

We are entitled to hear urgent news. For instance, everybody is interested in His Majesty's health. Yet whilst all other countries are broadcasting news, the B.B.C. muddle along. Other countries are coming on the air with very powerful S.W. transmissions, whilst we still have our "experimental." Does this mean nothing to the Government and the B.B.C.?

Alexandria, Egypt. "MAHANDIS."

A NUT CONVENTION.

Sir,—With reference to "Mahandis'" letter in *The Wireless World* of July 31st regarding hexagonal terminal nuts, we would advise that we have fitted hexagonal nuts with slot for screwdriver to the whole range of our components for some considerable time. We are in entire agreement with "Mahandis" that the multitude of various forms and sizes of milled-edge terminals are totally unsuited for radio components. The hexagonal nuts permit the use of a flat or box spanner and also a screwdriver for those cases where nuts are in inaccessible positions. BURNE-JONES AND CO., LTD.

AMATEUR STATUS.

Sir,—I think that all amateur transmitters of this country will be grateful to you for your championship of their cause, and I hope it will result in some much-needed improvements, as did your crusade for Empire broadcasting.

There is one point, however, which should not be overlooked; the 20- and 40-metre wavebands are hopelessly overcrowded, even from the point of view of European stations. One can but vaguely surmise the conditions at the other side of the Atlantic, where there are 17,000 licensed amateurs in the United States alone. Since the new regulations came into force communication with America on 42 metres has been almost impossible. On 21 metres it is rarely possible to converse with an American unless he is able to report signals at least R5. Even an "R6" or "R7" report is frequently followed by "Sorry, interference bad, please repeat." On the other hand, the 5-, 10- and 160-metre bands are almost deserted. I would suggest therefore that, in the interest of amateur radio as a whole, the 21- and 42-metre wavebands should be reserved for those who wish to undertake serious work of an experimental nature.

Most other work which might warrant the granting of a transmitting permit could be done on the 80- and 160-metre wavebands, and it is to be hoped that the authorities will remove some of the "red-tape" restrictions at present imposed; such work, for instance, as Army-amateur co-operation should receive every encouragement, and there is no really valid reason why "traffic" should not be allowed in this country, as in the U.S.A., provided it is kept off the 20- and 40-metre "DX" bands.

Another amateur activity which could do with some encouragement is the development of waves below 10 metres. At present these waves have no commercial use, neither have amateurs shown overmuch interest in them. If such an interest could be stimulated, instead of limited by restrictions, it would not only reduce the congestion on other wavebands, but might well lead to remarkable developments. When a use has been found for these waves it will be time enough to introduce restrictions; in the meantime, I would suggest that all amateurs be granted the use of 160 and 80 metres and *all* waves below 10 metres—the latter *free from all restrictions;* but that special justification should be shown for the use of the 20- and 40-metre bands. L. A. MOXON (G6XN).

Hampstead, N.W.6.

Sir,—Having followed with much interest the correspondence which has recently appeared in *The Wireless World* with regard to amateur status might I be permitted to occupy a little of your valuable space in voicing the opinions of several amateur transmitters, including myself?

First, the present conditions under which transmitting permits are issued, severe though they be, give considerable freedom of operating to amateurs. In this connection the R.S.G.B. should be congratulated on having obtained more or less reasonable terms from the Post Office.

There is, in fact, little wrong with the R.S.G.B., except perhaps a certain amount of snobbishness which everyone notices in a small number of officials of the R.S.G.B. in London. This evil could be remedied by the retirement of the snobs, who, though in a minority, make themselves known and heard only too well. Persons well-versed in the technicalities of radio should not regard with scorn those less technical.

It is foolish to believe that there is any society in Great Britain so representative of amateur interests as the R.S.G.B., and all that is needed is a little more cameraderie and individual help. ETHERIS.

London.

TELEVISION.

Sir,—By a peculiar coincidence I happened to be looking over your back number of July 18, 1928, where the following note under "Current Topics" caught my eye:—

"Mr. Samuel Izenstark, described as 'the pioneer of wireless manufacture in America,' prophesied last week that television sets will be installed in 14,000,000 homes in America within the next twelve months."

It would be interesting to know how near this optimistic dream is to its fulfilment in America, now that exactly a year has elapsed since this statement was uttered.

One mustn't outdo Jules Verne.

Paris. RONALD A. BRADFORD.

THE ULTRA-MICROSCOPE.

Sir,—I would like to comment on the reference to the ultramicroscope on page 135 of the issue of August 7th.

If blue-green light ($500\mu\mu$) just shows the shapes of certain particles, then extreme ultra-violet ($100\mu\mu$) will show the shapes of particles five times smaller in diameter (I believe that $100\mu\mu$ is about the limit). But that is only a high-frequency amplification of five times; it is not ultra-microscopy, for the particles can still be seen; the ultra-microscope locates the position of particles that are too small to be seen by any light! Possibly it is a frequency-changer: I am not sure. Given fluorescence, yes.

A lamp filament three yards away may be invisible when cold. When glowing, though its position is indicated, it is still invisible! Though it seems a bit thick, yet, like the stoutness that is beauty in Africa, the thickness is in the eye of the beholder.

We know that Saturn wears a red flannel belt summer and winter: he is big enough and near enough to be seen. But we do not know whether Sirius wears the regulation collar, for he cannot be seen; but he emits light by which he is located.

In the ultra-microscope, particles are strongly illuminated against a dark ground. They glisten. Their shapes are not seen—they are too small; only blobs of light show where they are.

Incidentally, two microscopes in cascade do not constitute an ultra-microscope. M2 is only a low-frequency stage: it cannot amplify detail that is not already shown by M1, nor position either.

If there were lumps in the ether, and we sprayed them with short waves . . . W. RAWSTHORNE.

Hadfield, Derbyshire.

RECENT RECORDS OF INTEREST.

VERY few wireless sets of to-day are considered complete unless provision is made for using a gramophone pick up in conjunction with the amplifier and loud speaker for the electrical reproduction of gramophone records. It is, therefore, natural that the user of a wireless set is becoming more and more interested in the products of the various record manufacturers.

Columbia has recently produced some interesting works. Perhaps one of the most important is the Thanksgiving Record, reproducing some of the music as rendered by the Choir of St. George's Chapel, Windsor, on the occasion of the Thanksgiving Service for the recovery of His Majesty the King. This is not only a very beautiful record, but is also a memento of an historic occasion. On the reverse of this record (No. 9808, Columbia 12in.) we have the Coronation Offertorium—"O Hearken Thou unto the Voice of My Calling"—beautifully rendered by the same choir.

Lovers of opera will welcome the new Columbia 12in. record, No. 9654, which gives a fine rendering of the beautiful duet between Pinkerton and Butterfly at the close of the first act of Puccini's ever-popular opera; the singers are Isobel Baillie and Francis Russell. The most exacting purist can hardly object to "Madame Butterfly" being sung in English, as the principal characters represented would naturally speak in our language. On the reverse side Miss Baillie's clear soprano blends effectively wi ı Miss Nellie Walker's contralto in the Barcarolle from Offenbach's Tales of Hoffman."

Another fine record (Columbia 5466, 10in.) is that of Brahms' Hungarian Dances, Nos. 5 and 6, as played by the Hallé Orchestra in the Free Trade Hall, Manchester, and conducted by Sir Hamilton Harty.

A most remarkable piano record is Percy Grainger's rendering of "Shepherd's Hey" and "Country Gardens," which are recorded on Columbia 10in. No. D. 1664. Those who have not heard these pieces will be amazed at the variety of tone which Percy Grainger is able to obtain from the piano, and the result is distinctly invigorating, if music may be so described.

As a real test for the high-note performance of a pick-up amplifier and loud speaker we commend to our readers a duet for two piccolos, entitled "The Merry Brothers," by Jean and Pierre Gennin, Columbia 12in., No. 9821, on the reverse side of which is recorded "Echoes of the Valley," a duet for flute and echo flute. The former of these pieces would, we venture to think, open the eyes (or rather ears) of many a listener to the shortcomings of his equipment so far as high notes are concerned.

Among the recent fox-trots and other dance music may be mentioned the following Columbia records:—No. 5484, "When my Dreams come True" and "Reaching for Someone and not Finding Anyone," played by Paul Whiteman and his Orchestra, and No. 5482, "Excuse Me, Lady" and "Huggable, Kissable You," as played by the B.B.C. Dance Orchestra, conducted and led by Jack Payne.

READERS' PROBLEMS ANSWERED

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.

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

Short-circuiting or Condenser Charging?

A spark due to the flow of charging current into the large by-pass condensers is generally produced when the H.T. battery is connected to my receiver. I am quite familiar with this effect and have come to expect it; consequently, when I recently connected up my batteries to a set in which there happened to be an accidental short-circuit across the H.T. terminals, I did not take much notice of the fact that the spark was rather more intense than usual. The fact that the H.T. battery was ruined has taught me to be more careful in future. Is there any easy way of telling whether the spark is normal or whether it is due to an excessive flow of current through a partial short-circuit? S. E. C.

There is a very easy way of determining th s point; all that is necessary is to tap the connecting lead lightly on the terminal and observe if the usual spark takes place. Then make contact again and observe if another spark is produced. If it is *not*, it can be assumed that the condensers are fully charged up and that there is no appreciable leakage.

Of course, the valve filament switch should not be "on" while this test is being made.

○○○○

A Simple Two-circuit Tuner.

You have given your blessing (in the "Readers' Problems" section) to the use of the "Flat Dwellers' A.C. Three" with an open aerial, but have stated that when modified in this way the set will not be highly selective. It seems to me that its performance in this respect should be quite satisfactory if a separately tuned aerial circuit, loosely coupled to the grid coil, were used. Will you please suggest the simplest possible arrangement likely to be effective? C. D. S.

Your proposed scheme of modification is a good one, and the selectivity afforded by a properly designed two-circuit tuner, even with optimum aerial coupling, should be sufficient for average requirements. Further, thanks to the high amplification afforded by the H.F stage, it will be possible to obtain sensitivity above the average when aerial coupling is reduced well below the value giving loudest signals, and consequetly the set should be found satisfactory in situations where interference is intense.

A simple but satisfactory form of connection is shown in Fig 1. In this diagram, L and L_1 are respectively medium-

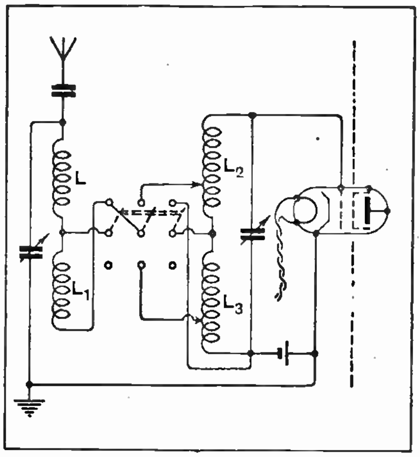


Fig. 1.—A simple auto-coupled aerial tuner for the "Flat Dwellers' A.C. Three." A screen should be interposed between the aerial coils and the grid inductances.

and long-wave aerial loading coils. The latter is short-circuited when required by the left-hand blade of the three-pole switch. The middle blade of this switch transfers the loaded aerial connection to a tapping point near the earthed end of the appropriate grid coil L_2 or L_3. The latter (the long-wave winding) is short-circuited by the right-hand switch blade when it is in the "up" position.

You will observe that a series fixed condenser is inserted in the aerial circuit. This is optional, but will generally be of advantage, as it enables one to cover the normal broadcast band with a single aerial loading coil and a variable tuning condenser of 0.0005 mfd.

○○○○

"The Foreign Listeners' Four."

Will you please tell me the name of the makers of the special indirectly heated S.G. high-frequency valves used in "The Foreign Listeners' Four"?

The S.V.4 valves are manufactured by the Mullard Company, which also produces the type 164.V. triode used as a detector in this set.

○○○○

An Awkward D.C. Voltage.

I am in the unfortunate position of having a D.C. supply of 150 volts only, and am doubtful whether I shall be able to obtain sufficient voltage for the output stage to ensure good quality at reasonable volume. If I decide to make up an H.T. eliminator, can you give me any idea as to what voltage will be lost in the smoothing devices? W. S. R.

Without knowing the anode current consumption of your output valve we cannot say exactly what voltage will be "dropped" in the smoothing circuits; but if you choose a good choke with a low D.C. resistance there is little reason why you should lose more than some 15 volts. This means some 135 volts will be available for the set.

○○○○

A Correction.

In the description of the "New Kilo-Mag Four," the maximum value of the volume control resistance is given as 200,000 ohms in the inscription under Fig. 2, and as 20,000 ohms in the "List of Parts." Which is correct? T. C.

A maximum value of 200.000 ohms is suitable, and consequently the figure given in the "List of Parts" is incorrect. This error is regretted.

RULES.

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

(2.) 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.

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

(4.) Practical wiring plans cannot be supplied or considered.

(5.) Designs for components such as L.F. chokes, power transformers, etc., cannot be supplied.

(6.) Queries arising from the construction or operation of receivers must be confined to constructional sets described in "The Wireless World" or to standard manufacturers' receivers.

Readers desiring information on matters beyond the scope of the Information Department are invited to submit suggestions regarding subjects to be treated in future articles or paragraphs.

Test the Grid Leak.

My "New All Wave Four" has worked well until recently; it now seems to become choked, signals failing almost completely for an appreciable time and then coming back to original volume. Can you tell me what is wrong? W. T. D.

If the "choking" coincides with the reception of a signal of exceptional strength (or of a strong atmospheric discharge), your description of the trouble would lead us to think that it must be due to a faulty grid leak (in the first L.F. grid circuit), and in all probability the replacement of this component will put matters right. If it does not, it must be assumed that the trouble is not due to true grid choking, and it will be necessary to make careful stage-by-stage and point-to-point tests, in order to locate an intermittent partial disconnection.

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Picture Reception.

I have built the Picture Receiver described in January, and for some time it worked perfectly, but lately some fault seems to have developed which makes the picture blurred. I enclose specimen pictures, including one received from Berlin. W. A.

The trouble you are experiencing with your picture receiver is no doubt due to an incorrect adjustment of friction. Excessive friction causes a serious retarding of the clockwork drive giving a varying speed of starting on release. Insufficient friction gives a poor start when the catch is withdrawn. Carefully reset the catch plate and critically readjust the friction plungers so that there is no change in the running of the governor with stopping and starting. Look also to the friction pad of the governor, as well as the centre mountings of the spindle.


(a) Wavy line produced by an incorrect adjustment of friction. (b) Picture from Berlin submitted by querist.

Two A.C. H.F. Stages.

Would it be possible to use A.C. valves throughout in the "Kilo-Mag Four," making only the obvious modifications and adding the necessary cathode and heater connections? S. E. L.

This receiver could be operated with A.C. valves, but some adjustment, particularly of the H.F. transformer ratios. would be necessary, and unless you have had a good deal of experience of multi-stage H.F. amplifiers, we think you would be safer in adopting something on the lines of the "Foreign Listeners Four," which is specially designed for indirectly heated valves.

oooo

Grid Bias for H.F. Valves.

On page 108 of your issue for July 31st it is stated that the sensitivity of an S.G. high-frequency amplifying valve can be improved by fitting a potentiometer so that grid bias may be adjusted to the minimum value necessary to prevent the flow of grid current under the influence of signals. Can it be taken that a similar refinement is of benefit where a neutralised triode is in question? W. P.

The mutual conductance of any valve will be improved by operating it with the minimum negative grid voltage required for the purpose on hand, and it is a fact that the performance of a neutralised triode H.F. amplifier can often be improved by making provision for critical control of grid bias. Unless the voltage applied from the usual dry cell (or cells) happens to be unusually wide of the mark, however, it is unlikely that the addition of this refinement will yield a readily perceptible increase in signal strength.

Where Reaction Cannot be Used.

Is it possible to apply reaction to the "Multiple Valve Portable," and, if so, will you please tell me how to proceed? H. R. F.

In the multiple valve used in this receiver no connection is led out from the anode of the detector valve element, and consequently any conventional form of reaction is out of the question. In point of fact, it is possible to increase sensitivity by passing back to the detector grid circuit a certain amount of energy from the output valve element anode circuit (in which a certain amount of H.F. energy is flowing), but this course is hardly to be recommended.

oooo

Indirectly Heated Cathodes.

As a new reader of your journal, I cannot understand how indirectly heated valves derive their low tension current from the mains, nor can I see in what respect they differ radically from battery valves. Can you give me a few words of explanation, particularly with regard to the latter point? J. F.

Indirectly heated A.C. valves are fed with low-tension current through a step-down transformer—generally providing about 4 volts—connected to the A.C. mains. The filament through which A.C. current is passed is not the emitter or cathode in the ordinary sense of the word, but serves merely to heat another element (the cathode proper), which is placed in close proximity to it, and is chemically coated or otherwise treated so that it provides a copious emission of electrons at a comparatively low temperature. This cathode serves the purpose of a filament in an ordinary valve, but only one connection from it is led out from the interior of the glass bulb.

oooo

Short Wave Aerial Coupling.

I have made a 2-valve det.-L.F. short-wave set on conventional lines, the general design following that of circuits discussed in "The Wireless World." It works quite well, but I find that over the majority of the waveband covered results are distinctly better when the earth connection is completely removed. Does this indicate that there is a fault? M. S. D.

When a short-wave set works best with the earth disconnected, it can generally be assumed that it does not include provision for a sufficiently loose aerial coupling. We think that attention to this point will put matters right; although a short-wave set may work quite well without an "earth," hand capacity effects are likely to be less troublesome when this connection is included.

If your set includes a separate aerial winding with variable coupling to the grid coil you should make provision for a weaker coupling than at present, and, if necessary, remove some of the aerial turns; if an auto-transformer arrangement is used, provision must be made for connecting the aerial nearer to the earth point.

MISCELLANEOUS ADVERTISEMENTS.

NOTICES.

THE CHARGE FOR ADVERTISEMENTS in these columns is:

12 words or less, 1/- and 1d. 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.

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 ooo, c/o "The Wireless World." Only the number will appear in the advertisement. All replies should be addressed No. ooo, 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.

THE SALE OF HOME-CONSTRUCTED UNLICENSED APPARATUS.

A Service to our Readers.

We have made an arrangement with the Patentees whereby readers who wish to dispose of a home-constructed receiver not licensed under the patents made use of, can license the set by means of the Deposit System referred to above.

The person desiring to sell, in sending us particulars for his advertisement, will in every case make use of a Box No., and should add to the price which he requires the amount of royalty customarily paid by manufacturers.

If the purchaser is satisfied with his purchase, the sum realised will be forwarded to the seller, less the amount due in respect of royalties, which amount will be paid by "The Wireless World" to the owners of the patents concerned, and a certificate will be handed on to the purchaser of the set.

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

3-VALVE All-wave Receiver, latest type, powerful, perfect; £4.—V. Taylor, 57, Studley Rd., Stockwell, London. [0274

SUPERHET Gecophone Portable, just returned from makers, in perfect condition; £25.—Bridger, 151, High St., Slough. [5742

READ and MORRIS, Ltd.,

THE Mains Pioneers, who in 1925, equipped the hospitals with mains sets.

STILL Supreme in all Mains Work.

LOW Tension A.C. Eliminators Permanently Replacing Batteries; now only £5/15.

THE Original Electrolytic Condensers, as used in above 2,000 m.f.; only 13/-, including postage.

MOVING Coil Speakers.

ALL Mains Power Units.

READ and MORRIS, Ltd., 31, Eastcastle St. (facing back of Warings), Oxford St., W. [5745

ELSTREE Six, in mahogany pedestal cabinet, complete with valves (2 spare), 6-volt 80-amp accumulator, Philips H.T. eliminator (A.C.), with G.B., Ediswan trickle charger, Marconi moving coil, gramophone L.S. unit, and mahogany pedestal gramophone with 2 sound reproducers; the lot £30, or would consider sale separately.—S. McDonald, Branscoombe, Brook Gardens, Kingston Hill, Surrey. [5776

NEW Sets to be Cleared at Sacrifice.—32 guineas Symphony Radio gramophone, £25; 31 guineas Chakaphone combined gramophone and portable five, £24; £3/12/6 Philips 220 D.C. eliminator, £2/17/6; £23/10 Pye portable, £15; 15 guineas Truphonic portable, 11 guineas; 16 guineas Pamphonic portable five, £12; Mullard Master Three, with large horn Amplion and valves, £8/10; Cossor Melody Maker, with valves, £5; Mullard S G.P., with large cabinet containing speaker, batteries and valves, £11. Write for requirements of components batteries, etc., at bargain prices.—Box 2540, c/o *The Wireless World.* [5771

GECOPHONE Portable, £17/10; Pye portable, £12/10; Langham, £11; Burndept Ethophone grand, 5-valve, £15; Burndept 7-valve superhet, 1925-26, £12; ditto, 1926-27 model, £16; Marconi V2 and amplifier, £7/10; Burndept 4-valve, £8/10; also Burndept bureau cabinet (with partly built set), £12.—James Scott and Co., Radio Engineers, Dunfermline. [0320

WIRELESS is a Fascinating Subject, but makes heavy demands upon the purses of its devotees. For one who is determined to keep abreast of the times, there are always new components to be bought, and sets and loud-speakers to be superseded.

AT the Same Time, the would-be buyer is often deterred from buying because he knows that there will be still one more piece of apparatus left on his hands, to add to those already in the junk box.

WE Have Opportunities of Disposing of Semi Obsolete Apparatus to those who are not fortunate enough to be able to afford the latest type, and will take such apparatus or components, providing they are in saleable condition, in part exchange for any new set, loud-speaker, or component required.

ALL We Ask is that You should Send Along a List of Your Old Apparatus, together with your new requirements, or, better still, send the apparatus to us to inspect, when we will make you a fair offer.

IF You Approve of this You can Send your Remittance for the Balance, and we will forward the apparatus required; if you have sent your old apparatus and you do not approve of our offer, we will return, carriage paid.

THE Principal of this Firm, who has been a professional wireless engineer since 1910, and has been manager for the Sterling Telephone Co., radio expert to the General Electric Co., and Chairman of the Technical Committee of the National Association of Radio Manufacturers, will willingly give advice to those who are desirous of purchasing apparatus; we are entirely unbiased and will recommend the best apparatus for your particular purpose; you save money by having genuine expert advice.

DON'T Forget We Will Take Your Old Receiver or Components in Part Exchange.

WE Will Also Build Any Sets to Specification (Marconi royalties payable), and install anywhere in the British Isles; sets modernised; send for estimate.—Scientific Development Co., 51, Fishergate, Preston. Tel.: 1364. [0226

GECOPHONE Portable, purchased April, H.T. battery just replaced; £18 cash.—Hector, 121, Norton Way, Letchworth, Herts. [5898

CLEARANCE of Surplus Stock.—Sets, portables, components, accessories, loud speakers; genuine bargain list post free.—Coxon's, 240, County Rd., Walton, Liverpool. [5837

Receivers for Sale.—Contd.

VALVE Amplifier (inclusive 20/- transformer), 12/6; another, 10/-; 2-valve amplifier, 16/9.—Gillespie, 78, Wemyss St., Glasgow. [5937

SIMMONDS BROS.—Receivers constructed to your own or any published design; also repairs, reconstructions, and modernisations at moderate charges; best materials and workmanship guaranteed; numerous testimonials; quotations free—Address, Shireland Rd., Smethwick. [5882

MARCONI Receiver, 4-valve, complete with Celestion speaker; cost £80, will take £25, or best offer.—97, Clarendon Rd., Putney. [5958

GECOPHONE 6-valve Stabilised Set, in mahogany, gramophone jack, Osram valves, cost £56, sell for £30; Gecophone 7-valve supersonic heterodyne portable, immense range, perfect condition, cost £38, sell for £17.—BM/ZNRM, London, W.C.1. [5953

F. W. SMURTHWAITE, A.M.I.R.E., Specialist in the Highest Grade Wireless Apparatus.—Why buy a mass production article when you can have a special instrument made in my works to meet your exact requirements? Buying from the actual manufacturer you get infinitely better value.

A LONG List of Receivers does not convey much, and probably would not include the exact instrument you are looking for, therefore I give a few specimen sets only, and ask you to let me know your needs; my unbiased advice is at your service.

SCREENED Grid Five.—A receiver to be proud of, since there is nothing to compare with it at even double the price, built to an ideal, absolutely irrespective of cost, with the finest components obtainable; comprises 2 S.G. H.F. stages covering long and short waves without coil changing, completely screened in beautifully made aluminium screening box, anode rectifier, and an L.F. amplifier specially designed to give the best possible quality on an M.C. speaker, jack for pick-up, and volume control fitted, gives enormous range and selectivity without detriment to quality; prices from £35.

SCREENED Grid Four, A.C. model.—A similar set to the above, but with one H.F. stage only, gives immense H.F. amplification as the Cosmos AC/S valve with an amplification factor of 1,200 is used, the finest all mains set on the market; prices, complete with valves, from £20.

ALL A.C. Radio-gramophones.—I have designed a number of unique combined instruments, and all interested in high grade reproduction are cordially invited to call and hear them; each instrument is individually made, tested, and guaranteed; cabinet work to your own choice.

I DO Not Take Old Sets in Part Exchange.—They are practically unsaleable, and to do so simply means that new work must be charged at a higher figure to cover the losses; all my new instruments are sold at the lowest possible cash prices, consistent with first class work and materials.

REPAIRS and Reconstructions.—I am always pleased to quote for work of this kind, and guarantee satisfaction; many old type receivers can be brought right up to date at a moderate cost.

MCMICHAEL Screened Dimic Three.—Factory-made instrument, absolutely unscratched, complete with set of selected valves; £11/10.

F. W. SMURTHWAITE, A.M.I.R.E., 15a, Onslow Gardens, Wallington, Surrey. Works: 24, Belmont Rd. 'Phone: Wallington 1982. New showroom: 104b, South End, Croydon. [5950

MEWFLEX, less valves, £4; also Titan, ditto, £2/10.—Young, 119, Peckham Park Rd., S.E. [5944

MULLARD S.G.P. Three, full kit with valves, as brand new: cost £9/15, bargain £6.—69, Gorringe Park Av., Mitcham. [5921

NATIONAL Portable, 5-valve, little used, complete; £9, a genuine bargain.—Box 2814, c/o *The Wireless World.* [5964

BATTERIES.

PENTODE Users, write for details of new size self-charging battery; 7d. per volt; illustrated catalogue giving data post free.—U. Taylor, 57, Studley Rd., Stockwell, London. [0273

WET H.T. Replacements.—Sacs (capped or uncapped), highest grade, No. 1, 10d. per doz.; No. 2, 1/9 per doz.—See below.

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

WET H.T. Batteries.—Parts per dozen, jars, No. 1, 2¼x1½ square, 1/3; No. 2, 1/6; zincs, No. 1, 10d.; No. 2, 11d.; sacs, No. 1, 1/2 dozen; No. 2, 1/9; terminals, 8d., 10d.; dozen cells (18 volts), complete with bands and electrolyte, No. 1, 4/1; No. 2, 5/-; post 9d.; high efficiency, long life, self charging, upkeep small; send 6d. for sample unit; illustrated booklet free, carriage free orders 10/-; write for free list wireless bargains; trade supplied.—W. Taylor, 57, Studley Rd., Stockwell, London. [0039

C.D.E.S. Accumulator Hire and Maintenance Service (5 mile radius).—98, Cherry Orchard Rd., Croydon. [4062

BETTER Accumulator Charging.—We guarantee precise charging and maintenance by expert personnel. The prices are very economical and include trouble-free collection and delivery; also hire and part hire service of Oldham batteries; official Oldham service station.—Anelor Radio (associated with Anelor Products), 36 Hindmans Rd., East Dulwich, S.E.22. Tel.: New Cross 4074. [5926

CHARGERS AND ELIMINATORS.

TANTALUM Electrode Strips for H.T. Rectifiers, suitable for A.C. mains eliminators; 2d. each, or set of 8, 1/-.—1.7, Dalton St., West Norwood, S.E.27. [0308

TANTALUM and Lionium for A.C. Rectifiers; make up your own inexpensive chargers; blue prints for H.T. and L.T., 1/- each; Lionium electrodes fitted with terminals 2-3 amps., and 5-8 amps.—Blackwell's Metallurgical Works, Ltd., Liverpool. [4593

TRANSFORMERS and Chokes for Battery Eliminators, and for all wireless purposes, receiving or transmitting; enquiries invited.—Chester Bros., 244, Dalston Lane, London, E.8. [4903

VORTEXION Transformers, chokes, etc., wound to any specification; write or 'phone for quotation; best quality components only.—Vortexion, 72, Merton Rd., Wimbledon, S.W.19. Tel.: Wimbledon 2814. [0319

PHILIPSON'S Safety High Tension Battery Eliminators.

PHILIPSON'S Safety Eliminators Give Consistent Results.

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PHILIPSON and Co. Ltd., Radio Engineers, Astley Bridge, Bolton. 'Phone: 2038. 'Grams: Safety Bolton. Est. over 50 years [0318

JUST Out!—The new improved model Unifex H.T. A.C. eliminator kit; 30/-; giving full output of 120 volts, 15 milliamps, free from hum results.

THE New Kit includes Shielded Mains Transformer with terminals, heavy choke, 3 Hydra type condenser, tested 500 volts, D.C. Locwe vacuum resistance and clip, valve holder, panel ready drilled, and 3 sockets fitted, all the components mounted on a polished base board, and neatly boxed, with full instructions and picture diagram, ready for assembling in a few minutes; sent anywhere in the British Isles, per parcel post, c.o.d., 30/-, on the receipt of a postcard stating mains voltage, and cycle.

MULLARD D.U.10 Valve, recommended, 15/- extra (please state when ordering if valve to be sent); every part guaranteed; satisfaction or money refunded.

THE New Model is the Finest Value in England; thousands now in use; hundreds of testimonials.

FULL Particulars and Diagram Free; dealers write for terms.—Liverpool Radio Supplies, Unifex Works, 64, Myrtle St., Liverpool. [5853

AUSTIN Mains Transformers and Chokes are Described in One Testimonial as "a first class job at a very moderate price" any output supplied, for any purpose, guaranteed; Foreign Listeners' Four, 28/-; Flat Dwellers' A.C.3, 24/-; low resistance chokes to 100H, from 12/6; send your enquiries now.—Austin Mills, St. Alban's Ave, Heaton Chapel, Stockport. [5896

RADIO EXCHANGE!—Burndept 25 milliamp H.T. eliminator, 200 volt A.C.; £5/5.—80, Treville St., Plymouth. [5929

SAVAGE'S Transformer Laminations and Bakelite Bobbins, 2 new sizes available; intending home constructors should write for list.

SAVAGE'S for Complete Mains Transformers and Power Chokes.

SAVAGE'S Mains Transformer for Foreign Listeners' Four, 30/-; smoothing choke, 15/-; 1,000 volts D.C. test condensers 2-mfd., 3/-; 4-mfd., 5/3.

SAVAGE'S Mains Transformer for Cosmos SP42/U Rectifying and 3 A.C. Valves, 26/-.

SAVAGE'S for Reliable Apparatus at Reasonable prices, specialists in wireless power from the mains.

SAVAGE, 146, Bishopsgate, London E.C.2. 'Phone: Bishopsgate 6998. [5876

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CABINETS.—First class goods at competitive prices; send for lists.—Gilbert Cabinet Maker, Swindon. [9833

ARTCRAFT Radio Cabinets are Britain's Best Value. [0313

KAY'S Cabinets, the greatest range of pedestal cabinets in the kingdom; original creative designs at prices 50% lower than elsewhere; quotations for specials by return; delivery at short notice guaranteed; moving coil, portable, baffle, vignette, radio-gramo, electric pick-ups, television, etc.; illustrated lists free.—H. Kay, Wireless Cabinet Manufacturer, Mount Pleasant Rd., London, N.17. 'Phone: Walthamstow 1626. [5362

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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.

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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

ARTCRAFT Radio Cabinets; Britain's best value; lowest prices consistent with highest quality; illustrated list free from actual manufacturers.—Art-craft Co., 156, Cherry Orchard Rd., Croydon. 'Phone: Croydon 1981. [0040

THE Following are the Finest Bargains Ever Offered, all of which are genuine Burndept manufacture, and you know Burndept quality; unless otherwise stated these cabinets are either slightly soiled or scratched, and every one is worth at least £3, but note our clearance prices.

BURNDEPT Portable Cabinets (suitcase type), inside measurements 14¼in.×14¼in.×4½in., with lid 14¼in.×14¼in.×3½in., exactly as used in the Burndept £25/12/6 portable; our price 16/6 each, or in perfect condition as new, 25/-; carriage 1/3 extra.

GENUINE Brand New Burndept Loud-speakers, to fit lid of above, everything complete, ready to fit in lid; 32/6

BURNDEPT Mahogany Portable Cabinets, measurements as above, 25/-; or in perfect condition, as new, 35/-.

BURNDEPT Ethodyne, take 23in.×10in. panel, with raised panel double doors, solid mahogany, and a lovely piece of furniture, 35/-; ditto, without front doors, 25/-.

BURNDEPT Screened Four Mahogany Cabinets, take 16in.×10in. panel and 16in.×10in. baseboard, with raised panel hinged lid, condition as new; 25/-; carriage extra.

BURNDEPT Battery Eliminator Oak Cabinets, inside measurements 14in.×8¼in.×7¼in. deep, with hinged lid; 6/-; carriage 1/3 extra; satisfaction guaranteed.—Hughes and Sons, 149, Chepstow Rd., Newport, Mon. [5895

ARTCRAFT Radio Cabinets are Britain's Best Value. [0310

FINEST American Types, astonishing value, special offer oak cabinets, hinged lid, baseboard, highly polished, take 12in.×6in. panel; sample, carriage paid, 6/6; trade discounts for quantities.—Mag.Radio, 112, Warstone Lane, Birmingham. [2665

LOUD-SPEAKER Cabinets, extraordinary offer, oak cabinets, handsome fret front, highly polished, 13in. square, 6in. deep, finished moulding, take all ordinary units; sample, carriage paid, 6/6; trade discounts for quantities.—Mag Radio, 112, Warstone Lane, Birmingham. [2666

ARTCRAFT Radio Cabinets are Britain's Best Value. [0309

DAYSON Radio-Gram Cabinets take sets up to 21in.×8in.×13in., ample room for batteries, loud-speaker, records, etc., hand french polished, oak finish, No. 2, 37in.×24in.×19in., 72/6; crate 5/- extra, ret., No. 1 De Luxe model, 40×24×20, 92/6; crate 5/- extra, ret.

DAYSON Moving Coil Pedestal Cabinet, baffle size, 18×18 height 40in., oak finish, 45/6; crate 4/6 extra, ret.

DAYSON Loud-speaker Cabinet, 10in. cone size, 10/6; 12in. cone size, 15/6; moving coil type, 22/6.

DAYSON Special Pedestal Model for Cossor M.M., Mullard Master Three, etc., space for batteries; special price, 52/6; crate 4/- extra, ret.

DAYSON Cabinets are all Hand French Polished, satisfaction is guaranteed; send for illustrated list now; save 50% by buying direct from the actual manufacturers.

DAYSON Cabinets. Dayson Works, Grant Rd., Croydon. [5946

COILS, TRANSFORMERS, ETC.

1,000 ohm Decoupling Resistances for "Wireless World" Circuits; 1/3 each, post free.—Groves Brothers, St. Mary's Place, Shrewsbury. [5753

600-OHM Decoupling Resistances for "Wireless World" Circuits, hand made and tested in our own workshops; 1/- each, post free.—Groves Bros., St. Mary's Place, Shrewsbury. [5832

FOREIGN Listeners 4, set of three low wave coils, 32/6; highwave, 32/6; bases, 1/6 each.—Radiograph.

S.G. Multi Valve Portable Coil, 21/6; Europa portable coils, 21/- pair.—Radiograph.

S.G. Regional Coils 37/6 pair; Europa III coils, 22/6 pair.—Radiograph.

LITZ Wire, 9/40, 1/6 per doz. yards; 27/42, 2/6 doz. yards.—Radiograph.

REDFERN'S Deep Ribbed or Becol Tube, 5d. per inch; slotted for winding, 1/6 extra.—Radiograph, Station Rd. corner, New Inns, Handsworth, Birmingham. [5852

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FOR HOME CONSTRUCTION. LINEN DIAPHRAGM, STEEL CHASSIS BUILT LOUD SPEAKER KIT.

Constructed in half an hour with a screw-driver. Size 20"×20". Has a double linen diaphragm and adjustable damping attachment. Will take any popular Cone Movement, "G.E.C.," "Blue Spot," "Triotron," "Hegra," "Brown," etc. Complete Kit includes Dope, Brush Instructions, and Ornamental Sides.

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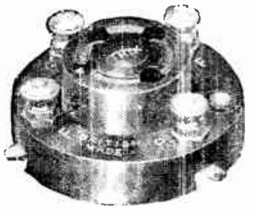

Coils, Transformers, Etc.—Contd.

SIMMONDS BROS.—Bereli coils, new Kilo Mag Four, 50/- set; Foreign Listener's Four, set of 3 low wave, 30/-; set of 3 long wave, 37/-; modulated wavemeter, pair coils, 22/-; screened grid regional coils, as specified, 43/- pair; Mullard SGP dual range coils, 30/- pair, approved by Mullards; Bereli standard coils for New All-wave Four, Standard Four, A.C. Three, Regional, Everyman Four, 77/9 set of 4, with bases; Bereli standard coils for the Lodestone series (specified "Wireless Magazine"), 76/6 set of four, with bases; New Empire, set of three coils and base, 21/-; Titan unit, 15/-; all "Wireless World" and similar coils in regular production by the original specialists; lists free; trade supplied.—Simmonds Bros., Shireland Rd., Smethwick. 'Phone Smethwick 751 for quick c.o.d. service. [5883

S. PULSFORD.—Coils, transformers; Europa Portable, 21/- pair; Multiple Valve Portable, 21/6; S.G. Regional, 37/6 pair; Flat Dwellers' A.C.3, 16/6; Kilo-Mag Four, 60/- set; 600 ohms resistances, 1/6 each.

S. PULSFORD.—Foreign Listeners' Four, complete set of coils, 62/-; bases, 1/6 each.

S. PULSFORD.—New Kilo-Mag Four coils; 56/- set. —S. Pulsford, 135, Hockley Hill, Birmingham. [5945

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1/16 h.p. Ball Bearing Motor, 200v. D.C., will run on A.C.; 15/-; or exchange pick-up and arm.—Isaac, 58, Hambledon Av., Bierley, Bradford. [5914

M-L Rotary Transformer, new and guaranteed by makers, 12-250 volts, 40m.a., £5/10; 2 6 volt 50 amp. accumulators, as new, £2 each; Ferranti moving coil voltmeter, 8in. dial, 50-100 volts, brand new, £1; portable set case, with cone speaker, £1; twin petrol engine, air cooled, 4½h.p., less magneto, £2.—Evans, Goring, Sussex. [5938

MORTLEY Generator, type C.F./248, H.T. 2,250 volts 125 m.a., L.T. 13.5 volts 10 amps., belt coupled to Century ¾h.p. 220-volt single phase A.C. motor, complete with starter, generator can also be run as rotary transformer, perfect order, as new, every continent in world worked with above outfit; also 1 Mullard 250-watt valve, type S.W.2, little used; lot cost £42, what offers?—5SZ, West Point, Menston, Yorks. [5971

FOR Sale, Marconi hand generator, 600 volts 30 m.a.; £3/10, carriage paid.—70, Fieldhead Av., Elton, Bury, Lancashire. [5972

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£4 Brown Pick-up, not done over 12 records, perfect; 38/-; wanted, Dubilier K.C. condensers, drum control.—A. Thompson, 1, Coppy Nook, Greetland, near Halifax. [5957

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COIL Drive Speakers, Goodmans; call any date between 12.30 p.m. and 1.30 p.m. during the City luncheon hour, and hear any of our products demonstrated.—Goodmans, 27, Farringdon St., E.C.4. [0091

IF You are in London Call and See Goodmans' Coil Drive and Reed Units before purchasing elsewhere.—Goodmans, 27, Farringdon St., E.C.4. [0090

ABSOLUTELY Unsolicited Appreciations Testify to the Definite Superiority of Goodman's Products!!

OF the P.G.3 Double Acting 4-pole Balanced Reed Unit (25/- type), W.B., Old Trafford, Manchester, writes: You certainly merit congratulations on placing the P.G.3. on the market. At the last Manchester Exhibition it came under the notice of my friends and self, and there was nothing at that Exhibition which excelled the P.G.3.

F.S., Lewisham, writes: Upon test this is a very fine unit. Although I have tried several, for purity of tone and faithful reproduction over the whole musical range, it is better than them all. I congratulate you upon the production of a unit which marks a definite advance in the efficiency of the cone speaker unit.

L.D.C., Doncaster, writes: They are without equal.

GOODMAN'S Cone Chassis Assemblies, the cone fitted to which are unique, by reason of Goodman's exclusive doping processes, can be fitted with any cone unit in 2 minutes; new model, 12/6; enthusiastic users write:—

J.M.P., Plumstead, writes: The cone chassis is working splendidly. It is quite capable of handling the full output of my Everyman Four, and its response to faint signals and purity of reproduction are far in advance of anything in cone speakers I have previously obtained.

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ILLUSTRATED Lists Post Free from Goodman's, 27, Farringdon St., London, E.C.4. [0066

FINEST Suspension Leather, for fixing cones to moving coil or reed units, as supplied to principal makers; 2/- sq. ft., 1/6 10in. square; segments up to 12in cone 9d. for 4; all post free, cash with order.—Dilley, 8, Ashby Rd., Essex Rd., N.1. Clissold 0736. [5662

Loud-speakers.—Contd.

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SELHURST RADIO Moving Coil Speakers are of Proved Efficiency and recognised as the best obtainable. Sold direct from address below, or from dealers in 10 countries. 14 days' approval.

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THE "Wireless World" Reader Prefers a Baker's Electro Magnet, because the highly efficient unit used is correctly designed, and by the use of special steel a high degree of magnetisation is obtained, resulting in louder signals without the necessity of an elaborate amplifier requiring high voltages.

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OUR Moving Coil Speakers are of the Highest Grade, and appreciated everywhere. Radio enthusiasts from all parts have sent their unsolicited and written testimony of the high efficiency and magnificent performance achieved.

MOVING Coil Speakers, manufactured by Baker's Selhurst Radio, are of proved efficiency.

ON Receipt of a Postcard, our new 36-page booklet will be sent at once.

VOLUME, with natural reproduction of both speech and music, obtained from Baker's speakers.

IN all Cases we are Happy to Advise You on any point concerning loud-speaker reproduction.

NEW Centreing Devices are Available which overcome all difficulties of centreing.

GIVES Pleasure to all Music Lovers, Baker's moving coil speakers are being used for "Talkies," in leading restaurants and hotels, by manufacturers of radio-gramophone receivers, and for all purposes where volume and clarity of reproduction is essential.

CALL at our Works at Croydon and Examine all Models; you will be convinced of their superiority.

OUR Moving Coil Speakers, with floating diaphragm, were the first made in this country.

IDEAL for Use with the Megavox Three or the Mullard S.G P Master Three, with pentode coil.

LOW to High Notes are Reproduced with a tone quality of an entirely new order, and with a range covering the entire musical scale. Directly you hear a Baker's Moving Coil Speaker you are impressed by the brilliance of reproduction and the natural tone.

LISTEN in with a Baker's Moving Coil Speaker.

ORIGINAL Pioneers of Moving Coil Loud-speakers, Baker's Selhurst Radio.

USED by True Lovers of Music the World Over.

DIFFERENT Instruments and Voices have delicate tone differences which may be called quality, colour, or timbre, and are caused by harmonics of higher pitches which are added to the fundamental notes; Baker's moving coil speakers are designed to reproduce these different shades of tone, that is why they are preferred to all other makes.

SELECO Moving Coils are recognised as the best obtainable.

PERMANENT Magnet Speakers, made by Baker's, retain their magnetism.

EVERY Model can be Supplied as a Complete Speaker, ready to connect to receiver if desired.

ALL Baker's Moving Coil Speakers are manufactured throughout at Croydon, and are British.

KEY to Realistic Reproduction, Baker's moving coil speakers.

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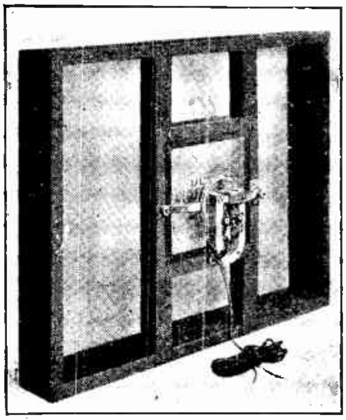
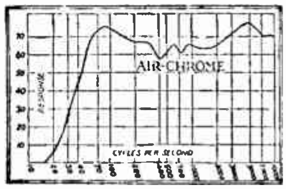
READ Our Free 36-Page Booklet To-day.

SEND to Baker's Selhurst Radio, 89, Selhurst Rd., South Norwood, S.E.25 (Tel.: Croydon 1618), or call at our Works (always open), 24, Cherry Orchard Rd., East Croydon (15 minutes non-stop from Victoria or London Bridge). [0231





The remarkable performance curve of the Ultra Air Chrome Speaker.

Mr Percy W. Harris uses the Ultra Air Chrome Chassis in the All-Electric Gramophone

Mr. Percy W. Harris writes: "Its suitability for the Wireless Constructor Electric Gramophone lies in the fact that it gives a remarkably uniform response to a wide band of frequencies, is extremely sensitive, requires no special magnet-energising current and is very reasonable in price" . . . "gives a low-note reproduction comparable with the best moving-coil speakers, but also is quite good in the upper register, thus giving the 'brilliance' which is so much needed."

Type L. Chassis	12" × 10"	42/-
Type K. Chassis	14" × 14"	52/-
*Type F. Chassis	18" × 23"	84/-
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** Type F is that used by Mr. Percy W. Harris and illustrated above.*

ULTRA
AIR CHROME

Ultra Electric Limited, 661-663, Harrow Road, London, N.W.10. 'Phone: Willesden 1616/7.

Loud-speakers.—Contd.

EPOCH, the greatest scientific achievement of the year

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EPOCH.—Marvellous new model moving coil speaker.

EPOCH.—Requires no accumulator! No mains! No complications!

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EPOCH.—Does not require umpteen valves; a crystal and one valve or a portable will work it.

EPOCH.—The only straight line speaker.

EPOCH.—Straight line reproduction from 50 to 8,000 cycles.

EPOCH.—No resonance! No background! Clear as a bell!

EPOCH.—Sharp, crisp attack. No drumming! No hissing!

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EPOCH.—A good soprano does not sound like a contralto, nor as if she had a cold.

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EPOCH.—A flute sounds like a flute but a violin doesn't.

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EPOCH.—A piano does not come through like a broken down banjo, nor like a harpsichord or barrel organ.

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EPOCH.—The only range of speakers that reproduces speech as well as music with absolute accuracy.

EPOCH.—The speakers that have eliminated the defects of ordinary moving coil speakers

EPOCH.—Greatest variety on the market to suit all requirements and pockets.

EPOCH.—20 models; price from 50/-.

EPOCH.—See the new 9in. public address model.

EPOCH.—A happy model 66P.M. user asks us to state that an Epoch does not make a bad set good, but it makes a good set perfect.

EPOCH.—Testimonials by every post.

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EPOCH.—One of the greatest authorities in this country, after a comparative test with many other well known makes, has pronounced Epoch as infinitely superior to the best of the others.

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EPOCH.—One of the best known experts, whose name is a household word, after most exhaustive comparative tests, has just bought one for his private use.

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EPOCHS are in use in many Talkies, have been adopted by scientific institutions, and are the preferred choice everywhere after comparative tests.

EPOCH is Made for Quality; the low price being only possible by quantity production and small profits.

EPOCH Speakers are very Massive, sturdy, foolproof, and made for everlasting wear.

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EPOCH.—Dealers often push substitutes because of bigger profits; insist upon getting Epoch.

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EPOCH.—If your dealer will not take your order, the manufacturers will supply you direct.

EPOCH.—The only proper way to compare speakers is on your own set with a quick switch over: Epoch 66 welcomes such a comparison.

EPOCH.—You can have any type Epoch, subject to 7 days' approval.

EPOCH Speakers are Fully Guaranteed.

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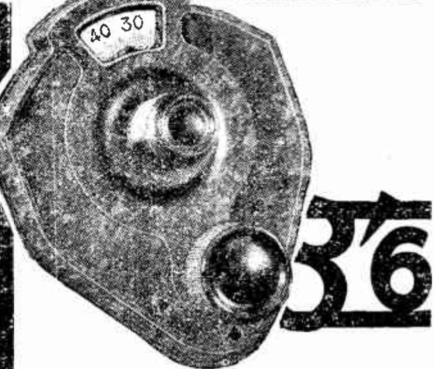
EPOCH RADIO MANUFACTURING Co., Ltd., are the manufacturers. City Office and Service Station, 25, Laurence Pountney Lane, E.C.4 (off Cannon St.). 'Phone: Mansion House 4683. [500

DOMINION VERNIER DIALS



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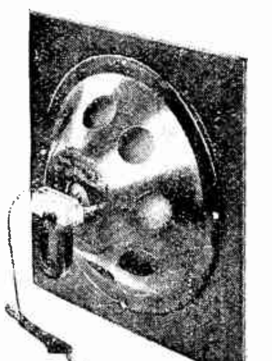
Non Metallic, Non Resonant Cone Chassis. 12 in. Floating Cone. 16 in. Baffle.



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PRICE **10/-**

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DEMONSTRATIONS Daily.

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BECAUSE the Webson B.S.7 is designed and made for the use of musical critics to whom only the finest possible reproduction is good enough.

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OUTPUT Valves.—The ideal valve for purity output to moving coil and other large loud-speakers is an A.P. L.S.680; it dissipates 10 watts on 200 H.T. and requires only half the H.T. of the equivalent 3-electrode.—Kindly see Aneloy Products advertisement under Valves section. [5866

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POLISHED Oak Cabinets for Above Speakers, 22in. square: 27/6, all carriage paid.—Hammonds, 1, Stratford St., Nuneaton. [5899

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EPOCH by Deferred Payments.

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EPOCH.—Any responsible householder can obtain any type Epoch moving coil speaker by easy terms; no references, no interest.—Particulars from Mr. Laserson, 110, Cannon St., E.C.4. [5518

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£1.—B.T.H. C2 horn speaker, as new, perfect.—40, Harrington St., Regent's Park, N.W. [5954

NEW L.P.18 Lion Power Chassis; cost £8, sacrifice £5/10.—Felts, "Brielau," Donington, near Spalding. [5933

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AMPLION Cone, oak, perfect, practically new; 35/-, bargain.—Whittaker, 33, Westcliffe Rd., Southport. [5923

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VALVES.—Rectifying half wave valves, 4v. 53 amps., output 30 m.a., do same work as a 15/- valve at under quarter the cost, 3/6.—Braidwood, 1, High St., Barnet. Try one! [5795

A.P. L.S.680, the ideal super output valve, which dissipates 10 watts at only 200 H.T.—half the usual voltage, "g"=3.0, mu=3.0, R_a=1,000 ohms; the valve is perfect for big amplifiers and lower power transmitters.

WE are so sure of A.P. Valves that we will send you the type required on 3 clear days' approval against cash order, and will accept risk in transit.

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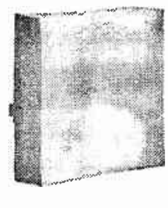
DUPLEX CHASSIS

(Prov. Pat. 14452/29)



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Chassis only, **22/6** Post 1/-

Recommended Units:

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Full particulars from:

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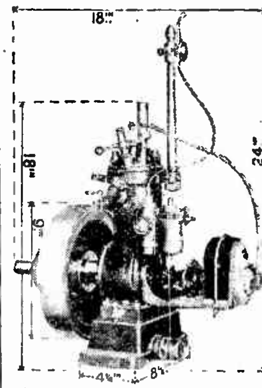

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SCREENS PAREX COILS

NEW KILO-MAG 4

METAL CABINET AS SPECIFIED, highly polished and mottled, with baseboard and beautifully finished OAK BASE and inside screens for S.G. valves.

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S.G. VALVE HOLDERS **2/-** each.

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By W. JAMES.

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EXPERIENCED Amateurs Will Recognise Value of Calton-Stewart H.F. choke, 2,000 turns, in segments, each surrounded by air, all wavelengths; 2/- by post.—Calton-Stewart, 28, St. Enoch Sq., Glasgow. [5915

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MARCONI Generator, 1,500v., D.C., £2; Cossor M.M., without valves, in cabinet, £3/10; 3v. dual range, needs slight attention, £2/10; few E.B coils, 1/3 each; cone speaker, 15/-; Nesper horn speaker, 10/-; other goods cheap.—Send S.A.E., Moorcroft, Hathersage. [5786

D.C. H.T Eliminator, output 1,750, 40 m.a., £2; Grassmann moving coil 6v. loud-speaker, £3; Whiteley Boneham 47/6 loud-speaker, 35/-; T.C.C. electric condensers, 10/6; Phillips 328 rectifying charging valve, new, used once for testing.—E.S., Box 2564, c/o *The Wireless World.* [5785

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EXPERIMENTER'S Surplus for Sale.—Rice-Kellogg 6 volt moving coil loud-speaker, bargain, £5; Cyldon triple gang condenser, 30/-; Lewcos triple screen coil unit, long and medium wave switch, cost £5, bargain £2/10; all above as new; valves and other components for sale; write for list.—Allwright, c/o Gollin and Co., Ltd., Trading Estate, Slough. [5924

A.F.3, 12/6; A.F.4, 10/-; P.M.3, 4/-; P.M.4, 4/6; Lotus 2-way coil holder, 3/-; 0.0005 Ormond S.L. condenser, with vernier, 3/6.—Box 2801, c/o *The Wireless World.* [5925

DIMIC No. 1 and Base; Pye 32H choke; 6 1 mfd., T.C.O. Mansbridge; Utility switches, D.P.D.T. and 4P.D.T.; 2 0.0005 Ormond S.L.F.; Cosmos H.F.C.; Dubilier 2 meg., with base; Edison jacks, 2 S.F., 2 D.F.; plug-in condensers, 0.00005, 0.001, etc.; 31/- post free.—Write, 10, Kingscourt Rd., S.W.16. [5927

Components, Etc., for Sale.—Contd.

APPLEBYS.

NAMED Inseparably with Radio Part Exchange, wherever the English language is spoken.

THERE are Those whose Æsthetic Tastes Revolt when Confronted by Cheap Production, whose mentality allows of no pretence, to whom rash promises are a vulgarity and colourful offers a bore; who require £1 worth of value for every £1 expenditure, and know full well that no living being can give them more.

TO Them in the Radio Field Appleby's Appeal; in part exchange exists the most economical method of purchase.

BRIEFLY, here is Appleby's service simple, straightforward, fair; a not too dull brochure, more fully descriptive, will be sent to you immediately upon request.

WE Supply Practically All the Leading Lines of Radio Apparatus at Current List Prices, and make no carriage charges except on accumulators and batteries and exceptionally bulky articles.

IF You Wish, we will take in part exchange any branded receiver, component, or loud-speaker, for which you have no further use, providing such is reasonably modern and in workable condition.

TO Make Fair Offers we Must See the Material; on receipt of a parcel, which must contain a list of contents and name of sender, we will send our offer, which is as an allowance from an order for new requirements totalling not less than twice the allowance—but it is fair. In the unlikely event of no agreement being reached, we will return your material carriage paid. We cannot execute part exchange orders of less than 10/- nett cash value, that is after part exchange allowance has been deducted.

A CURSORY Analysis into Points of Economical Relation and Psychological Effect, of these terms of part exchange, proves interesting.

POINT One.—The terms have existed since the inauguration of radio part exchange several years ago; their suitability may be gauged by the fact that we have served thirty-nine more part exchange customers in the half year ending June 29th, 1929, than in the whole of the year 1928; that 87% customers have repeated their first transaction, and 46% customers have put through five or more transactions.

POINT Two.—We must see the material; making offers for material we have not seen proves inadequate, indefinite, and misleading; it helps no one and progresses nowhere; upon reflection, this is obvious, as the value of an article greatly depends on its condition and production age; the likelihood of receiving an inadequate offer for material sent to us can be determined by the fact that our rejected offers are, and always have been, below 1%.

POINT Three.—Twice the allowance; this stipulation ensures you a fair offer always; the more we offer you, the more you ultimately spend with us; therefore, in our own interest as much as yours, we offer the maximum market value.

WE Do Not Require You to Purchase to the Value of Twice the Allowance Immediately; if you require a lesser value, half the cost is payable in cash, and the balance of credit due will await use at your convenience; virtually, the system is a radio bank; material may be deposited against a credit note, and no purchase made for several months; for those whose affairs take them periodically abroad this is particularly useful.

POINT Four.—Appleby's part exchange service is conducted in premises separate for the purpose, employing British labour of proved integrity, British capital, and British behaviour; it is the original part exchange service—and a known quantity.

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NATIONAL Portable 5v., used for demonstration purposes only, £10, cost £15; Amplion Lion cone L14, £2/10; M.P.A. plaque cone, 15/-; Amplion A.R.114 speaker, 15/-; Ancloy Radio valve, L.S.680, 15/-; Ferranti output, push-pull transformer, 13/6; Pye 20 Henry choke, 8/6; Hegra pick-up, 5/-; Cossor 410R.C., 410L.F. valves, 5/6 each; or offers for any of the above.—McFarlane, 15, Rotherfield Rd., Enfield Wash, N. [3932

FLAT Dwellers' A.C. Three; complete kits of parts, with valves and wound coils, everything included, precisely to specification (frame aerial and oak bureau excepted); when ordering state resistance of speaker; £21, carriage paid; kit for outside aerial £1 extra.—F. W. Gill, Carter Lane, South Normanton. [5939

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PAREX Screens.

PAREX Coils.

PAREX S.G. Valve Holders for the New Kilo-Mag Four (see advert., page 14).

E. PAROUSSI, 10, Featherstone Buildings, High Holborn. 'Phone: Chancery 7010. [5974

ROTARY Transformer, 12 volts input, 400 volts 100 m.a. output; £4, or near offer.—Apps, 322, High St., Chatham. [5975

W.W. S.G. Regional Receiver, complete screening by Parex (new), 20/-; coils, 25/-; owner unable to complete.—Godfrey, 68, Elsham Rd., W.14. By appointment only. [5684

C.A.V. 2N.S.9 Accumulator, Igranic gramo pick-up, 1 Cleartron S.G.215, 1 D.E.5B, 2 D.E.2L.F., all new, 3 D.E.R., 2 P.M.1.H.F., 3 McMichael vernier dials, 2 0.0003 Ormonds, 2 0.005 ditto; offers.—Lyall, Ewart, Wooler, Northumberland. [5945

HIGHLY Sensitive Microphones for Transmitting Speech and Music Over a Distance, through loud-speaker or headphones, splendid instruments for making Detectaphone, deaf aid, loud-speaking telephone, announcements through loud-speaker, amplifier for crystal or valve set, experiments.—Below.

EXCLUSIVELY Super-Microphones were Used by Mr. Barnes-Jones in his wonderful invention of the Fog-Compass described in the "Times" and other papers of July 16th. 1929; each Super-Microphone guaranteed more sensitive than any other type known; fitted with a 3ft. silk connecting cord, 6/6; microphone transformer for same, 2/-; small 10 ohms earpiece for use with Super-Microphone as a highly efficient deaf aid, 6/-.—Below.

FULL Directions for Using Super-Microphone for Many Purposes and Diagrams of Connections Free; all instruments guaranteed and despatched by return post.—Fredk. Adolph, Microphone Manufacturer, 27, Fitzroy St., London, W.1. 'Phone: Museum 8329. [5961

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NATIONAL Portable, 5-valve, little used, complete; £9, a genuine bargain.—Box 2813, c/o *The Wireless World.* [5963

WESTON Voltmeter, 4 range, 3 to 300 volts, £1/10; Wheatstone Bridge, 4 dial, triple ratio, with galvanometer, £3.—Box 2820, c/o *The Wireless World.* [5970

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SCOTT SESSIONS and Co.—New sets constructed with your components or parts supplied by us; guaranteed finest workmanship; we specialise in "The Wireless World" circuits, high grade radio-gramophone apparatus, etc.; let it mean something to you that we have satisfied customers throughout the British Isles! London service; experienced engineers sent to all parts; portable sets demonstrated.—Tel.: Tudor 5326. Halliwick Parade, Muswell Hill, London, N.10. [0262

EASY Payments.—We supply, by easy payments, components, accessories and sets, any make; 10% down, balance spread over 10 months.—Send list of requirements to London Radio Supply Co., 11, Oat Lane, London, E.C.2. [0097

METERS. Meters.—Milliamp. and ampmeters, recalibrated and shunts provided, voltmeters fitted with resistances for higher ranges, send meters for estimates.—Chester Bros., 244, Dalston Lane, London, E.8. [5299

IF Your Set is not just as it ought to be, send for Allan Martin, the radio doctor; moderate charges with satisfaction; sets rebuilt and modernised if desired; Greater London only.—82, Finchley Park, N.12. [4959

ALEXANDER BLACK, the original wireless doctor, will call (London and Home Counties) and cure your set; sets installed, maintained, and brought up to date; complete satisfaction or no charge; gramophone pick-ups, H.T. eliminators, and Webson moving coil speakers demonstrated by appointment; purity reproduction specialist.—2a, Woodville Grove, N.16. Sloane 5105 or Clissold 3687. [0277

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YOUR Old Apparatus Taken in Part Payment for Latest Type; see our advert. in column Receivers for Sale.—Scientific Development Co., 51, Fishergate, Preston. [0229

IF You Use, charge, sell, or repair accumulators, we can interest you.—Write Amylol Products, 1, Strode Rd., Forest Gate, London, E.7. [5952

PATENTS.

FOR Sale, British patent No. 297,296, wireless wander plug and electrical connector.—B. H. Roper, Guernsey. [5991

PATENT AGENTS.

PATENTS and Trade Marks, British and foreign.—Gee and Co. (H. T. P. Gee, Member R.S.G.B. and A.M.I.R.E.), 51-52, Chancery Lane, London, W.C.2. 'Phone: Holborn 1525. [0001

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SCOTT SESSIONS and Co., Great Britain's radio doctors; read advertisement under Miscellaneous column. [0263

TWELVE Months' Guarantee Accompanies All Our Repairs; any make of L.F. transformer, headphones, or loud-speaker repaired and despatched within 48 hours; 4/- post free; don't discard if burnt out; terms to trade.—Transformer Repair Co. (Dept. W.), 214, High St., Colliers Wood, S.W.19. [0011

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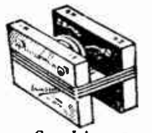

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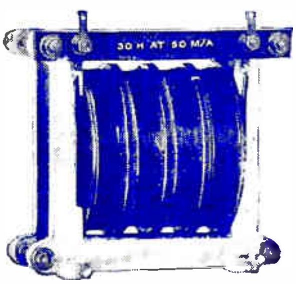

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