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SUPPLYING TECHNICAL DATA WITH APPARATUS.

THE discussion of the question of the advisability and practical utility of adopting a uniform system of valve nomenclature which will indicate the general characteristics of valves, revives interest also in the more general consideration of whether it is not desirable that more data concerning all components should be supplied by the manufacturer. The valve, of course, is an outstanding example because, without knowing the technical characteristics of a valve, it is impossible to do justice either to the valve or to the set in which it is used. We must know the purpose for which the valve has been designed before we can use it intelligently in any receiver.

Now, proceeding with the example of the valve, we believe that there must be an enormous number of cases where valves give a disappointing performance simply for the reason that the user has not been supplied with the necessary information as to the characteristics of the valve, or perhaps a certain amount of information may have been supplied in the carton in which the valve was originally contained, but there is nothing on the valve itself to indicate its characteristics. Some permanent form of marking on the valve itself is the only satisfactory solution of the difficulty. With sets which are purchased ready made, with valves already in place, not much difficulty is likely to arise because, for when a replacement is necessary, the owner of the set would naturally see to it that he obtained a valve which corresponded with the one originally in the set, but if the set is home-built, or if the owner of a purchased receiver decides to experiment a little for himself, then it immediately becomes imperative that the full data concerning the valve should be available to him. Where, too, the valve is required definitely for experimenal work, the need for this information is all the greater.

A Point Deserving Consideration.

The same argument applies with almost all the other components. If when fixed condensers were supplied, instead of being given their capacity value we were told that they were "grid condensers" or "H.T. shunt condensers," we should be very ill-satisfied with such a substitute for the information we ordinarily require. Transformers and chokes, too, should be clearly labelled with all the technical data likely to be needed in deciding upon the suitability of a transformer or choke for any purpose. It may be argued that technical information of this kind is not required by the majority of users, who are not sufficiently skilled to be able to interpret it even if it were supplied to them. Such people can, however, ignore the information if it is of no value to them, but this argument does not, in our opinion, relieve the manufacturer from the obligation of supplying the data for those who may require it.

Many of our readers who, of course, it is understood, are interested technically in wireless, have written to us from time to time expressing regret that manufacturers in their announcements often fail to indicate essential factors relating to their valves and components. The technically interested section of the public does not want to know that a certain valve has "the world's best filament"; such prospective buyers of valves would never purchase one on the strength of such a claim unless the other characteristics of the valve were such as would meet with their particular requirements.

We commend to those responsible for the production of our valves and component apparatus for wireless receivers to give consideration to these requirements, the supply of which we are confident will enhance the reputation of those manufacturers who provide it and be of very great benefit to the user generally.

How Newspaper Illustrations are Telegraphed. Details of an Important New Process.

PICTURE transmission as an adjunct to the production of the daily newspaper has been the subject of much experiment for many years. Although on occasions demonstrations and tests have proved moderately satisfactory, the ability of the several systems to provide a reliable commercial service has not been maintained and only recently has practical phototelegraphy become a *fait accompli*. Our leading daily newspapers having recently claimed an extension of their news facilities by way of telegraphing illustrations both by wire and wireless, interest turns to the technical details of the apparatus being employed. Picture transmission must not be confused with television, which demands the transmission of many complete pictures per second of the changing image. In the many articles which have appeared in this journal from time to time describing the practical methods of picture transmission, the term "phototelegraphy" has been applied, and one should guard against the use of the term "telephotography" in this connection, a word, unfortunately, so frequently used. Telephotography relates, of course, to the use of telescopic lenses in photographic work.

Recent references in our daily newspapers to the transmission of pictures by wire and wireless is indicative of the progress being made in phototelegraphy. Telegraphed pictures unless perfect cannot be utilised for newspaper illustration. Important developments of the past few months have advanced the scope of picture transmission beyond the experimental stage and the new equipments are now capable of giving reliable commercial service.

All present-day systems of picture transmission, and there are several in use, such as the Ranger-Marconi, Western Electric, Thorne-Baker, Belin, Siemens-Karolus, etc., consist of traversing the image either luminously or electrically. The image is invariably mounted on a cylinder as an original photograph, a transparency or a deposited insulating image on a conducting surface. Either a metal stylus or a pencil of light analyses the image as it is rotated on the cylinder, and by means of a spiralling action the picture is slightly shifted on after each revolution of the cylinder. Between transmitter and receiver there may exist amplifying and oscillating valves, line and radio circuits, until a similar rotating drum to that at the transmitter is reached upon which the image is to be formed. It is obvious that the cylinders at transmitter and receiver must rotate in perfect synchrony, and herein lies one of the principle difficulties standing in the way of commercial phototelegraphy.

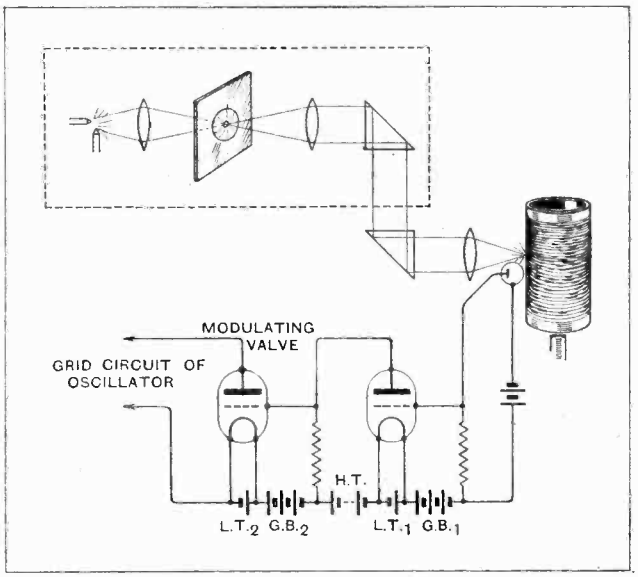
During recent months considerable advancement has been made in the Karolus system[1], and it is probably the most perfect apparatus available to-day. Pictures to be telegraphed by this system are not prepared in any special manner, and if of suitable size are attached directly to the transmitting cylinder. This is mounted vertically and traversed by rotation by a narrow pencil of light which is regulated by focussing lenses and diaphragms, and reaches the picture through the centrical opening in a Schröter photo-electric cell. Light falling on the white parts of the photograph is dispersed and thrown back on to the light-sensitive deposit in the cell creating a minute difference

[1] Siemens-Karolus Telefunken System. Siemens-Schuckert (Great Britain), Ltd. The writer is indebted to Mr. L. Hermes, formerly of the Marconi Company, for providing facilities for gathering the technical data contained in this article.

Phototelegraphy.—

of potential. The potentials developed obviously depend upon the brilliancy and colour of the parts of the image as it is scanned.

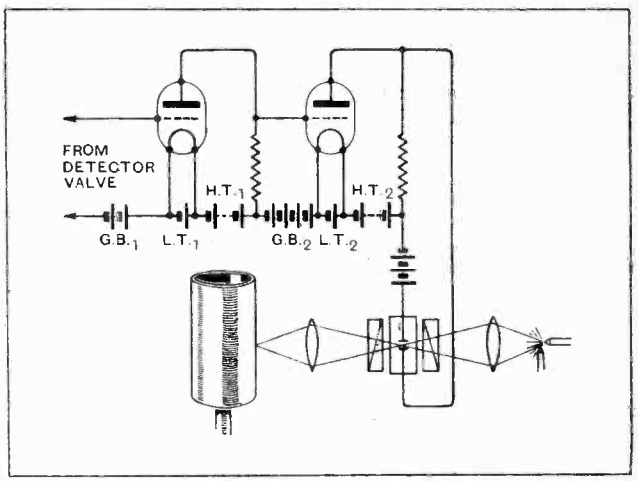
A steadily changing potential created by the light and shade portions of the picture would be delivered by the photoelectric cell were it not for the introduction of a rotating disc with holes interposed between the image and the source of light. By this means an interrupted current varying in amplitude, depending upon the extent of illumination, is produced by the cell, which can be magnified by valve amplifiers or used to modulate a valve transmitter. Both for line and radio transmission amplifiers



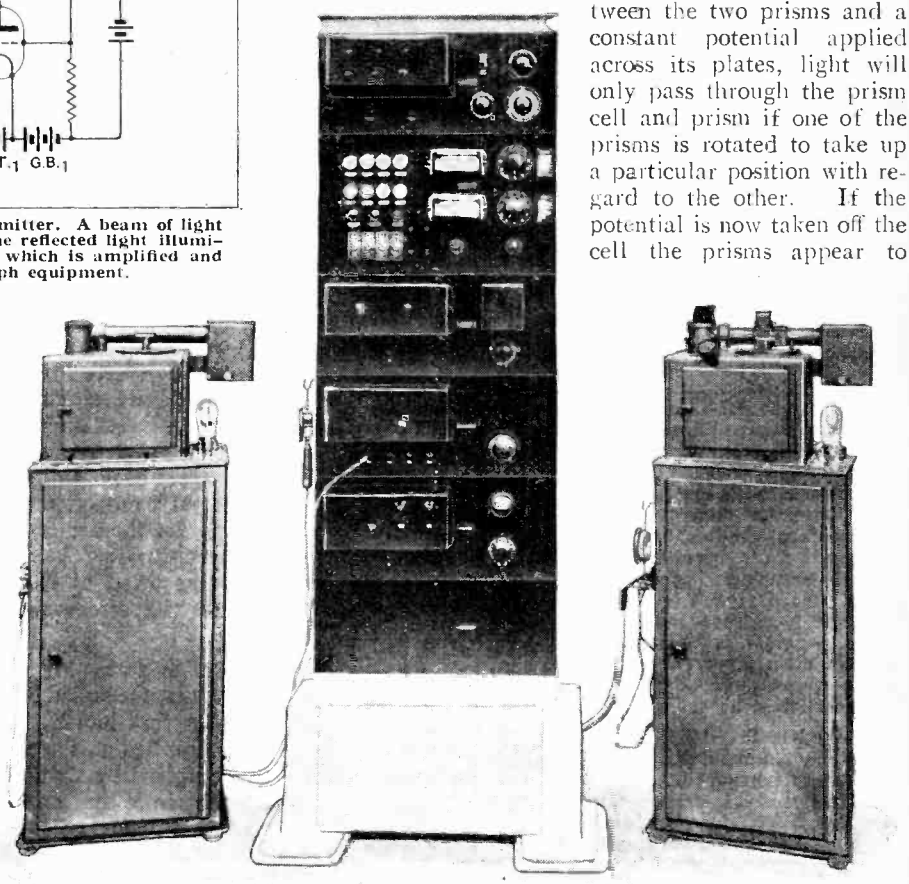
Schematic diagram of the Karolus transmitter. A beam of light is focussed upon the revolving picture, the reflected light illuminating a photoelectric cell the output of which is amplified and passed to radio or line telegraph equipment.

carefully designed to avoid distortion of wave form are situated at transmitter and receiver.

Neglecting for the moment the process of synchronisation, the amplified potentials are passed to a Kerr cell, and it is this device on which the success of the system mainly depends. It is a small glass cell containing nitrobenzine into which two small plates are introduced forming a condenser with nitrobenzol as dielectric. The two plates are set up so that a beam of light can pass right through the cell, traversing that part of the dielectric immediately between them. A pencil of light linearly polarised by a Nicol prism is passed between the plates, and the effect of applying a potential across the cell is to rotate the plane of polarisation. Simply explained, a source of light may be viewed through a pair of Nicol prisms say, conveniently arranged at either end of a small tubular brass mount. Light can only pass through when one prism is rotated to a particular position with regard to the other. If, now, the Kerr cell is interposed between the two prisms and a constant potential applied across its plates, light will only pass through the prism cell and prism if one of the prisms is rotated to take up a particular position with regard to the other. If the potential is now taken off the cell the prisms appear to



At the receiver the amplified potentials are fed to a Kerr cell interposed in a beam of light, focussed upon a revolving cylinder carrying a sensitised wrapping.

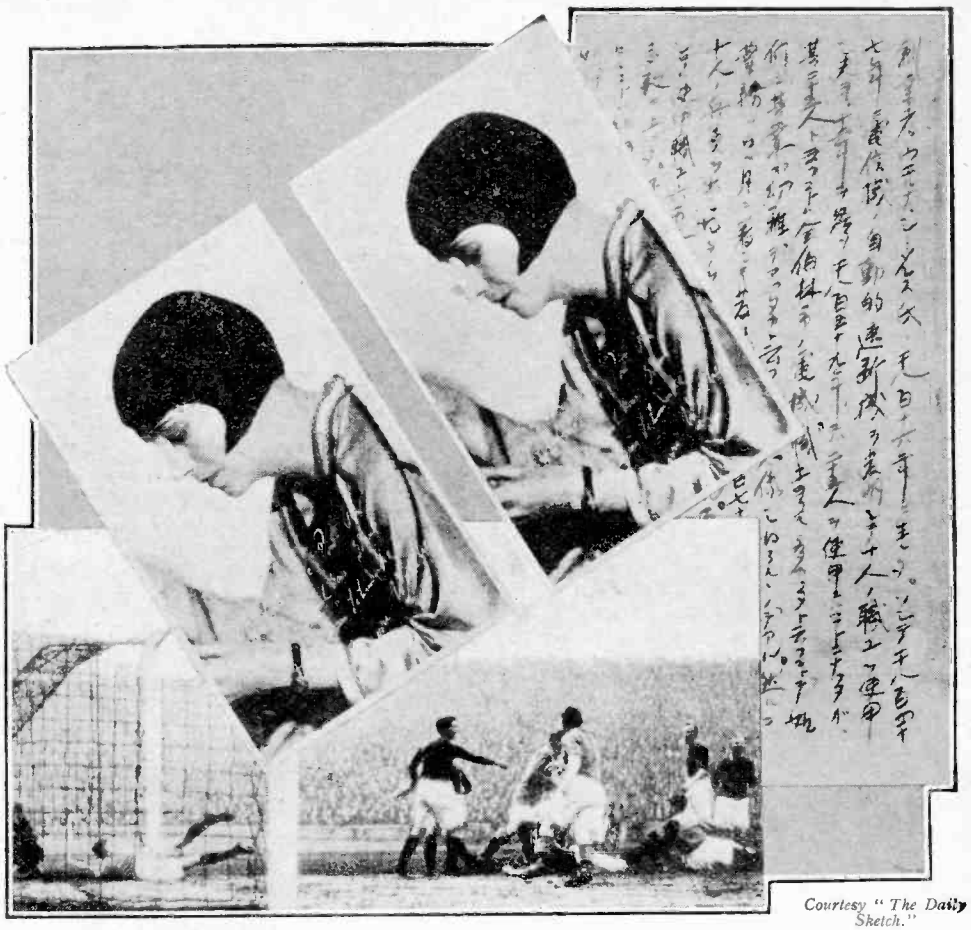


A set of apparatus with control board and outgoing line equipment. The standard equipment includes a valve voltmeter.

Phototelegraphy.—

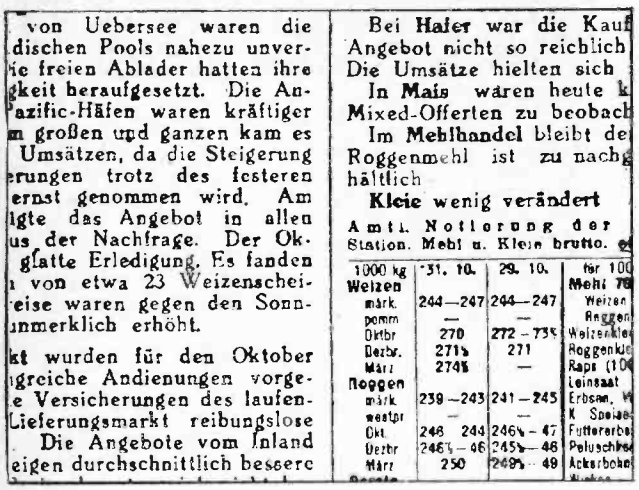
become opaque to light unless one is slightly re-adjusted by rotating it. It is thus obvious that the cell interposed in the polarised pencil of light acts like an electrically-operated shutter and depending upon the original adjustment of the Nicol prisms can be made to pass or obstruct the light when a potential is applied across the plates of the Kerr cell. The effect on the pencil of light by way of either reducing or increasing its luminosity on passing through the Nicol prisms (depending on whether a positive or negative image is required) varies with the potential difference applied between the plates of the cell. Varying shades of half-tone are thus obtained after passing through the Nicol prisms and Kerr cell, the light falling upon a cylinder covered with sensitive film or paper where it reconstructs the original picture.

The synchronisation between transmitting and receiving cylinders is independent of the transmission of a synchronising frequency or controlling impulses between the two instruments such is as sometimes adopted. Such synchronising signals are either interposed in the "picture signals" after each rotation of the cylinders, sent over a separate circuit or superimposed by the use of dual transmission on a common circuit. Although the transmission of synchronising signals effectively holds the transmitting and receiving machines in step, it brings about a reduction in speed of transmission as well as calling for the use of special relays. In the Karolus system synchronising is obtained solely by the aid of tuning forks fitted to the transmitter and receivers, for several sets can, of course, be arranged to receive simultaneously.



Courtesy "The Daily Sketch."

These pictures were transmitted over the telegraph circuits between Berlin and Vienna. The perfection of the results can be gauged by comparing the above original and transmitter portraits, the latter being on the right. Chinese characters which, of course, cannot be transmitted by Morse code can be sent successfully by this system.



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1000 kg	31. 10.	29. 10.	für 100
Weizen			Mehl 78
märk.	244—247	244—247	Weizen
pomm.	—	—	Roggen
Oktbr	270	272—73¾	Weizenkle
Dezbr.	271¾	271	Roggenkl
März	274¾	—	Raps (10
Roggen			Leinsaat
märk.	239—243	241—245	Erbsen,
westpr.	—	—	K. Speise
Okt.	244 244	246¼—47	Futtererbs
Dezbr	246¼—46	245¾—46	Peluschke
März	250	248¾—49	Ackerbohn

It is sometimes quicker and certainly more accurate to transmit tabulated figures by phototelegraphy. This "line" illustration was made from a "half-tone" image transmitted on the Berlin-Vienna circuit.

Valve-maintained Tuning Forks

The forks are maintained in vibration by means of valves, the action being that a potential set up by the prong of a fork moving in a magnetic field near a coil of wire is applied to the grid of the valve, while another coil is energised by the fluctuating anode current and maintains the fork in motion. A variable condenser connected across either of these coils serves also to slightly modify the frequency so that a critical adjustment is conveniently possible. Temperature changes which would, of course, produce an appreciable change in frequency, are avoided by the use of a thermostat.

Phototelegraphy.—

The valve maintained tuning forks at transmitting and receiving sets provide an alternating current of fixed frequency which is amplified and used for controlling alternating current synchronous motors. In itself a small synchronous motor does not provide sufficient power for operating the apparatus, and it is, therefore, directly coupled by a common shaft to a D.C. motor. Should the D.C. motor run slightly too fast, the A.C. motor acts as a generator, and inasmuch as the power generated is absorbed by the amplifying valve of the tuning fork, a breaking effect results. On the other hand, the A.C. motor can absorb power from the amplifying valve and thus speed up the D.C. motor should the latter be set to a too low running adjustment.

Coupled to the shaft of the D.C. motor is a white card disc carrying a number of black lines. This disc is illuminated by a neon lamp bridging the A.C. output of the valve-operated tuning fork. When the motor is running correctly in step with the A.C. supply and illuminated by the fluctuating light from the neon lamp, the markings on the disc appear to be stationary. This stroboscopic method of checking motor speed gives an immediate visual indication of any error in synchronising should it arise. When once set, however, adjustment remains constant for a prolonged period.

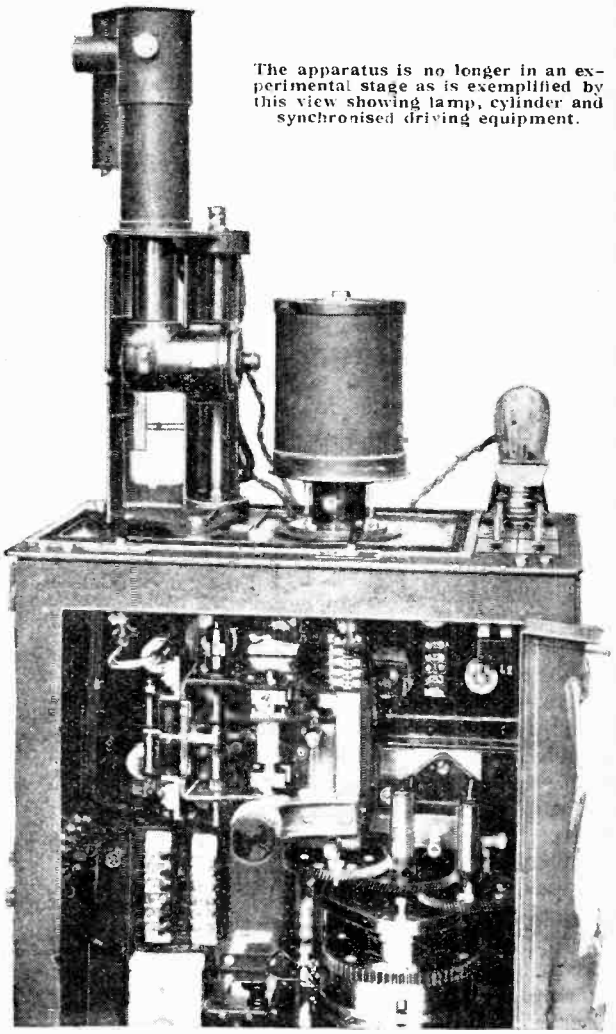
Transmitting a Picture in 15 Seconds.

Not only must the transmitting and receiving cylinders revolve at the same speed, but must also take up similar positions in rotation, or otherwise a picture would be formed across the join in the sensitised paper at a receiver. The correct position is indicated by the sending out automatically from the transmitter of what might be called a "phasing signal," prior to the scanning of the picture. A small neon lamp rotates on the cylinder at the receiver and flashes with the phasing signal, and it is only necessary to momentarily arrest the cylinder so that flashing occurs against a fixed mark. In addition, this neon lamp phasing signal checks synchrony, for should the glow move a little to one side or the other the tuning fork will need slight readjustment by means of the variable condenser. It is understood that such readjustment is scarcely necessary more than once a day.

Precise synchronising can be effected by even more accurate means, for the actual tuning fork A.C. can be sent out and applied to the neon lamp of the stroboscope, so that the disc with its lines, which is driven by the motor of the receiver, may be periodically illuminated by the alternating potentials of the transmitter. Slight adjustment of the variable condenser is made until the disc is seemingly motionless.

Five different speeds of rotation of the cylinder are obtainable, and the actual time taken to transmit a picture 10 × 10 cms. can be arranged to be 4, 2, 1, $\frac{1}{2}$ or $\frac{1}{4}$ minutes. The maximum size of pictures which can be accommodated is 18 × 26 cms.

It is interesting to note that each equipment is fitted with a valve voltmeter and immediate readings can be taken of the outgoing potential of a transmitter, its percentage modulation as well as the peak potential fed to the Kerr cell. It should be noted in connection with the Karolus system, that one of its most important features is that light and shade is obtained by a continuous variation of the amount of light falling upon the sensitive paper, as compared with other systems where light and shade is produced by an assemblage of a varying number of points per unit of area. There are no moving parts operated by the picture signals, so that the apparatus acts without inertia, the speed of transmission depending entirely upon the electrical properties of the link between transmitting and receiving stations. In addition, the picture to be transmitted requires no special preparation, while successful tuning-fork synchronising avoids the wasted transmission of synchronising signals.



The apparatus is no longer in an experimental stage as is exemplified by this view showing lamp, cylinder and synchronised driving equipment.

Arrangements have already been entered into for installing transmitting and receiving gear in the London and provincial offices of certain of our daily newspapers, and it is not anticipated that operating or maintenance difficulties will arise in conducting a commercial service. Wire and wireless transmitted pictures received from distant parts and relayed between local centres will bear no mark revealing the processes to which they have been subjected, and any suggestion of novelty must of necessity disappear for the system to be a success.

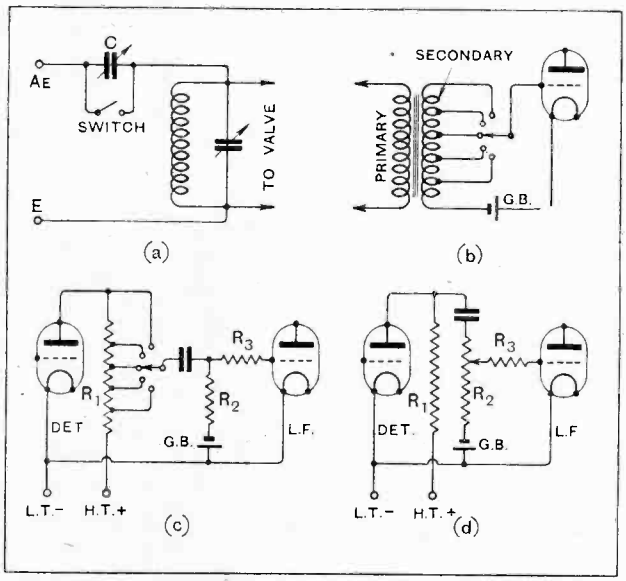
F. H. H.

VOLUME CONTROL.

Methods of Reducing Signal Intensity.

By "RADIOPHARE."

PERHAPS it may seem a little inconsistent that so much time should be devoted, on the one hand, to increasing the sensitivity of wireless receivers, while, on the other, a good deal of thought is applied to the devising of methods whereby a considerable proportion of the amplification so hardly won may be thrown away. In this matter, however, the wireless designer can make out a good case for himself; it is a fact that some form of volume control is necessary for every receiver unless it is known definitely that the set is to be used under conditions where it cannot be overloaded by signals from the nearest station. Even this exception is not a perfectly valid one, for such a set will not be really satisfactory, as clearly it cannot have any "margin of safety." The need for volume control will be obvious if we realise that the H.F. voltage due to a powerful station which is developed across a tuned aerial coil may amount to some 5 or 6 volts at three or four miles, while a distant station may produce but a few hundredths of a volt in the same position. Now, in the absence of interference, it is possible for both distant and local stations to give good loud-speaker reception, but clearly the amount of overall magnification which must be applied to each signal will be widely different. Volume control is, after all, nothing more than a method of reducing amplification.



Volume control connections. In circuits (c) and (d) anode resistance, grid leak, and damping resistance are lettered respectively R_1, R_2, R_3.

Let us first consider some of the incorrect methods which are often adopted with a view to preventing overloading. Dimming the filaments of all the valves is definitely wrong; by doing this the proportional frequency amplification of the L.F. amplifier is generally changed, due to an increase of valve impedance, and at the same time the working straight part of the output valve characteristic is reduced, almost invariably out of proportion to the reduction in signal input. The insertion of a variable resistance in one of the tuned circuits is also open to serious objection, as selectivity will be reduced; if we are in the immediate vicinity of one station and remote from any other, this does not matter, but nowadays one should budget for the future, and, assuming the early inauguration of the "regional" scheme—perhaps rather a rash assumption—anything which tends to impair selectivity cannot be tolerated.

The connection of a variable resistance across the loud-speaker windings amounts really to tackling the problem at the wrong end; however, it cannot be denied that it is convenient, and it is certainly helpful when but a small reduction is required. Generally speaking, it is best to apply a volume control to the detector output, or, even better, before its input.

Detuning is liable to introduce interference troubles and also distortion, although this latter will only be produced if one of the circuits is detuned by a few kilocycles; the rule here is that the detuning must be thorough if it is to be unobjectionable.

We now come to more satisfactory methods. In the pre-detection category we have the control of H.F. filament brilliancy (which must not be confused with the dimming of all filaments, which has already been deprecated). It provides a convenient and continuous regulation of volume, except in the "wipe out" area surrounding a transmitting station. It is clearly not applicable to detector-L.F. sets; for these the method shown at (*a*) in the accompanying diagram is recommended. A small variable capacity, C, with a low minimum (a neutralising condenser will do) is joined in series with the aerial, with a switch for short-circuiting it when full volume is required. Alternatively, a separate aerial terminal or socket may be fitted. When the condenser is set at a low value intensity is considerably reduced, but the arrangement is not of much value when incoming signals are so strong—or the receiver so sensitive—that the energy picked up by coils and wiring is sufficient, after amplification, to produce overloading.

Post-detection methods are shown at (*b*), (*c*), and (*d*). For (*b*) a first-stage transformer with some four or five tappings is required, a switch being connected so that a chosen proportion of the total voltage developed across the winding may be applied to the first L.F. grid. As an alternative in a transformer-coupled amplifier, a variable resistance of high value may be connected across the secondary, but this plan should be adopted only when it is included in the design. The well-known "anode potentiometer" device, as applied to a resistance amplifier, is shown in diagram (*c*); its action is essentially the same as that of the tapped transformer. The grid potentiometer (*d*) operates on the same principle, its application being restricted only by the limited number of suitable high-resistance potentiometers on the market.

SMOOTH REACTION CONTROL

The Design of Receivers Without High-frequency Amplification.

By A. P. CASTELLAIN, B.Sc., A.C.G.I., D.I.C.

THE problem of the design of a receiving set *not* employing high-frequency stages, from the point of view of equal ease of control using any length or type of aerial, is one which appears to have received much less attention than it deserves, especially in view of the popularity of such receivers.

Receivers employing correctly designed efficient H.F. stages are practically independent of the type of aerial employed as regards their stability and ease of control, and therefore will not be considered in this article. A very large number of stations may be received to-day with a single-valve receiver on headphones, and should two stages of L.F. amplification be added a loud-speaker can be satisfactorily worked provided an outdoor aerial is used. In most cases a condenser is used for reaction control with some form of fixed reaction coil, and so long as it is possible to oscillate over the whole range of the main tuning condenser the set is usually considered satisfactory.

Erratic Reaction Control.

However, cases have arisen where a set of this type, while perfectly satisfactory on one aerial, will refuse to oscillate over the whole of its range with another aerial, even when the latter aerial is known to have insulation beyond suspicion. In such cases the second aerial is also usually more efficient than the first for wavelengths over which reaction control can be obtained.

Another thing which may happen is that two exactly similar sets on two different aerials will be totally different in their ease of control—one may require a small but steady increase of reaction capacity with increase of wavelength, while the other may require only a small variation of reaction over part of its wavelength scale but a large and rapid variation over the rest of its scale, although being able to oscillate all over the scale.

The effects above described are obviously in some way due to the aerial system, and it would be decidedly advantageous to find some simple solution of this difficulty. In order to investigate the problem a single-valve receiver was built on the lines of the Three-valve Radio Gramophone receiver recently described by the writer.

The circuit of the single-valve receiver is given in Fig. 1. L_1 is the grid coil tuned by C_1; L_2 is the reaction coil, with C_2 the reaction condenser and L_3 the aerial coupling coil. The only substantial difference between this receiver and the corresponding part of the Radio Gramophone set is the size of the reaction condenser C_2, which was of smaller total capacity in the case of the single-valve set. This difference was only made as the writer happened to have the smaller condenser available, and the only difference that will be made due to its use is that the variation of reaction will be over a larger number of degrees on the smaller condenser.

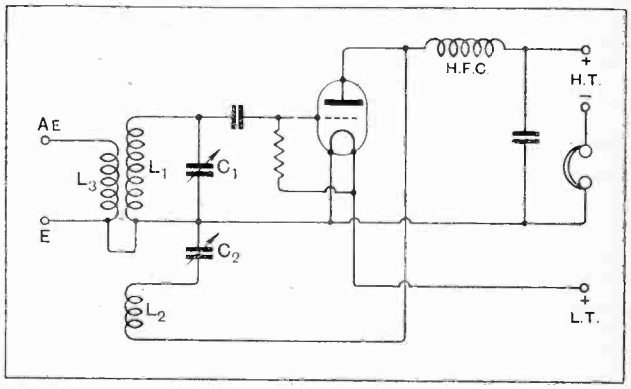


Fig. 1.—The circuit arrangement of the single valve receiver used in obtaining the curves shown in this article.

Design of Coils.

The particular arrangement of the coils L_1, L_2 and L_3 used for the Radio Gramophone receiver is shown in Fig. 2, and was arrived at after experimenting to find the best arrangement for constant or nearly constant reaction setting over the whole wavelength range (230-510 metres approx.) of the receiver. The various points that must be considered in the design of such a set will be dealt with in order. Firstly, to obtain as large a wavelength range as possible with a given coil, it is necessary to obtain as large a variation of tuning capacity as possible. If the aerial is connected to the grid end of the coil so that the aerial-earth capacity is in parallel with it, the minimum capacity across the coil con-

Smooth Reaction Control.—

sists of the aerial capacity plus the minimum capacity of the tuning condenser plus the strays due to the valve and wiring and the self-capacity of the coil, totalling probably between 300 and 400 micro-microfarads. The maximum capacity across the coil will be the above capacity plus the difference between the maximum and minimum capacities of the tuning condenser, say, about 450 micro-microfarads for a usual case.

The capacity ratio is thus about $\frac{450 + 350}{350}$, or just over 2 : 1, giving a wavelength range of about $1\frac{1}{2}$: 1 (*i.e.*, the maximum wavelength is about $1\frac{1}{2}$ times the minimum). The wavelength range may be increased by reducing the effective aerial capacity, the maximum range being obtained when the latter is reduced to zero. If this reduction be obtained entirely by the use of a small series condenser a definite limit will be found to the amount advisable owing to serious loss of signal strength when very small series condensers are used. On the other hand, if the aerial is coupled by means of a coil so constructed and positioned that the coupling is entirely electro-magnetic, then the wavelength range will still be as large as possible and signal strength not reduced.

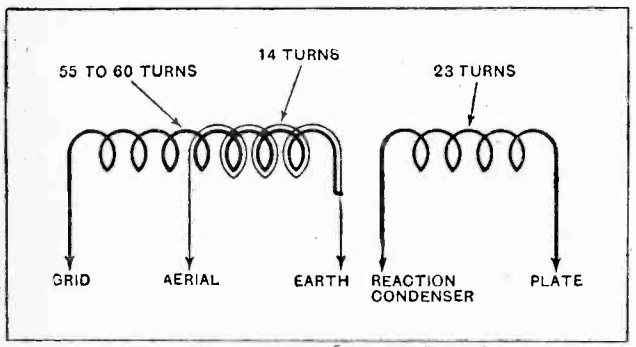


Fig. 2.—Details of the coils which are supported on a 3in. "Becol" former.

A spaced coil of fine wire, as used in the Everyman Four and the Radio Gramophone receivers, comes very close indeed to this ideal, the residual capacity between the coils being very small indeed.

Other advantages besides increase of wavelength range are obtained with a loose coupled aerial, namely, that the setting of the *tuning* condenser for any given station is practically independent of the length or type of aerial used, and also that the receiver is very much more selective than one with a direct-coupled aerial.

So much for the type of aerial coupling. The next point to consider is the design of the main tuning, or grid, coil. For good selectivity when reaction is *not* pushed to the absolute limit, it is essential to obtain a low resistance tuning circuit. This point has been clearly shown by the writer in a recent article.[1]

The use of a loose coupled aerial circuit reduces the damping of the closed circuit L_1 C_1 (see Fig. 1) due to the aerial resistance quite appreciably, but there still remains the possibility of damping due to the presence of the reaction coil L_2 in close proximity to the coil L_1, and also the damping due to the detector valve. As will be seen later, the reaction coil L_2 consists of few turns of wire, and its damping effect may be considered practically negligible with the type of construction adopted. There remains the damping due to the valve. It is obviously not worth going to the trouble of constructing a very low-loss circuit for L_1 C_1 if considerable losses are going to be introduced by the valve.

If the valve is used as an anode bend rectifier, then its loading effect on the circuit will be negligible on the waveband considered (above 200 metres), provided that the grid bias is greater than the peak signal voltage.

If the valve is used as a grid leak detector then there will be a definite loading effect due to the valve, the percentage loading varying with the actual signal voltage, *decreasing* with increase of signal voltage for normal values of the latter.[2]

Leaky Grid Detection and Loading.

The same valve will, however, give very much greater sensitivity when used as a grid leak detector, and this increase of sensitivity in a large number of cases more than compensates for the loss due to the loading. Further, although increased sensitivity may be obtained with anode bend rectification by using a valve of high amplification factor, yet it will be found necessary to use much higher H.T. values for the latter, which, again, may constitute another disadvantage.

It is possible to obtain a very high degree of sensitivity with no loading by the use of a four-electrode valve as an anode bend detector on low H.T. values, but this is not considered quite relevant to the present problem, and will be discussed in a future article. The valve, therefore, will be used as a grid leak detector, so that it will not be necessary to go to the refinement of using Litz wire for the grid coil or for keeping accurately to the shape theoretically necessary for the lowest high-frequency resistance. However, since quite a large proportion of the H.F. resistance of a circuit can be caused by the turns of the coil being very close together, it will be as well to space the turns, especially as a ribbed type of former (such as the Becol or Colvern) enables this to be done quite easily, the point being that, although it is not necessary in this case to go to the limit in reducing H.F. resistance, yet the latter should be kept as low as possible consistent with ease and cheapness of construction.

A usual and suitable diameter of former is 3in., which gives a grid coil of 54-60 turns spaced approximately 18 to the inch. A suitable aerial coil will have 10-15 turns of fine gauge wire wound on $\frac{1}{8}$in. separators. This coil must be wound over the low potential or "earthy" end of the grid coil, and the turns may have any convenient spacing which does not crowd the wire. The coil may be tapped so as to reduce the aerial coupling if desired.

In describing the Radio Gramophone Receiver, already referred to, the writer discussed at some length the various types of reaction which might be employed, showing

[1] *The Wireless World*, December 7th, 1927.

[2] Anode Bend or Grid Rectification? *The Wireless World*. February 22nd, 1928.

Smooth Reaction Control.—

finally that capacity reaction with a small fixed reaction coil and a comparatively large reaction condenser is preferable for ease of control to almost any other form where a large wavelength range is required to be covered with one set of coils.

The actual reaction coil consists of 23 turns of wire spaced similarly to the grid coil, and commencing at a distance of about $\frac{1}{4}$in. to $\frac{3}{8}$in. from the latter, as shown in Fig. 2.

To show whether the design is suitable, *i.e.*, that it does give either a constant setting or a uniform change of reaction over the whole waveband covered with the main tuning condenser, the curve No. 1 in Fig. 3 was plotted. This shows the setting of the reaction condenser required for oscillation just to commence. In order to show up irregularities as far as possible, a P.M.2 valve with 16 volts H.T. was chosen. (If readers carry out this experiment it should be done in the morning or at such other times as will cause least interference.)

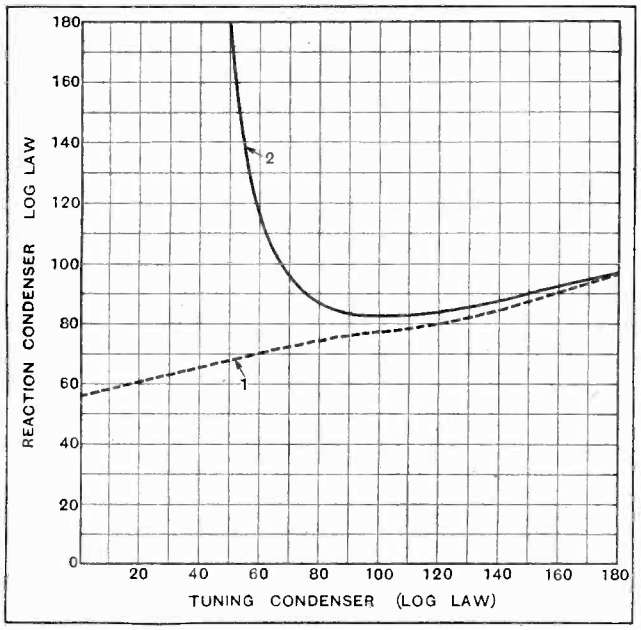


Fig. 3.—Curves showing reaction setting required just to oscillate (1) with no aerial, (2) with a high-capacity aerial.

Curve (1) in Fig. 3 is taken for the set without any aerial connected, and it shows that the reaction control involves a uniform change. The curve obtained with the writer's normal aerial had a very slight droop at the longer wavelengths, tending to make reaction more constant.

On connecting the receiver to a fairly long high-capacity aerial (within the P.M.G. limit), the interesting curve No. (2), Fig. 3, was obtained. This shows that the receiver will not oscillate at the bottom end of the tuning condenser scale.

Since curve (1) shows that this is not due to the inability of the set to oscillate at all at these wavelengths, it follows that the load due to the aerial must here have very seriously increased. The explanation which at once occurs to the mind is that the aerial system is resonating somewhere in these lower wavelengths, and due to this the load imposed on the valve is so much that it cannot oscillate with the H.T. supply available.

In order that no interference with reaction control may be experienced due to aerial circuit absorption, the latter must be made to resonate either well above or well below the waveband covered by the tuned grid circuit, or any resonance must be very highly damped. The aerial system consists of aerial and earth and the aerial coupling coil. If the aerial is to resonate at a wavelength above the maximum of the grid circuit, then its inductance or its capacity, or both, must be increased. The total inductance in the aerial circuit is quite small, so that it will probably be more convenient to increase the inductance by inserting a coil L_x in the aerial lead as shown in Fig. 4 (*a*) rather than to increase the capacity by shunting L_3 with a very large condenser.

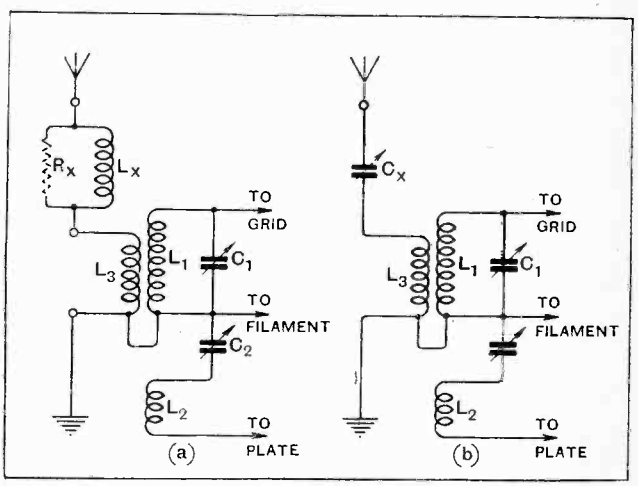


Fig. 4.—(a) Loading inductance L_x and (b) series capacity C_x have been added to obtain curves shown in figures 5, 6 and 7.

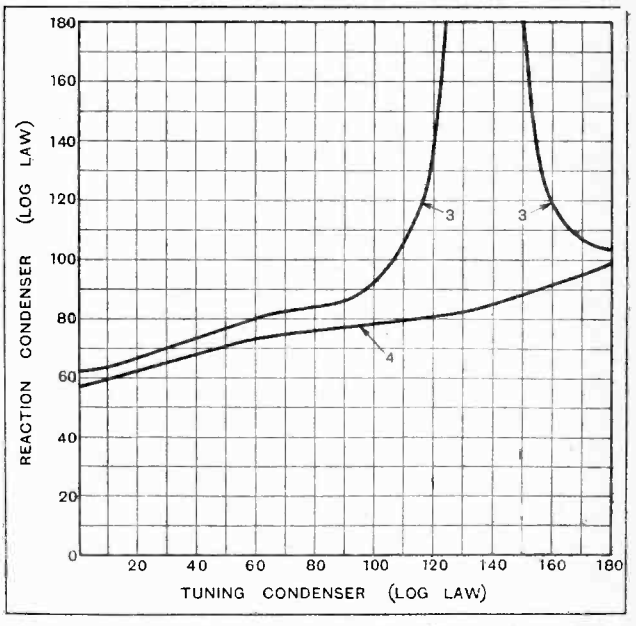


Fig. 5.—Curves showing reaction setting required just to oscillate with the high-capacity aerial and a loading inductance L_x of (3) 200 microhenries (4) 2,500 microhenries.

Smooth Reaction Control.—

In Figs. 5 and 6 are shown three curves for three different added inductances, curve (3) being for 200 microhenries, curve (4) for 2,500 microhenries, and curve (5) for about 300 microhenries in series with the aerial.

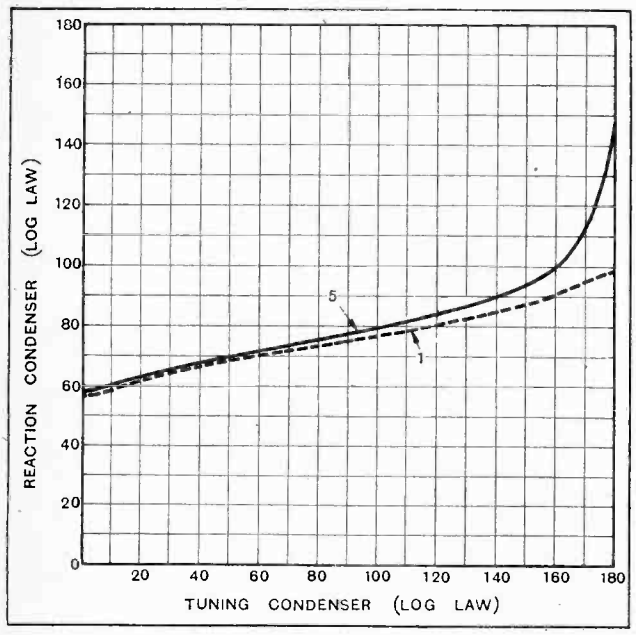


Fig. 6.—Curves similar to those in Fig. 5, but with L_x of 300 microhenries (5). Curve 1 with no aerial is shown for comparison.

While curve (2) for the aerial alone showed a resonance about 40° of the tuning condenser, curve (3) shows a very decided resonance at about 140°, while curve (5) shows a resonance just above 180°, but not sufficiently above to prevent interference with the reaction control. It would appear that about 500 microhenries would be sufficient. When a large inductance is used, sufficient to give resonance well off the scale, as is shown in Fig. 4, then the reaction control becomes uniform again.

Unfortunately, however, as might be expected, the addition of large loading inductances in the aerial circuit will cut down the signal strength quite considerably. This may be minimised by connecting a resistance across the loading inductance, as shown in Fig. 4 (*a*) by R_x, and a comparatively small coil, such as is used in curve (5) may be used with a damping resistance which will tend to make the reaction control more uniform. However, as will be seen later, this is not the best connection to use on wavelengths above 200 metres, but the curves shown are interesting from the point of view of *short-wave* receiver design, where the aerial naturally resonates (if of normal size) above the waveband it is desired to receive.

If the aerial is to resonate below the reception waveband, then its inductance or capacity must be decreased. The only convenient way of reducing the inductance of the aerial system is by reducing the number of turns in the aerial coupling coil, and if this is reduced too much a serious reduction in signal strength will result.

The capacity may be reduced by including a series condenser in the aerial lead, C_x, as shown in Fig. 4 (*b*).

In Fig. (7) are shown two curves of reaction setting with two values of series capacity, C_x. Curve (7) shows the aerial with 200 micro-microfarads in series. This has reduced the main resonant point below the tuning condenser zero, but not sufficiently so to stop interference with the reaction control, while curve (6) shows that with 100 micro-microfarads in series the high capacity aerial will resonate well below the bottom of the scale leaving the reaction control as it is with no aerial.

Reduction in signal strength is quite small, even with 100 micro-microfarads in series with the aerial, and the addition of capacity in this way appears to offer the best solution to adapt the circuit described to any type of aerial within the P.M.G. limits.

A very convenient type of condenser to use for this purpose is one known as a "Pre-set" condenser, which is of about the same size as an ordinary fixed condenser, but has a screw arrangement for compressing the plates, thus varying the capacity. This condenser should be put in the aerial lead and adjusted until the reaction control at the lower end of the scale is reasonably uniform.

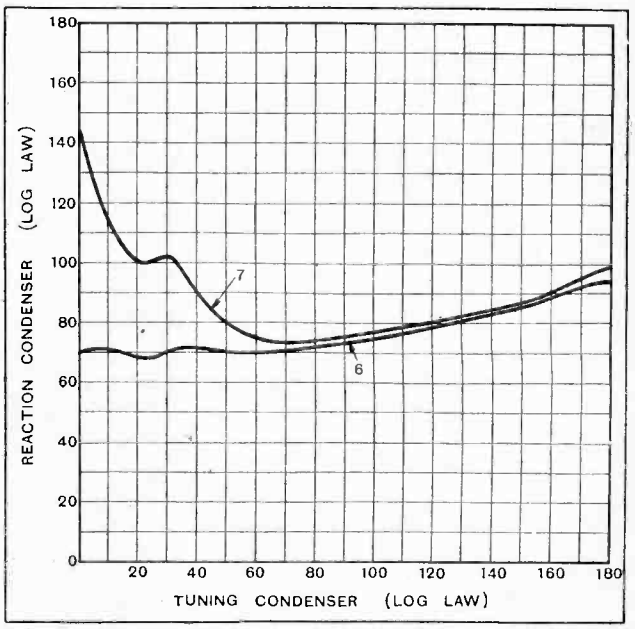
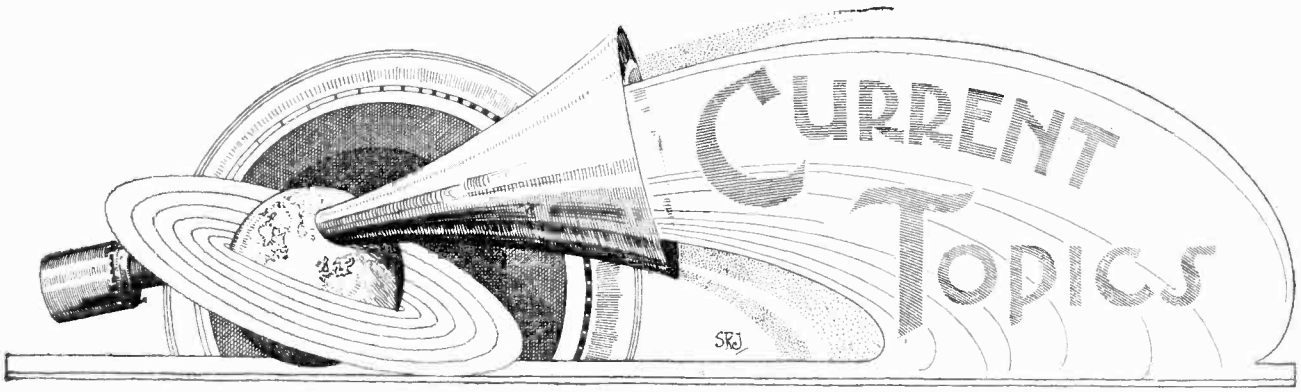


Fig. 7.—Reaction setting for receiver just to oscillate with the high-capacity aerial and a series condenser C_x of (6) 0.0001 mfd. and (7) 0.0002 mfd. capacity.

If any reader is having trouble with the reaction control of the three-valve Radio Gramophone Receiver, or of any reacting detector receiver in which the reaction control is intended to be uniform or "smooth," he is advised to insert either a 0.0001 mfd. or preferably an Igranic or Formodenser Pre-set condenser of *maximum* capacity about 0.00025 mfd. in his aerial lead, and adjust as above described.

A point that should not be forgotten is that a uniform reaction control leads to quick searching for stations with much less possibility of interference than with a set having an irregular reaction control, so that, even if the set will oscillate over its whole waveband, it is well worth while examining it to see if its control cannot be simplified on the lines which have been suggested in this article.



Events of the Week in Brief Review.

BRAVO, BALDOCK!

The wireless set recently installed in the Baldock Council School was constructed by the headmaster. The pupils built the cabinet and the cost of all materials was borne by parents and friends.

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ADVERTISING WIRELESS.

"Are You a Broadcast Listener?" This question is asked in a "slogan cancellation" now used by the Ceylon Post Office. A letter recently received by *Stamp Collecting* is postmarked with this query and the information: "License Rs. 10 per annum."

Here is an example which might be followed by our own Post Office.

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CLEARING THE AIRCRAFT WAVELENGTH.

Owing to serious congestion on the 900-metre wavelength allotted to aircraft, the Air Ministry has issued an instruction to pilots not to communicate with ground stations except in cases of necessity or when passing specified points.

It is no longer permissible to ask a ground station to check the wavelength of an aeroplane transmitter, arrangements having been made whereby any wavelength discrepancy will be automatically reported to the pilot by the nearest ground station. Another custom now forbidden is that of asking the time by wireless.

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REPORTS, PLEASE.

The kind co-operation of British short-wave enthusiasts is hoped for by the Danish wireless papers "Radiolytteren" and "Popular Radio," of Raadhusplads 55, Copenhagen V. A series of experimental transmissions is being made from their station 7RL, operating on 42.12 metres. The following is the present schedule:—

Sundays, 12.00 to 14.00.—Telephony and Morse course.

Mondays, 23.00 to 00.30.—Telegraphy.

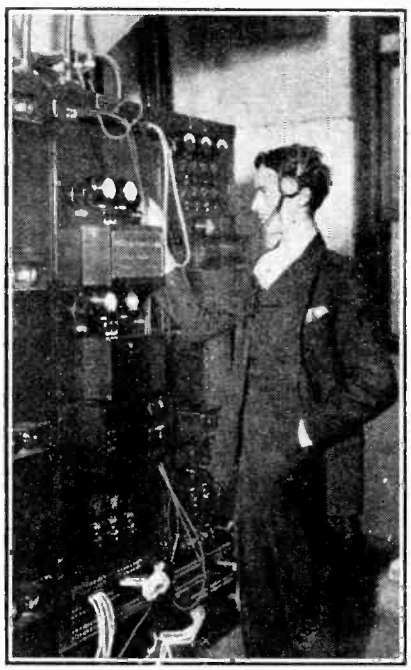
Tuesdays, 22.00 to 24.00.—Telephony and Morse course.

Fridays, 22.00 to 24.00.—Telegraphy.

The times given are G.M.T. Reports will be warmly welcomed at the above address.

LOUD-SPEAKERS IN YORK MINSTER.

Acoustical difficulties in York Minster have been overcome by the installation of a public address system. Seven loud-speakers have been erected, including one outside the Minster for the benefit of overflow congregations.



HOTEL WIRELESS. 2,200 rooms in the Pennsylvania Hotel, New York, are now equipped with broadcast receiving "points." The switchboard seen in the photograph distributes programmes throughout the rooms and also controls the transmission of programmes from the hotel.

KING AMANULLAH'S SUPER-HET.

His Majesty the King of Afghanistan has, after several tests, purchased a Marconiphone eight-valve super-heterodyne receiver with a gramophone pick-up and amplifier for the entertainment of his court. These instruments are now installed at Claridge's Hotel, and will eventually accompany him to Kabul.

LOOKING AHEAD.

The annual wireless *salon* of the French Manufacturers' and Traders' Union is to be held this year from October 25th to November 4th at the Grand Palais in Paris.

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OUR NORTHERN OFFICES.

Readers in the North of England may be interested to learn that the Northern offices of *The Wireless World*, *Experimental Wireless*, and their sister publications have been removed to 260, Deansgate, Manchester.

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PROFESSOR APPLETON ON SIGNAL FADING.

Professor E. V. Appleton, F.R.S., in his paper before the Wireless Section of the Institution of Electrical Engineers this evening (Wednesday) will deal with the study of signal fading and the work of the radio research station at Peterborough. Particulars of the meeting will be found under "Forthcoming Events."

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SHORT WAVES FROM AMERICA.

Short-wave transmissions are now being conducted by KDKA, Pittsburgh, on Mondays and Thursdays between 7 and 9 p.m. (G.M.T.) on a wavelength of 26.8 metres. Occasional tests are made on 21.3 and 26.3 metres.

2XAD, Schenectady, transmits on the same days and at the same times on a wavelength of 21.9 metres, while 2XAF, one of its sister stations, works on 32.79 metres at about 11 p.m. on Tuesdays, Wednesdays and Fridays.

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AIR-MASTERY: THE FINAL STROKE.

An "automatic radio set" which dispenses with ordinary tuning controls and permits any desired station to be heard by the pressing of a particular button, is about to be manufactured by the Zenith Radio Corporation of America.

Rather startling praise of the "new invention" comes from the lips of Commander E. F. McDonald, who, incidentally, is President of the Zenith Corporation. He says: "I believe that this

automatic is the greatest development since the advent of broadcasting"; and (quoting Rear-Admiral Fiske, of the U.S. Navy): "The last frontier of radio resistance will bow before this final stroke of air-mastery."

It is stated that the Zenith Corporation considers that the Automatic Radio Set is too important to be monopolised by one company and that it is prepared to issue licences to its competitors.

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ALTERATION IN COPENHAGEN TRANSMISSION.

A change in transmitting arrangements is reported to us by *Radioposten*, the Copenhagen wireless journal, whose short-wave broadcast programmes were referred to in our issue of March 21st. The new series of transmissions by 7MK is being carried out on a wavelength of 39.2 metres on Tuesdays and Fridays between 23.00 and 01.00 (G.M.T.). Reports will be warmly welcomed by *Radioposten*, 10, Snaregrade, Copenhagen, K.

WIRELESS AT WESTMINSTER.

(From Our Parliamentary Correspondent.)

Wireless matters received a considerable amount of attention in the House of Commons last week.

Interference by Trams.

Replying to Mr. Walter Baker, the Postmaster-General said that no effectual remedy had yet been found either in this country or in Germany for interference with broadcasting caused by trams working on the roller trolley system. Tramway authorities in various parts of the country, notably at Birmingham, Blackpool and Glasgow, were experimenting with various devices, but the experiments were not yet completed. The engineers of the British Broadcasting Corporation and of the Post Office were co-operating with the tramway authorities in an endeavour to find a remedy.

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Privacy of Beam Messages.

Asked by Sir H. Cowan whether his attention had been called to the possibility of tapping beam wireless messages from Australia, the Postmaster-General said he was aware that the Anglo-Australian Beam service, in common with other wireless services, had been criticised on the ground that it was liable to illicit interception. In practice, however, the beam services were worked at so high a speed that interception would only be possible by means of a complicated and expensive receiving apparatus requiring an expert operating staff. The risk of such illegal interception was for all practical purposes negligible.

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Wireless and Cable Rates.

Mr. Pilcher asked the Postmaster-General if he would state whether, and if so, what, reductions in cost of cable messages to India and South Africa had been conceded since the introduction of beam competition during the past year; and whether he could give an assurance that such reductions would not be annulled as a result of a cable-wireless merger or through other causes.

Sir William Mitchell-Thomson said: "A year ago the cable rates to India and South Africa were 1s. 8d. a word and 2s. a word respectively. The present rates to India are 1s. 5d. by cable and 1s. 1d. by beam; the rates to South Africa are 1s. 8d. by cable and 1s. 4d. by beam. Corresponding reductions have been made in the rates for deferred telegrams and letter telegrams.

"No statement can be made concerning future rates until the report of the Imperial Wireless and Cable Conference has been received and considered."

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Experiments with Wireless Beacons.

Sir Philip Cunliffe-Lister, in answer to Sir R. Thomas, said that the rotating loop direction-finding system had been developed by the Air Ministry as an aid to air navigation. The system had been investigated by the Department of Scientific and Industrial Research, and preliminary trials had been carried out in connection with marine navigation. The Board of Trade had considered the results of this investigation and were now examining, in conjunction with the Air Ministry and Trinity House, the question of establishing an experimental station of this type in a position where its utility, as an aid to shipping, could be fully explored. It was hoped to reach a decision on this question very shortly.

NEWS FROM THE CLUBS.

Institute of Wireless Technology.

"The Response of H.F. Circuits to Steady and Transient Modulation" is the title of a paper to be read this evening (Wednesday) by Mr. W. B. Medlam, B.Sc., at a meeting of the Institute of Wireless Technology at 7 o'clock at the Engineers' Club, Coventry Street, W.

Information respecting the objects and activities of the Institute may be obtained from the Hon. Secretary, at 71, Kingsway, London, W.C.2.

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A Competition Night.

The Bristol and District Radio Society held the last Friday evening meeting of the winter session on March 23rd with a "competition night." A splendid array of apparatus constructed by members was on view and a most interesting evening resulted. The apparatus was divided into three classes, viz., broadcast receivers, short-wave receivers and loud-speakers. The sets were judged by the members and the voting revealed the following as winners in the respective classes:—

Mr. J. L. Thomas (four-valve receiver).
Mr. A. E. Fry (two-valve short-wave receiver).
Mr. H. C. Blandford (exponential loud-speaker).

A lecture and demonstration entitled "6QW Bristol Calling" will be given this evening (Wednesday) at 7.30 o'clock at the Merchant Venturers' Technical College. The demonstration will include the actual transmitters used at this well-known station, and also demonstrations of high-power coil-drive reproduction.

Hon. secretary, Mr. S. J. Hurley, Arno's Vale, Bristol.

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The Development of the Cone.

Mr. R. F. G. Holness demonstrated at the last meeting of the Tottenham Wireless Society a cone loud-speaker fitted into a fire screen which acted as a baffle, the total cost working out at about a sovereign. In his lecture Mr. Holness dealt with the development of the cone type of loud-speaker, and described the three chief types, viz., the free-edge once, the fixed-edge cone, and the semi-free edge, the last-named type being, in his opinion, the most efficient.

Hon. secretary, Mr. F. E. R. Neale, 10, Bruce Grove, Tottenham, N.17.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 4th.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshments at 5.30). At the Institution Savoy Place, W.C.2. Lecture: "The Study of Signal Fading: The Work of the Radio Research Station at Peterborough," by Professor E. V. Appleton.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Monthly business meeting, followed by discussion on Summer programme.

Wigan and District Technical College Radio Society.—Annual general meeting and social evening.

Institute of Wireless Technology.—At 7 p.m. At the Engineers' Club, Coventry Street. Lecture: "The Response of H.F. Circuits to Steady and Transient Modulation," by Mr. W. B. Medlam, B.Sc.

Bristol and District Radio Society.—At 7.30 p.m. At the Merchant Venturers' Technical College. Lecture-demonstration: "6QW Bristol Calling."

South Croydon and District Radio Society.—At 8. p.m. At the Surrey Drovers' Hotel. Mystery night.

THURSDAY, APRIL 5th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way. Lecture and Demonstration: "Remote Control of Radio Receivers," by Mr. L. Hartley, B.Sc.

FRIDAY, APRIL 6th.

Leeds Radio Society.—At Leeds University. Annual general meeting.

South Manchester Radio Society.—At the Co-operative Hall, Wilmslow Road, Didsbury. Smoking concert.

A Convincing Demonstration.

An impressive demonstration of a moving-coil type loud-speaker was given at the meeting on March 23rd of the Radio Experimental Society of Manchester, held at the residence of the vice-president, Dr. Hodgson. In the opinion of the members present the demonstration was one of the most convincing ever heard. By means of a gramophone and electrical pick-up unit every kind of music was "on tap," and the meeting was able to experiment with various types of pick-up. Experiments were also made with different sizes of baffle board for the loud-speaker and in the variation of input energy. Four power valves were used in parallel, with 200 volts on the anodes.

Hon. secretary, Mr. R. M. Kay, B.Sc., 82, Daisy Bank Road, Victoria Park, Manchester.

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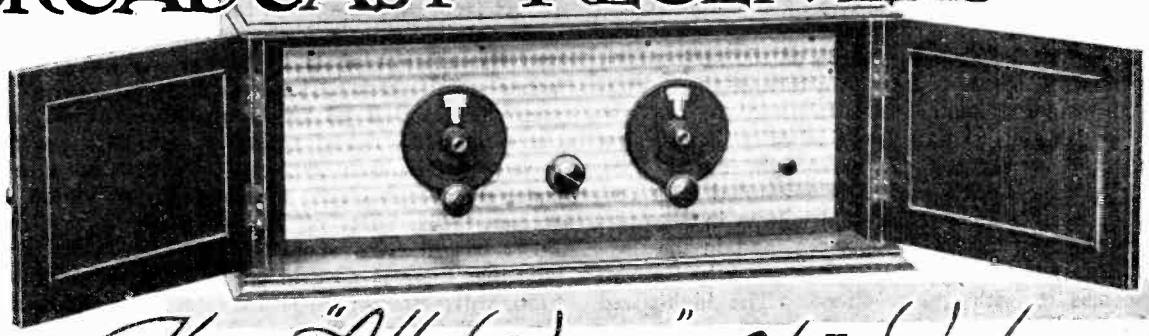
Transformer Coupling Explained.

"True Radio Reception" was the title of a lecture recently given before the Wigan and District Technical College Radio Society by Mr. Garside, of Messrs. Ferranti, Ltd. The lecturer, who gave a well-considered account of transformer-coupling and transformer construction, supported his statements with calculations based on actual curves obtained from tests. The lecture was accompanied by demonstrations with a five-valve transformer-coupled *Wireless World* set of excellent quality.

The committee has become increasingly aware that supplementary lectures are necessary to enable members to acquire the necessary familiarity with formulæ for an adequate appreciation of the somewhat mathematical expositions of lecturers. Steps are being taken to rectify the deficiency.

This evening (Wednesday) a social programme will be carried out. The membership list is still open, and prospective members—both ladies and gentlemen—are asked to communicate with the hon. secretary, Mr. M. M. Das, B.Sc., Library Street, Wigan.

BROADCAST RECEIVERS



The "All-Wave" 4/5 Valve Set

A Receiver Appealing Equally to the Broadcast Listener and the Short-wave Enthusiast

SHORT-WAVE reception, hitherto the exclusive province of the experimenter and transmitting enthusiast, is rapidly gaining in importance to the broadcast listener, and the time is not far distant when provision for short waves will be expected in any commercial broadcast set, just as Daventry and the long-wave stations are demanded as a matter of course today. Indeed, a glance through the list of short-wave transmissions published in the February 8th issue of this journal would persuade many people that the time has already arrived. It reveals the fact that, apart from innumerable stations testing on telephony, there are nearly forty broadcasting stations operating on wavelengths below 100 metres. True, many of these are more than 3,000 miles away, but the extraordinary properties of short waves quite upset one's ideas of distance as conceived on the 300-500 waveband.

From 19 to 2600 Metres.

The case of the "all-wave" set may also be advanced from the point of view of the short-wave enthusiast who does occasionally wish to hear some special item of broadcasting even at the risk of being classed as a "B.C.L." The possession of a separate set for broadcast reception would at once place him in this category, but with a single "all-wave" set coils can be inserted surreptitiously for the B.B.C. wavelengths on favourable occasions without his "ham" friends being any the wiser.

The set under review meets the needs of both classes of listener. It is made by the Short-Wave Communications Development Co., Ltd., Wickford, Essex, and each set is tested and personally approved by Mr. Gerald Marcuse, the well-known amateur. Accordingly, a high standard of performance is to be expected on the short waves, and special attention was given to this aspect in testing out the set.

The circuit has been developed along conventional lines and comprises three stages of resistance-capacity coupled L.F. amplification preceded by a detector with reaction. Provision is made in the output stage for two D.E.5 valves in parallel, and the loud-speaker is fed through a choke-filter circuit.

Three plug-in coils with fixed coupling are used for tuning, the first an "aperiodic" aerial coil, the second a tuned grid coil, and the third a capacity-fed reaction coil. With the exception of the single-turn aerial loop for the shortest wavelengths, Gambrell coils are used throughout. There are nine combinations of coils, giving the following measured wave ranges:—

Combination.	Aerial	Grid.	Reaction.	Metres.
1	Loop	A_3	a_3	19—62
2	Loop	a_2	a_2	48—125
3	a_3	a	a	68—185
4	a	A	A	90—240
5	A	B	A	156—475
6	A	C	B	265—660
7	B	D	C	280—1200
8	C	E	D	720—1850
9	D	F	E	1080—2600

It will be seen that there is overlapping between each band, so that there is no discontinuity over the range from 19 to 2,600 metres. If desired, a special set of loop coils may be purchased as an extra for wavelengths between 15 and 30 metres.

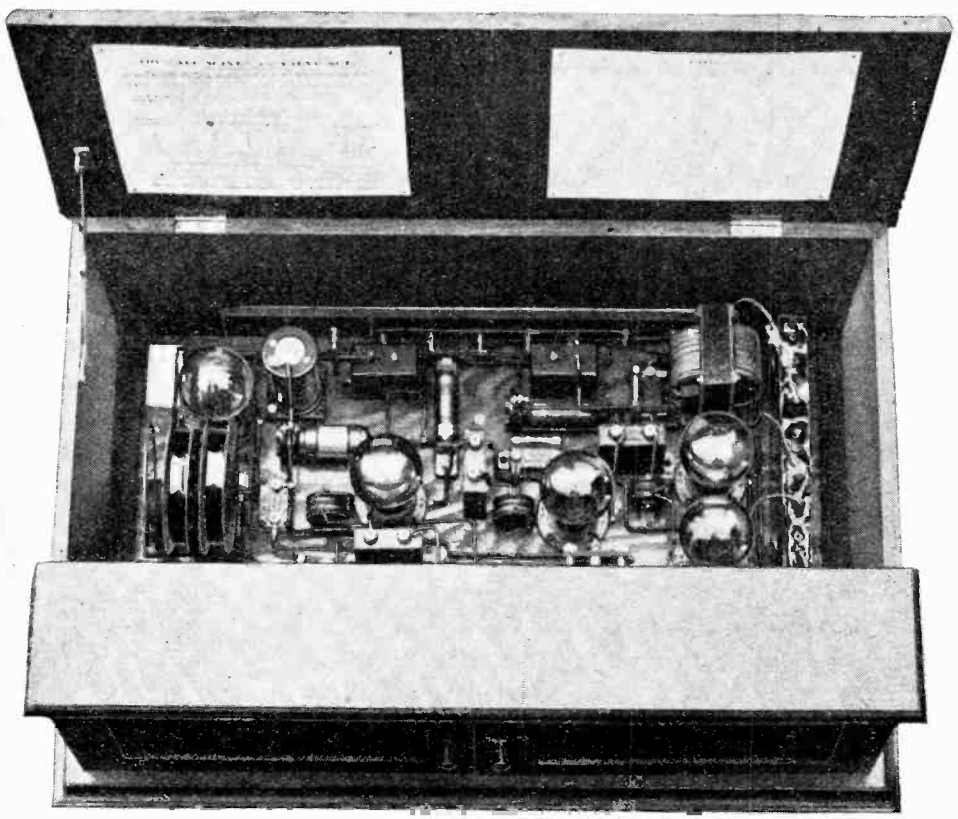
Performance on Short Waves.

So stable is the set on the 19-62 metre band that tuning is no more difficult than on the normal broadcast wavelengths. Hand capacity effects are negligible, thanks to the aluminium front panel, and the hand may be brought near to the loud-speaker leads without materially affecting the tuning. With the H.T. voltage to the detector valve properly adjusted, there is no "backlash" in the reaction control, neither is there any threshold howl above 24 metres. In the particular instrument tested, there was, however, a "blind spot" on about 23 metres, which could not be traced to spare tuning coils or any other objects lying near the set. Below this wavelength threshold howl was present to a certain extent, but from

Broadcast Receivers—The "All-Wave" 4/5 Valve Set.—

24 metres upwards the behaviour of the set was exemplary.

Prearranged tests were carried out with a well-known transmitting amateur whose 45-metre signals were copied with ease. The "45-metre" amateurs occupy about four degrees on this set between 80 and 84 on the tuning dial. This is equivalent to one-quarter of a turn of the "Indigraph" slow-motion knob, which turns in the opposite direction to the dial, so that some difficulty may at first be experienced in turning slowly enough, but a little practice soon enables stations to be separated with certainty. In the evening amateur transmitters in all parts of Europe can be logged by the dozen, and in the daytime telephony from PCJJ, FL, and some of the German stations comes in with great volume. The high-speed telegraphy from the various beam stations is another interesting feature of the lower wave-band. The Thursday



Interior of the "All-Wave" 4/5 Valve Set. Tuning coils for the 20–60-metre waveband are to be seen on the left, and the parallel D.E.5 output valves and choke filter circuit on the right, near the grid bias battery.

transmission between 7 p.m. and 9 p.m. from 2XAD, Schenectady, U.S.A., was successfully received on 21.96 metres, speech being clearly distinguishable. The "signing off" announcement with call-sign and wavelength was clearly heard word for word, but fading was bad during the previous musical items. The 11 p.m. transmission which followed from 2XAF on 32.7 metres was also received, though not so well as 2XAD, but reports from other sources confirm that the particular evening of these tests was by no means ideal for American reception.

On the higher wavelengths it is possible to judge the overall amplification of the L.F. stages by testing on well-known stations. While the amplification is in every way satisfactory, it is somewhat less than one would expect from three stages in the ordinary way. Evidently some amplification has been sacrificed to obtain stability, and the absence of H.F. in the L.F. stages on short waves would seem to justify this view. The first L.F. amplifier is a D.E.5B with an anode resistance of 100,000 ohms, and the second a D.E.5 with 50,000 ohms. In each grid circuit is connected a series resistance of the order of 20,000 ohms, wire-wound in a slotted ebonite former. The effect of this resistance is to reduce the H.F. passed from stage to stage. It is interesting to note that there is no grid condenser and leak in the detector valve circuit; the grid is returned through the tuned circuit direct to L.T.−. This method, although conducive to stability, is not so sensitive as leaky grid rectification, and its employment must result in some loss of signal strength. It is no use having signal strength, however, if the tuning is unmanageable, so this small sacrifice in the interest of stability is quite justified.

Quality of reproduction from the B.B.C. stations and PCJJ on the short waves is good. The volume obtainable is dependent on the H.T. voltage applied to the output stage, and is somewhat limited with the D.E.5 valves supplied. With 150 volts on the plate and a "2,000-ohm" loudspeaker, the increase in volume obtained with two D.E.5s in parallel does not in our opinion, justify the addition of 0.25 amp. to the normal filament current of 1.0 amp., and we found it more satisfactory to use a single D.E.5A or P.M.256 in the last stage. This is desirable only when receiving strong signals, and a single D.E.5 is better when receiving American telephony, on account of its higher amplification factor. Under these conditions the total anode current is only 10 mA., which permits the use of a large size dry-cell H.T. battery. A volume control is incorporated in the grid circuit of the first L.F. valve to prevent overloading. The cabinet is of unusually high quality and finish, and, with the mottled aluminium panel, gives the set an air of distinction.

The price is £22 10s. inclusive of a complete set of coils for 20 to 2,600 metres, but exclusive of valves and royalties.

B 22

News from All Quarters: By Our Special Correspondent.

Giving Away the "Effects."—National Concerts.—What of the Regional Scheme?—A Use for the Oscillator.—The Wireless "Season."

Where is the Illusion?

Surely the B.B.C. Dramatic Department makes a mistake in disclosing the crude mechanical details of "effects" which are to feature in a forthcoming play. The sole value of these artificial aids lies in their ability to produce an illusion; if we know how the "illusion" is manufactured it must to a large extent lose its point.

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Killing the Goose.

When I have it carefully explained to me that the noises I shall hear in the next radio play are only imitations of the real thing; that the car smash will involve nothing more serious than the clatteration of a few bits of lumber; that the thunder will be created by the resilient properties of a piece of pasteboard—I feel sorely tempted to retort with that overworked allegory concerning the goose that laid the golden eggs.

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Behind the Scenes.

No doubt it will be urged that the legitimate stage is bolstered up with all sorts of artificial devices which everyone accepts as "part of the game"; but we do not find theatrical managers explaining what goes on behind the curtain, or how the thunder and lightning are produced. We have shrewd notions regarding the methods employed, but we choose to forget their existence.

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Wasting Money.

It seems, then, a waste of listeners' money to collect old lumber for the production of "effects" if these are to be fully explained beforehand; the B.B.C. might just as well pay an announcer or professional "plane crash explainer" to make necessary interpolations at appropriate moments.

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How Many Weights?

Yet the listening public, prior to the broadcasting of "Speed" on Monday last, had already been informed that a plane crash would be represented by the dropping of weights on an aeroplane wing, and that it was hoped that this expedient would produce a faithful impression. Why bother about a faithful impression? Knowing so much about the affair, we should like to have been told how many weights were used, and how far they were dropped.

FUTURE FEATURES.

London and Daventry (5XX).

APRIL 8TH.—Matins from York Minster, with Address by the Lord Archbishop of York.
APRIL 9TH.—Military Band Programme.
APRIL 10TH.—Grand Hotel, Eastbourne, Orchestra.
APRIL 11TH.—"Lord Jim," a romantic radio story play, taken from the novel by Joseph Conrad, by Cecil Lewis.
APRIL 12TH.—Charlot's Hour.
APRIL 13TH.—National Concert relayed from the People's Palace.
APRIL 14TH.—Kingsway Hall Concert.

Daventry Experimental (5GB).

APRIL 8TH.—A Military Band Concert.
APRIL 9TH.—"Out of the Shadows," a psychic mystery play by David Hawkes.
APRIL 10TH.—A Ravel Programme.
APRIL 11TH. — Vaudeville Programme.
APRIL 12TH.—Opening Concert of the Season of the National Orchestra of Wales.
APRIL 13TH.—Variety Programme.
APRIL 14TH.—A Ballad Concert.

Cardiff.

APRIL 8TH.—"The Childhood of Christ," by Berlioz.

Manchester.

APRIL 14TH.—"The Wandering Microphonet," a fantastical entertainment.

Newcastle.

APRIL 12TH.—"No Song, No Supper."

Aberdeen.

APRIL 10TH.—Scottish Programme.
APRIL 12TH.—A Community Singing Concert.

Where Ignorance is Bliss.

The happiest people among listeners to the play were those who, being in blissful ignorance of the devices used, were able to take "Speed" as a play, and not as an experiment in sound jugglery.

If we must know what is up the conjurer's sleeve, would it not be a happier arrangement if the revelation were made *after* the performance?

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George Robey at 2LO.

George Robey, who makes an appearance before the microphone on April 7th with members of his company in "Bits and Pieces," has not hitherto achieved any great success as a broadcast artist.

His previous effort—I believe he broadcast from the Newcastle studio two years ago—brought home to listeners how much of the famous comedian's magic resides in those irrepressible eyebrows which the microphone was unable to accommodate.

On Saturday next George Robey will be accompanied by Marie Blanche, Robert Leighton and the Gypsy Quintette.

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Have the National Concerts Succeeded?

Now that only three more National Concerts remain to be given before the conclusion of the season, it is worth while reviewing the series. The main characteristic of the winter's programmes has been the predominance of British talent, in regard both to conductors and solo artists. I recall the appearance of only three foreign artists, viz., Madame Suggia, Godowsky and Szigeti.

I do not know whether to regard it as another indication that a prophet is not without honour save in his own country, but it is a fact that the attendance at these concerts has been somewhat disappointing. The same could be said of the first half of the previous season, when foreign talent monopolised the stage, but it will be remembered that towards the close of that season, when the concerts became better known, the attendances swelled considerably, and even the Albert Hall was filled.

A Reaction?

The lack of interest in the present series may have been due partly to a reaction after the extraordinary success of the "Proms," which filled the Queen's Hall every night for six weeks last autumn. (Incidentally, I hear that the next Promenade season will occupy eight weeks.) As regards the concerts at the People's Palace, Mile End Road, there seems little doubt that the audiences would have been larger if another night than Friday had been chosen. Many Jewish music-lovers who reside in the district have been debarred from attendance by the obligations of their Sabbath.

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The Music of Italy.

It is hardly surprising that the policy of relaying programmes by land line from the Continent is not being pursued at present. The amount of enthusiasm aroused among British listeners by the recent efforts was not great.

Of far more importance in the establishment of international understanding is the scheme formulated some time ago at Geneva, whereby the music of each European nation receives special attention on a given day, when all countries combine to set forth the musical achievements of one nation. Such a day will be Sunday, April 15th, when the countries of Europe will broadcast the music of Italy. The B.B.C. programmes on that date will include the works of Verdi, Puccini, Rossini and other Italian composers.

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Question and Answer.

A strange veil of silence seems to have been drawn over the regional scheme in recent weeks. On March 23rd, however, an interesting little question was put in the House of Commons by Dr. Shiel, who asked the Postmaster-General whether, seeing that plans for new high-power broadcasting stations in Scotland were ready, and that only the permission of the P.M.G.'s Department was necessary for a start to be made with the scheme, he would say if that permission was likely to be given at an early date?

Sir William Mitchell-Thomson said: "I have received no application from the British Broadcasting Corporation for permission to proceed with the erection of a new station in Scotland."

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The Nightingale.

The B.B.C. engineers are making their plans early this year for the capture of the elusive notes of the nightingale. It has been arranged that the bird will be cajoled into the programmes during the fortnight beginning May 16th.

De Groot Again.

Many listeners will rejoice in the news that Mr. de Groot, the famous violinist, who probably set the fashion in restaurant broadcasts, is to return to broadcasting. He will make his appearance before the microphone for a single performance on Saturday, April 28th, but I understand that this may be the forerunner of a series.

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A Use for the Oscillator.

Not an unfair indication of the rise and fall in the number of listeners is probably afforded by the volume of complaints received at Savoy Hill concerning oscillation. The peak figure was reached during the second week in February, when 330 grouses came in, but since then the figure has never dropped below 250, and is now remaining fairly constant.

AUSTRALIA CALLING. 4QG, the broadcasting station at Brisbane, Queensland. The aerial system is erected on the highest building in the city.

This tends to disprove the assertion recently made that the "wireless season" is over.

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The Perennial Pastime.

The steady improvement in broadcast programmes and the perfection of technique are, I believe, factors which are going to popularise listening all the year round. Last year showed less tendency to seasonal change compared with 1926, and with the growing importance of the portable set it really looks as if broadcasting may come to be regarded as always "in season." If it does, it will eclipse all other pastimes.

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Royal Broadcasters.

The Prince of Wales and the Duke of York are both down to broadcast again in the near future—the Prince from Cardiff and the Duke from Hull.

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Bravo, Kent!

In the matter of school wireless the county of Kent appears to be well ahead of other parts of the country. After a systematic investigation of school receiving sets in Kent, the B.B.C. engineers who specialise in this department of work have found that 75 per cent. of the Kentish schools have ideal reception, whereas in other parts of the country the percentage is nearer 25.

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"Bonnie Banchory."

With the idea of letting listeners actually share in a broadcast Aberdeen station recently arranged a community singing concert in Buckie, which was relayed for broadcast from Aberdeen. The very great interest taken in that concert amply justified the extension of the idea, and it has resulted in a similar concert being arranged, which will be relayed from the Town Hall of Banchory, "the Gateway of the Highlands," on April 12th. This will be the first appearance of the microphone in Banchory.

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"Lord Jim."

Cecil Lewis, who adapted Joseph Conrad's novel, "Lord Jim," for the microphone, tells me that the coming repeat performance on April 11th should be a still greater success than the performance of a year ago. Studio facilities for an elaborate work of this description are now much better, and radio-drama technique is benefited accordingly.

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Return of Reginald Foort.

Reginald Foort, whose organ music has not been heard by listeners since he relinquished his position at the New Gallery Kinema last year, will renew his acquaintance with listeners *via* the microphone on April 14th.

His performance will probably be relayed regularly on Saturdays from 6 to 6.30 p.m. from the Palladium, London.

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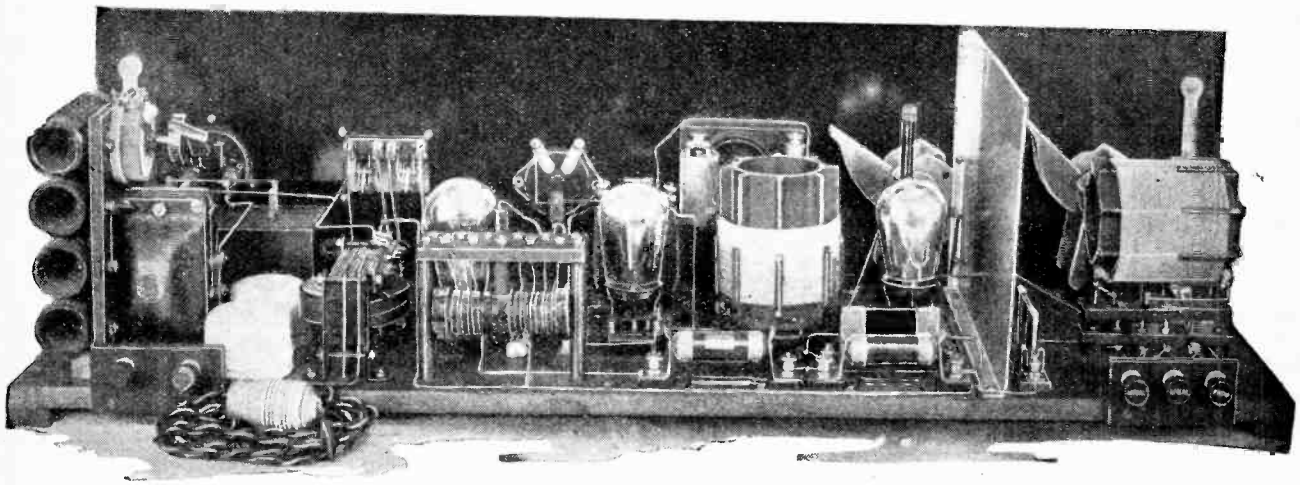
Sybil Thorndike in a Greek Play.

Miss Sybil Thorndike will be heard from 2LO on April 17th, when she is playing the name part in Euripides' "Medea," which is being performed in the studio. Sybil Thorndike is probably our greatest tragic actress at the present time.



D.C. MAINS THREE.

Notes on the Construction and Operation.

By H. B. DENT.

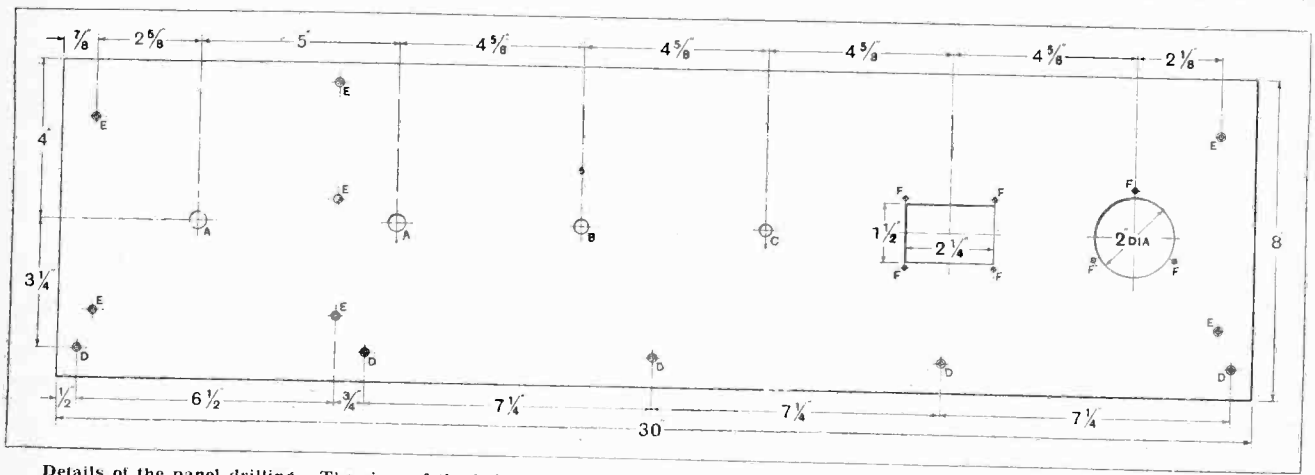
(*Concluded from page 331 of previous issue.*)

A MODERN receiver would be incomplete without some means of controlling the volume, and in the present case this can be achieved most conveniently by shunting the secondary of the L.F. transformer by a high-resistance potentiometer, the sliding contact being taken to the grid of the first low-frequency amplifying valve. To obviate loss in signal strength, a resistance of not less than one megohm is desirable, this must be silent in operation, and as it is not required to pass current a variable graphite type of resistance can be used, provided it is constant. In the present case the Igranic "Universal" high resistance model A was fitted. It has a total resistance of one megohm and is continuously variable.

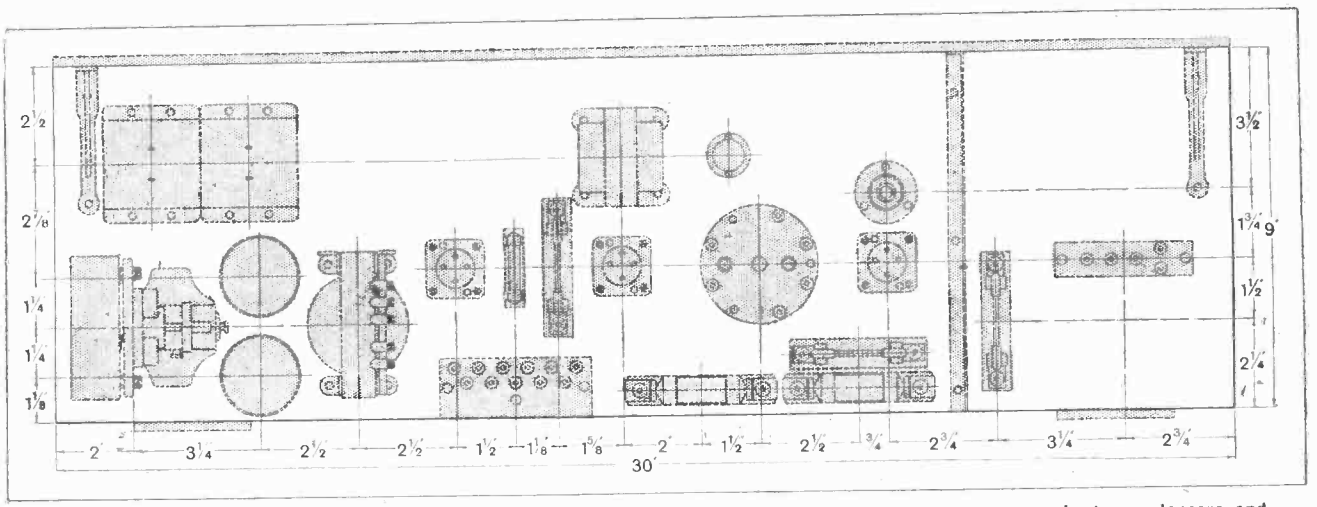
Assembly.

As far as practical considerations will allow, easily procurable components have been used, the only construction work of any intricacy is that of the coils, and even these should not present any insurmountable difficulties to the beginner with only limited workshop facilities.

The panel layout has been planned to be pleasing to the eye and at the same time the essential controls have been placed ready to the hand of the operator. A double-pole "on" and "off" switch is provided, which when in the "off" position completely isolates the supply mains from the set, so that coils can be changed, or any desired adjustments made, without fear of receiving a shock. It is desirable that this switch should possess a high standard of insulation, and, moreover, the make and break contacts should not be an integral part of the switch arm, nor should they be in electrical contact with any exposed metallic portion of the switch. An excellent component for use in this case is the Marconiphone double-pole quick-break switch, as this embodies



Details of the panel drilling. The sizes of the holes are:—A = 7/16in. dia.; B = 3/8in. dia.; C = 5/16in. dia.; D = 1/8in. dia., countersunk for No. 4 wood screws; E = 1/8in. dia., countersunk for No. 6 B.A. screws; F = 1/8in. dia.



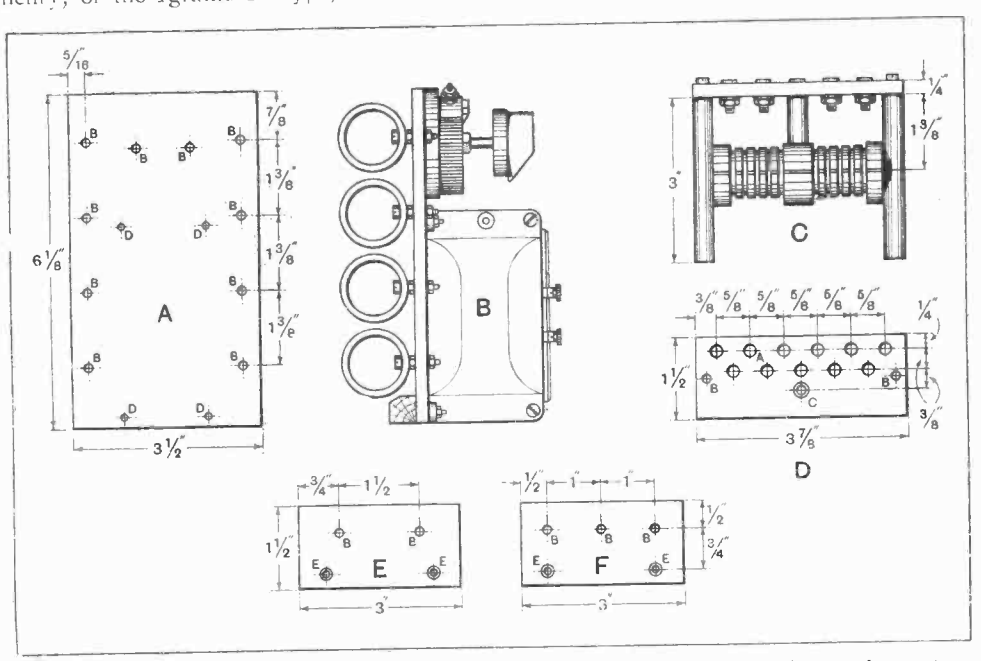
The baseboard layout. An extra smoothing choke can be accommodated if necessary between the two large condensers and the L.F. transformer.

all the desirable features outlined above. Before fixing the milliammeter in position, it would be wise to test it for continuity and at the same time one should carefully mark the positive and negative terminals, as this will eliminate the possibility of a faulty meter or incorrect connection leading to considerable delay when the testing stage is reached. This advice should be put into practical form in connection with all the components, and each individual piece should be thoroughly tested before it is assembled in the receiver.

The disposition of the components on the baseboard is such that they are not unduly cramped. A space has been provided which will accommodate a Pye 32-henry, or the Igranic F. type, choke should its inclusion be found necessary in view of the remarks passed in the earlier part of this article.

Biassing Resistances.

The method of obtaining grid bias has been discussed already, but the practical application of this has not been given due consideration. A power valve may be irreparably damaged by leaving the grid circuit disconnected from the biassing medium with the H.T. applied to the anode, and this risk will be intensified when the anode voltage is in excess of that normally used on the valve. Now the life of a valve will not be materially lessened by using a reasonably high value of H.T., provided an adequate amount of negative bias is applied to the grid, so that the anode current is kept to within a safe value and precautions are taken to guard against the possibility of the valve being run without bias. This is achieved in the present case by returning the low potential end of the grid leak R_5 to a point corresponding to -12 volts, dispensing with the usual wander plug and making a soldered connection. The 20,000-ohm Climax potential divider is connected across the filament pins of the valve V1, and as this resistance is tapped in 10 places the difference of potential across any two adjacent taps will be $\frac{1}{10}$ of 6 or 0.6 volt. The negative bias for the valve V2 is obtained by returning the low potential end of the L.F. transformer secondary to a tapping of this resistance, and to facilitate adjustment of the bias the tap-



Drilling details of panel supporting smoothing choke and resistances R_7 and R_8 are shown at A and B. Method of mounting grid bias resistance R_6 (C and D), also the two terminal battens (E and F). The sizes of the holes are :—A = 1/4in. dia.; B = 5.32in. dia.; C = 5.32in. dia., countersunk for No. 4 B.A. screws; D = 1/8in. dia.; E = 1/8in. dia., countersunk for No. 4 wood screws.

LIST OF PARTS.

2 Variable condensers, 0.0005 mfd. (Type K.C., Dubilier).
3 Fixed condensers, 0.01 mfd. (McMichael).
3 Fixed condenser holders (McMichael).
2 Fixed condensers, 4 mfds. (Type B.D., Dubilier).
1 Neutralising condenser (Neutracondenser, Ormond).
1 Grid leak, 2 megohms (Ediswan).
1 Grid leak holder (Bulgin).
1 Tapped potential divider, 20,000 ohms (Climax).
4 Tubular resistance units, 400 ohms (Igranic).
1 Potentiometer on porcelain, 400 ohms (Igranic).
1 High resistance potentiometer, 1 megohm (Universal High Resistance Model A, Igranic).
1 Resistance, 150,000 ohms (Duwirohm, Dubilier).
1 Resistance, 50,000 ohms (Duwirohm, Dubilier).
2 Resistance holders (Duwirohm holders, Dubilier).
1 Fixed resistor, 5 ohms (Burndept).
3 Valve holders (White line, Bowyer-Lowe).
1 L.F. Transformer, 5 : 1 ratio (Radiogrand, Telsen Electric Co., Ltd.).
1 Output Transformer, 1 : 1 ratio (Type No. 656, Pye).
1 Smoothing choke, 20 Henries (Type No. 664, Pye).
1 Double-pole quick break switch (Type No. B.1930, Marconiphone).
2 Bow cut-outs, 5 amps. (G.E.C.).
1 Milliammeter, 0-150 milliamps, moving iron type (Sifam).
1 Crystal detector unit complete (Carborundum Co., Ltd.).
4 Ribbed formers, 3in. diameter (Redfern).
22 Valve pins, parallel type (Lectro-Linx).
22 Screwed valve sockets (Lectro-Linx).
1 Ebonite panel, 30in. × 8in. × ¼in.
1 Baseboard, 30in. × 9in. × ½in.
2 Panel brackets, 6in. (Camco).
1 Aluminium screen, 9in. × 7in., 16 S.W.G.
5 Terminals: Aerial, Aerial, Earth, L.S. +, L.S. − ("Tapa" terminals, W. J. Charlesworth, 88, Aston Street, Birmingham).
Various wood screws, 4 B.A. screws, nuts, washers and soldering tags.
Various small pieces of ebonite ¼in. thick for terminal battens, coil bases, etc.
Quantity scrap ebonite.
1 Porcelain flash lamp holder.
20 yards 27/12 Litz wire.
¼ lb. 26 D.C.C. wire.
6 oz. 36 D.S.C. wire.
1 C.G. lamp-holder adaptor.
3 yards twin flex.
Quantity insulating sleeving and 18 S.W.G. tinned copper wire.
1 Wander plug (Lectro-Linx).

Approximate cost of above components, £11.

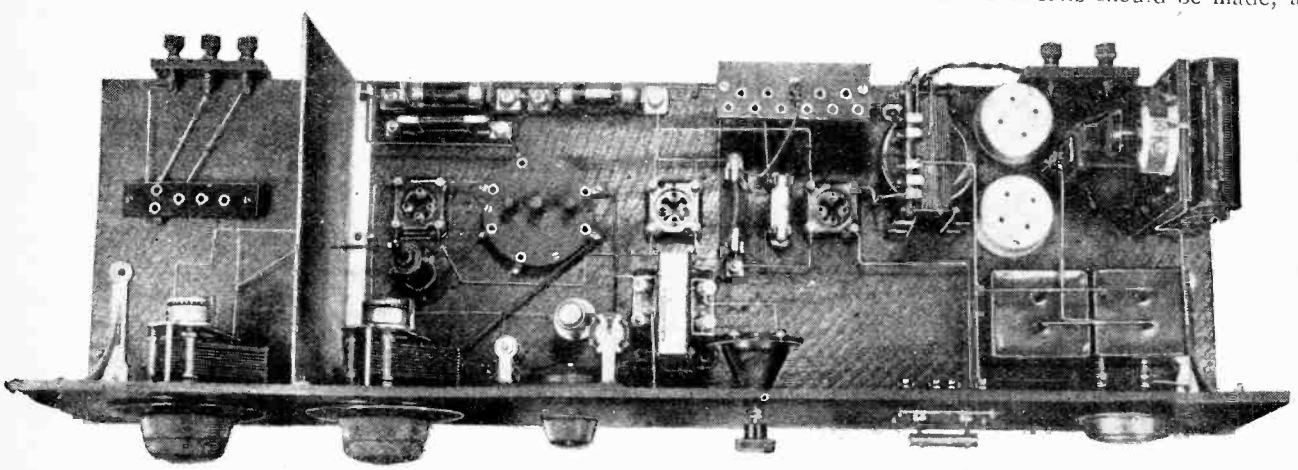
In the "List of Parts" included in the description of *THE WIRELESS WORLD* receivers are detailed the components actually used by the designer, and illustrated in the photographs of the instrument. Where the designer considers it necessary that particular components should be used in preference to others, 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.

pings are brought out to an ebonite strip carrying 11 sockets. As an initial adjustment, the wander plug should be inserted in the fifth socket from the end of the resistance connected to the negative leg of the valve V1. Moving the wander plug to the right of this point, that is to say towards that end of the resistance connected to the positive leg of the valve, will apply a smaller valve of negative bias, whereas movement in the opposite direction will lead to more negative on the grid of V2.

available a 1 : 1 ratio transformer should be purchased; on the other hand, if it is proposed to locate the speaker at a distance from the set it would be advisable to instal a low resistance loud-speaker and a step-down ratio output transformer. This will reduce to a minimum any losses due to capacity between long extension leads

The Choice of Valves.

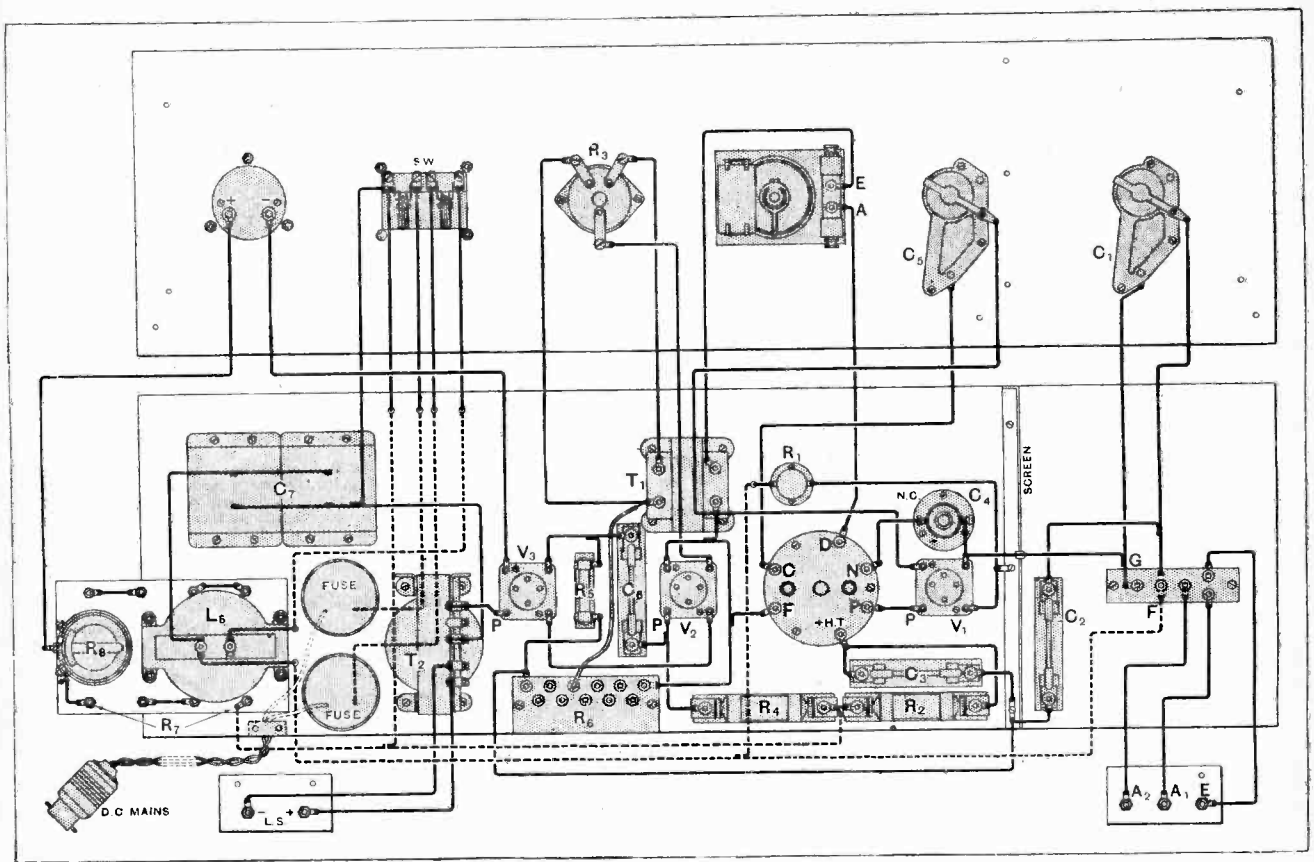
Having soldered the last wire in position, a careful check of all connections and circuits should be made, as



A plan view of the receiver with coils and valves removed.

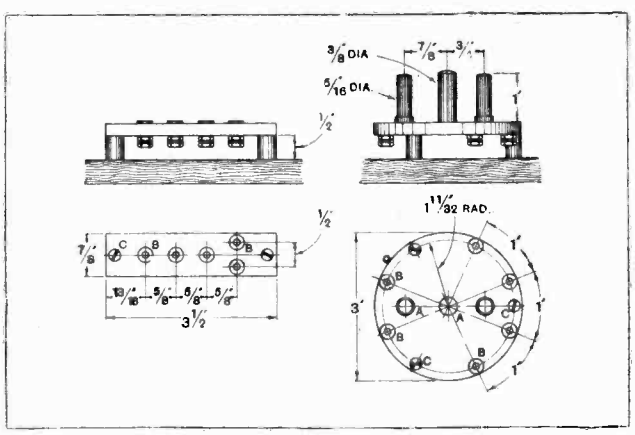
Passing on the valve V3 it will be noticed that an output transformer is recommended, and unless certain precautions are taken it would be inadvisable to employ the choke capacity output arrangement. The transformer enables the loud-speaker to be completely isolated from the supply mains, and this must be considered an essential precaution even though the loud-speaker is located near to the receiver. Of course, the alternative output arrangement would be permissible if large-capacity condensers were inserted in both leads of the speaker, but this combination would prove more expensive than a transformer. Where a high-resistance loud-speaker is

a little time spent on this may lead to the location of a faulty connection which, had this not been rectified, might have resulted in three valves coming to an untimely end. When the constructor is assured that everything is in order, then the coils and valves can be placed in position and the aerial and earth connections made. For the high-frequency stage a Marconi or Osram D.E.H. 610 valve will be required, and in the first and second low-frequency positions Marconi or Osram D.E.L. 610 and D.E.P. 610 valves respectively should be employed. All three valves take 0.1 ampere of filament current, so that they are suitable for the series arrangement of fila-



The practical wiring plan. Those leads shown dotted pass through the baseboard and are held in position on the underside by small ebonite cleats.

ments, and in addition the grid bias provided has been adjusted to suit this range. Before connecting up to the supply mains two pieces of very fine gauge fuse wire must be placed in the porcelain fuse boxes and the variable resistance R_8 adjusted to have all its resistance in circuit. Now insert the adaptor, or plug, as the case may be, in either the lamp socket or wall plug and switch on the set. If the connection to the supply has been made correctly the meter will register the filament current, but if it is found that the indicating needle has moved away from the scale then the adaptor or plug should be reversed in its fitting. The resistance R_8 can now be slowly reduced until the needle indicates 100 milliamperes (0.1 amp.), and the operator can now commence to tune in.



Details of baseboard coil mountings. The sizes of the holes are:— A = 5/32in. dia., countersunk from underside for No. 4 B.A. screws; B = 7/32in. dia.; C = 5/32in. dia., countersunk for No. 6 wood screws.

Operating Notes.

Unless a wrong connection has been made, or by some strange fluke of chance the neutralising condenser is adjusted to the correct capacity for stabilisation, the H.F. circuit will be in a state of oscillation when the aerial circuit is brought into resonance. This must be remedied by adjusting the balancing condenser. Thereafter this condenser need not be touched; however, if the occasion demands it can be utilised for the purpose of obtaining a little regeneration

Finally, the crystal potentiometer should be adjusted to give the maximum sensitivity; however, the reader must not be misled into believing that the component is faulty if no apparent effect is noticed on a very powerful signal, but its final setting should be ascertained on a comparatively weak signal. It must not be forgotten that the receiver is provided with a volume control, so that if satisfaction is not obtained on first switching on, the control knob should be turned to ascertain that it is not set in the minimum position.

A receiver of this type will not possess quite the same sensitivity as one embodying a highly efficient thermionic

D.C. Mains III.—

detector, so that a comparison of the relative performance of two dissimilar sets would not be strictly fair. It must be remembered, however, that a stage of high-frequency amplification is adopted, so that a reasonable degree of selectivity can be expected. In view of the extraordinary claims made for certain receivers of mediocre design, it would be impossible to do justice to the performance of this set by adopting a valve and circuit basis of comparison without resorting to a flight into the realms of imagination. The writer will content himself with the statement that this set should appeal to those whose requirements are not too exacting and who can derive pleasure from a receiver capable of reproducing a reasonable number of stations on the loud-speaker at good quality. In addition, it is entirely free from battery trouble and its attendant charging difficulties; the maintenance costs being limited to a fraction of a penny per hour for current and the replacement of a valve when this becomes necessary.

LETTERS TO THE EDITOR.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4, and must be accompanied by the writer's name and address.

OUTSIDE BROADCASTS.

Sir,—I have read with interest, in your issue of the 7th inst., the letter from Mr. W. K. Islip, of Cambridge, and he will no doubt be pleased to know that I have had exactly the same experience with regard to the reception of London transmission, and have compared notes with several of my wireless friends here in Birmingham, and find that the phenomenon is pretty general.

I could not give exactly the date at which I first noticed this trouble on 2LO, but I should think it is about twelve months since I became convinced that the trouble was not due to my set, and I could not identify it with any usual form of heterodyne: the possibility of interference between direct and reflected waves did not occur to me, but it certainly seems a possible explanation of the trouble.

In common with Mr. Islip and other unfortunates in this respect I have to change H.F. transformers, etc., to listen to London *via* 5XX.

P. W. PARR.

Birmingham,
March 8th, 1928.

IDENTIFICATION OF STATIONS.

Sir,—In my opinion, the advantages heavily outweigh any disadvantages of your editorial proposal in the March 7th issue.

B. J. WELLS.

Birmingham.
March 8th, 1928.

SUNDAY BROADCASTS

Sir,—May I voice the opinion of myself and many of my radio friends in regard to this much-discussed topic?

Sunday in many cases is the day of rest—often of family reunion—and as such the B.B.C. could, within reason, cater more sufficiently for the listener. Taking a case in point: Morning is often taken up with a visit to a place of worship—or a walk. The midday meal over, the order of the day is a comfortable afternoon and the radio (which unfortunately does not commence until 3.30). Then follows evening. After the evening service the family gathers round the fire, and it is time for a little more radio, but to avoid another service they are forced to try the Continent until the home programme comes along—when it is almost time for visitors to be leaving and the family thinking of sleep.

The suggestion I would therefore put forward (unanimously endorsed by my friends) is that the afternoon transmission commences about one hour earlier, and that the evening service coincides with the one held in the churches, followed by a programme from 8 o'clock, thus increasing the broadcast on that one day when the working man is able to listen.

PERCY H. DOWNING.

Endcliffe, Sheffield.
March 15th, 1928.

B.B.C OR CONTINENTAL BROADCASTING.

Sir,—I should like to support your most sensible little editorial in this week's issue (21st), and hope that your remarks will be properly heeded by the governors of the B.B.C. I think we must all appreciate their efforts (and their difficulties, too) to please their huge *clientèle*, but surely everybody will agree with you that if they have so much money to spare it is better to spend it in perfecting home distribution.

I should like to see the day when the English broadcasting shall be known throughout the world as the very best in it. And if it be suited to the best interests of our own people it will incidentally be valuable to those abroad who "listen-in."

I suppose the great bulk of those who habitually support the B.B.C. are not the noisy freaks, but the steady ones, of our country, and those who want foreign goods can, by the use of suitable sets, easily obtain them.

The fact is, there is the tendency with the B.B.C., as with so many of our public departments, to seek to govern us by their officialism. Why should names of our officials be so much paraded? They are paid servants of the public, and well paid, too, and should be sunk in their work, and, if they do not perform that work properly, be shifted for such as will.

The Radio Times is presumably the official organ, and should, in my opinion, be open to correspondence—a certain number of pages every week—*pro* and *con*. The B.B.C. would have something to guide them, whereas if anybody wrote them adversely to-day I doubt if it would be inserted. There is too much favour and fear and toadyism.

JOHN BULL.

Exeter.
March 21st, 1928.

EMPIRE BROADCASTING.

Sir,—When one makes a prophecy and then comes to the conclusion it has been, or is partly, fulfilled, it naturally gives a feeling of gratification. In a letter to you *re* Empire Broadcasting in your issue of September 14th, 1927, I prophesied that one of these days some station would show how to send short-wave transmissions well under any condition, and I now consider one station has at least half fulfilled that prophecy.

I take it most certainly for granted you are aware of the awful distortion that accompanied KDKA transmissions until recently, which seemed to get worse as he went on, until he could never be picked up free from it, and in contrast the remarkable purity of their transmissions now, *i.e.*, when they are not apparently still experimenting, but I suppose like most humans, once on the right track are not satisfied to leave well alone, for there has been plenty of occasions lately when he seems to have got as near to perfection as possible, when nothing seems to be able to spoil it; static can only interfere with but cannot spoil it, but however he comes through now that awful distortion of the past has been absent on the occasions when I have picked him up; he is also remarkably steady in this locality, and I presume elsewhere also.

It is a fairly safe hazard that the change is due to endeavour and not to alteration in the ether conditions on what is generally accepted as not one of the best of short-wave bands, and it is quite within the bounds of possibility that old England gave a helping hand to put them on the right track.

I suppose most of us have some favourite; KDKA has always been my favourite short wave, and it was a regret not to be able to receive it well, but as distortion fading and static has always been an interesting subject with me I

spent a fair amount of my short-wave time with KDKA, which caused convictions to grow, when last December I thought it was time to put them into more concrete form, so sat up for a few consecutive nights to diagnose, or analyse, the cause of the trouble. The result was a contention that it was not due to the ether conditions at all, but the fault of the transmitter, and sent along my report and diagnosis in support of that contention, and received the following reply :—

"Dear Sir,

"We thank you very much for your excellent report of receptions of the transmissions of KDKA. We are forwarding this to our engineers as we know they will be interested in such a report. We trust that you may enjoy many of the programmes from KDKA and that the distortion which you mention will be cleared up."

Illness for a time kept me away from the set, and you can judge my pleasant surprise when next tuning in to find that they had won through and was coming in absolutely the best long-distance short wave I have picked up, instead of the worst. Well, KDKA has proved that distortion can be cured, and when static is mastered the prophecy will be fulfilled; but I think that is as much, or even more, the concern of the receiver than the transmitter.

If, as I surmise, that my report was some help to them, and, under the circumstances that surmise seems justified, it shows the value of co-operation, even with the humble amateur, who is not so despised over there as he is over here—their courteous reply to a report always gives the feeling that your co-operation is welcomed.

The report is too long to quote here, but if you think you would like to see it, I should be pleased to forward you a copy, it may be interesting to yourself as well as to KDKA, as it contains one or two theories or contentions that I do not remember having read before, but which KDKA themselves seem to have fairly well substantiated. T. CLARK.

South Chingford, E.4.
March 19th, 1928.

ARE THERE TOO MANY TYPES OF VALVES?

Sir,—With reference to Professor Appleton's remarks on the above subject, and those contained in various letters to your journal, I entirely agree with the statement that the large variety causes confusion

I do not, however, agree with the suggested abolition of the 4-volt series. I, personally, have never found 2-volt valves to be anything like so satisfactory in use as either the 4- or 6-volt types, mainly owing to the fact that one cannot to the same extent take advantage of the voltage dropped over the filament resistance. From this point of view, the 6-volt valve is undoubtedly the best, but it has its drawback in the form of a larger and heavier accumulator—especially in the case of the multi-valve receiver. It is not everyone who is in a position to possess his own charging equipment, and the size of his L.T. battery is a matter of importance.

It would, therefore, seem to me that the 4-volt valve is a very happy medium between the 2-volt type, with its economy in L.T. battery and the 6-volt type with its greater flexibility. G. A. MAYARD.

West Norwood, S.E.27.
March 21st, 1928.

VALVE NOMENCLATURE.

Sir,—Your contributor, A. L. M. S., in to-day's issue of *The Wireless World* hits the nail bang on the head, and I do not think his scheme for valve nomenclature can be improved upon. His dictum that the vital information required by the average user is the impedance and amplification factor cannot be gainsaid. D. Ormerod's letter is also much to the point. I should like to add to his list of what manufacturers ought to tell us in their advertisements. When I buy an anode resistance, either wire-wound or of the grid-leak type, I want to know what its current-carrying capacity is. How many advertisers mention the point? Most makers of L.T. and H.T accumulators are careful to tell us the normal *charging* rate. Why are they so secretive about the *discharging* capabilities? At present there are endless numbers of H.T. eliminators on the market, and most makers give a figure for the output voltage. Very few, however, have the courage to say what current is obtainable at this voltage. It would almost seem that sales are obtained through misleading the public by withholding vital information!

In conclusion, I should like heartily to endorse your Editorial "Continental Broadcasts." It seems to me that the B.B.C. should learn to walk before it attempts to run—much less to fly! I think that much of the S.B. and other broadcasts depending on a long line transmission are, as regards quality, too dreadful for words. In my view 50 per cent. of the transmissions from 5GB—that great pioneer of the much betrumpeted but strangely nebulous "regional scheme"—are definitely bad in quality. Before the B.B.C. go footling about Europe in quest of their everlasting and dearly beloved "stunts," it would be more fitting were it to put things in order nearer home. A. W. SCOTT.

Carshalton.
March 21st, 1928.

Sir,—I have read with interest the article by Prof. E. V. Appleton and also the more recent article in your issue of March 21st, 1928, on the above subject. While there is probably more in the question of nomenclature than the technical points touched on in these articles, the matter certainly seems one which can be ventilated with advantage to all concerned.

The much-maligned "arbitrary numeral" method of designating a valve has, at all events, the virtue of brevity. This would be sacrificed in the scheme which proposes to substitute "6-volt 30/20" for DE5B, "2-volt 180/50" for B8, etc. However, with the object the writers have in view, this is probably inevitable.

Bearing this in mind, and what has already been said on this subject, a combination of the present system and a new one would probably be of most assistance, since all concerned would then have a designation which would link up with existing designations. Later, if it was agreed by all concerned that the figures denoting filament current were unnecessary, these could be dropped.

For power valves (*i.e.*, those designed mainly for operating the loud-speaker) the maximum power output is normally the most important thing the user wishes to know. It therefore seems desirable to include this information in the designation of the valve. Thus, type 220P might become type 220.05, denoting a power valve having an output of 50 milliwatts.

For other valves, one probably could not do better at present than a system along the lines already proposed. Thus, type DEL.210 would become type 210/17/9, denoting a valve of approximately 17,000 ohms resistance and amplification factor of 9.

The proposal to introduce a "maximum output" figure into the power valve designations no doubt raises the question as to how this is measured. It would be impossible to deal with this satisfactorily in the course of a short letter. It will be sufficient to say here that a method, well known to manufacturers, exists. For the purpose of the measurement a resistance load of twice the resistance of the valve (at the working bias) is assumed, and from suitable valve curves the change of current through such a load at E_g max. and for a fixed amount of distortion (usually 5 per cent.) is obtained. To the degree of accuracy necessary for the purpose, the method gives a perfectly fair comparison between different types of valves.

Rugby. L. A. BARRY.
March 23rd, 1928.

THE L.S.5 BRIGADE.

Sir,—Lecturing before a Manchester Society recently, a member of the research staff of Messrs. Graham Amplion stated that to obtain good speaker reproduction the volume should make conversation practically impossible. This is consonant with your policy of L.S.5A valves, or twin-valve low-frequency stages, etc.

As one of the many people who listen-in in their own homes, where rooms rarely exceed 18ft. square, may I suggest that the design of a wireless set to reproduce music purely yet quietly would be welcome. The greatest bugbear of the gramophone is that, with the average dance or band record, unless fibre needles are used and handkerchiefs pushed down the horn, the volume is so grossly excessive as to make listening a strain and without pleasure.

It would appear that the trend of design in wireless reproduction is based on the misconception that the public want a "small public address system" with which to generate sufficient volume to fill a cinema, and then by means of a volume control to reduce the volume to bearable dimensions.

How we should smile at a railway company who built such a powerful locomotive that the brakes had to always be partially on when the train was in motion!

In the writer's opinion, the correct volume of sound for comfortable listening is that which permits the same *intensity* of sound waves to enter the ear as would do so when, say, listening to a military band in the open air, or an orchestra in a large hall.

To try and cram into an average living-room even a twentieth part of the total sound emitted by, let us say, the Radio Dance band is absurd.

As I write this, a *Wireless World* "five" is playing *via* one stage of L.F. (A.F.5 and P.M.6 valve) and a good cone speaker, drums are audible as drums, and the music of a pleasing nature, and does not appear to lack balance, owing to suppression of upper or lower frequencies. Moreover, during intervals it is impossible to tell if the set is switched on, the background of hissing noise which is always present when plenty of milliamperes are being used being conspicuous by its absence.

In conclusion, I should like to hear if it is possible to use a moving-coil speaker with the small inputs mentioned above and retain the admitted extra clarity and frequency range of this type of speaker.

And now I will sit back and wait for the storm to burst. Forward the L.S.5 brigade!

Bramhall. FLUX.

CONTOURS OF 2LO.

Sir,—It may be well to call attention to a possible source of error, affecting general conclusions, based upon the most interesting measurements of the field strength of 2LO.

Apparently each of the contours in Mr. R. H. Barfield's paper represented in fact only some seven observations. Exact knowledge is therefore lacking as to the form of the contours in regions intermediate between the seven radial paths along which measurements were made.

In case it might be thought that this closeness of spacing is ample for the purpose, comparison should be made with the recent history of one branch of meteorology. A quotation from Dr. C. E. P. Brook's recent booklet, in Benn's sixpenny library, will illustrate the point.

"Until about sixteen years ago it was supposed that isobars should follow smooth flowing curves, without kinks, and, in fact, that in a perfect cyclone the isobars should be beautifully circular and concentric. . . . It is much easier to draw smooth isobars when there are only a few stations than when there are a large number. . . . Then came the Great War. Meteorological information suddenly became of enormous value, jealously guarded, and not imparted to neutrals, who had to do the best they could without it. The Norwegian meteorologists tried to make up for the absence of information from belligerent countries by establishing a large number of stations in their own country. The detail so obtained showed that the kinks were not only real, but as significant as the rest of the isobars, and this resulted in a new idea of the structure of cyclones."

In view of this experience, a detailed map of the field strength over a small extent of country including a steep hill and a small, dense wood, might prove most instructive. A scale of about six inches to the mile should be employed. Early Marconi experiments were thought to show that a headland, projecting into the sea between two ships, interfered with reception.

Low Fell, Gateshead. GEORGE M. MEYER.

March 23rd, 1928.

Sir,—In your issue of March 14th Mr. Wedlake contributes a letter referring to my article on the signal strength of 2LO. He attributes to me the contention that the irregularity of the contours is mainly due to the effect of trees. As a matter of fact, I do not make the contention. All I claim to have demonstrated is that after the waves have left the town they fall off in strength more rapidly in well-wooded country than in sparsely wooded country. This is shown in the map by the fact that the contour lines are crowded together in the south and spread out in the north—a fact which could not be caused by initial differences in their shape. It is also shown in an illuminating manner by Mr. Griffiths in an article on my experiments in your March 21st issue.

His method of expressing my results (see Fig. 1, page 300) shows that in the southerly direction the waves start off with greater intensity than to the north, but that at fifty miles they have fallen to about half the northerly strength. This makes it clear that the country apart from the town has an important effect. In the experiments so far recorded it is the effect of the country only that has been studied, but I can reassure Mr. Wedlake that the effect of the town with all its complicated structure has not been forgotten. It must, however, form the subject of a separate study.

March 24th, 1928. R. H. BARFIELD.

EXPONENTIAL HORNS.

Sir,—Mr. Alan Cartwright in your March 14th issue says in making the straight exponential horn described November 23rd, that he had a tough job to make the four edges meet where the curve is greatest. Three-ply wood is made with the grain of the two outside pieces running in the same direction; if the wood is cut so that the outside grain runs across the horn instead of lengthways, no difficulty will be experienced in doing this. I constructed this horn last Christmas, using a Brown U.G.A. unit. It is joined with No $0 \times \frac{3}{8}$ steel screws and seccotine; about a gross of screws were needed, but horn is very strong. I have a Brown H.1 loud-speaker, which I always considered good, but testing the two with a change-over switch is a revelation. Mine also hangs on the wall with the mouth about two feet from the ceiling, and the sound appears to be reflected evenly all over the room; the small end lies close to the wall well out of the way.

Oxford. J. A. COOPER.

March 18th, 1928.

TALKS.

Sir,—Mr. G. E. H. Rawlins finds only an inane and frivolous mentality in those who object to the incessant chatter of wireless speakers (or should it be talkers?).

A very large majority of people are amazed that a marvellous invention should be prostituted in order to spoon-feed a few who are too lazy to seek information in print. Ignoring for the moment the unfortunate blind, a full week's talks can be bought for twopence by purchasing *The Times* or one of the better class Sunday papers.

Not one listener in a hundred is interested in the bulk of talks given, and why, therefore, the vast majority should be deprived of the all-too-short musical items to please these isolated few, who could get more and better information elsewhere at a negligible cost, certainly is beyond our "inane and frivolous mentality."

Surely it is very evident that the real object of these "talks" is to give pleasure to the talkers, not the listeners.

Burnt Green, near Birmingham. F. G. SACKETT.

March 21st, 1928.

5GB PROGRAMMES.

Sir,—I wonder how much longer listeners in the North are to be deprived of the long-promised alternative programme from 5GB?

The reception of this station in this neighbourhood (ninety miles) is atrocious, signals fade worse than any Continental station, varying in strength from inaudibility to blasting on a super-power valve within the space of a few minutes.

We have hoped for some months that the trouble was of a temporary nature, and that it would be remedied, but it becomes worse instead of better.

Possibly the B.B.C. are not aware of the fading and distortion north of 5GB, as the Chief Engineer, in a recent talk from 2LO, said he was quite satisfied with 5GB. If such is the case he is more easily pleased than listeners here.

Bromborough, Cheshire. W. H. McMILLAN.

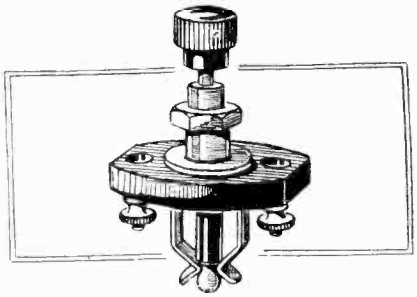
March 20th, 1928.

NEW APPARATUS

The Manufacturers'

LOTUS BATTERY SWITCH.

The latest product of the firm of Garnett, Whiteley and Co., Ltd., is a battery switch for panel mounting. It is of the



Lotus L.T. switch for panel mounting.

push-pull variety and is designed for one-hole fixing. The contact is positive and is made by two springs, thus avoiding the necessity of making the return contact through the spindle and bush. Terminals are provided for the L.T. leads, and the price is 1s. 6d.

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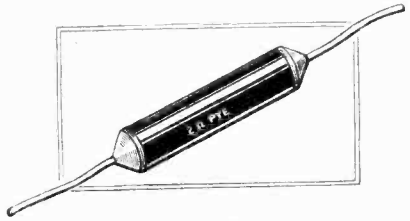
PYE GRID LEAKS.

The price of these leaks has now been reduced to 1s. for all values from 0.25 to 3 megohms. Their accuracy is guaranteed and two specimen 2-megohm



The Pye grid leak.

leaks which we tested were within 1 per cent. of their rated value. A useful innovation is the provision of tinned copper connecting wires in addition to the pointed end caps; the leak may therefore be wired directly into the circuit or inserted in any standard clip.

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"SUPER-PIRTOID" TUBING.

This new material, the product of Messrs. H. Clarke and Co. (M/c), Ltd., Manchester, is, like ordinary "Pirtoid," built up of specially prepared paper laminations, but in this case the tubing is impregnated with black bakelite. The surface is highly polished, and coils wound on this material should greatly enhance the appearance of any receiving set. In addition, it is claimed that the insulating properties are even better than those of the original "Pirtoid" material.

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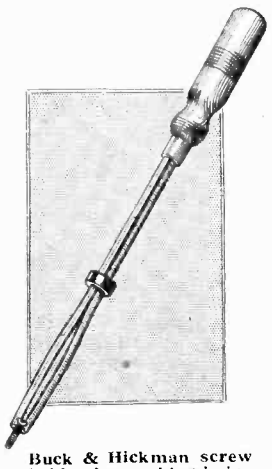
D.C. SCREW AND WIRE PLACER.

Wireless sets are full of inaccessible corners and difficulty is often experienced in starting screws in their threads, particularly in repair work where screws may have to be withdrawn and replaced with all the components in position. A new tool has been produced by Messrs. Buck and Hickman for dealing with work of this kind where space is limited. Not only is it suitable for screws and nuts,



Buck & Hickman screw holder for working in inaccessible places.

but also for holding wires in position for soldering.

The jaws, which are case hardened, are drawn together by a knurled brass collar and are shaped to grip either cheese-head or counter-sunk screws of any diameter from 11/64in. to 1in. The total length including the handle is 12½in. and the price 2s. 6d. A 24in. size is also available at 4s. 3d.

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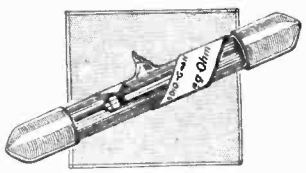
LOEWE RESISTANCES.

The metallised vacuum grid leaks produced by the Loewe-Radio Company are already well known. Experimenters and others requiring resistances of low self-capacity will be interested to learn that values as low as 10,000 ohms are now

Latest Products.

available from the London depot of this firm at 4, Fountayne Road, Tottenham, N.15.

The current carrying capacity of these resistances is remarkable having regard to the extremely thin cross-section of the resistance element. A series of these



Loewe vacuum resistances which are obtainable in values as low as 0.01 MΩ.

resistances which have been recently used in a special experiment have been subjected to a current of 2 milliamps for long periods and it has been found that the variation of resistance after the current has been passing half an hour is less than 1 per cent. Incidentally the change of resistance is a decrease, so that a resistance has a negative temperature coefficient for high current densities.

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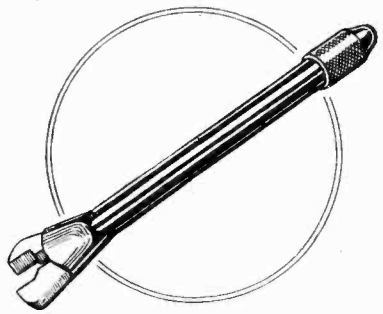
E.B.C. ADJUSTABLE SPANNER.

This tool may be used as a substitute for the more common bunch of magneto spanners and has this advantage that it can be adjusted to fit exactly any size of nut. In consequence there is less danger of slipping and damaging the



A useful tool for the experimenter; the E.B.C. adjustable spanner.

corners of brass nuts. The range of adjustment is from 3/16in. to ⅜in. measured across opposite flats of the nut, and the contraction of the jaws of the spanner is accomplished by rotating the knurled screw at the bottom end. The tool is made by Messrs. Hayward and Towell, Ltd., North Street, Peterborough, and sells at the moderate price of 1s. 4½d., its length is 3¼in. so that it can be conveniently carried in the pocket.

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.

An L.T. Trickle Charger for H.T.

Is it possible to use my L.T. trickle charger for charging H.T. accumulators by substituting a suitable step-up transformer delivering a sufficiently high voltage? The rectifier is of the permanent metal oxide type. N. V.

The arrangement you propose is not practicable. With this type of rectifier there is a limit to the voltage which may be dropped across individual elements, and in all probability that included in your instrument is designed for a maximum input of some 15 or 20 volts. For the charging of H.T. accumulators a much higher voltage than this would be required.

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H.T. Consumption.

If I add a parallel super-power valve to my existing receiver will the current consumed from my H.T. accumulator be doubled? M. R. R.

Provided that the added valve is of the same type as that you are already using it is correct for practical purposes to say that the anode current consumed in the output stage will be almost doubled. This is on the assumption that the load in the anode circuit (output choke, transformer primary, or loud-speaker winding) has a reasonably low D.C. resistance as compared with the A.C. resistance of the valves.

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Silencing a Motor.

Having experienced much interference from a D.C. motor, I was interested in a letter published in a recent issue of "The Wireless World," stating that interference from this cause can be eliminated by connecting large capacity condensers across the brushes and earthing the centre point. Can you please explain how the centre point of a condenser is found? W. G. S.

Unless the condensers are made specially for the purpose, it is not possible to make a connection at the mid-point, but this can be arranged by connecting two condensers in series and earthing at the junction of two condensers. This is shown diagrammatically in Fig. 1, where C1 and C2 are two 4 mfd. condensers connected in series and "earthed" at the mid-point *via* a fuse. The fuse is not essential, but its inclusion is recommended as a precaution should one or both of the condensers break down, as

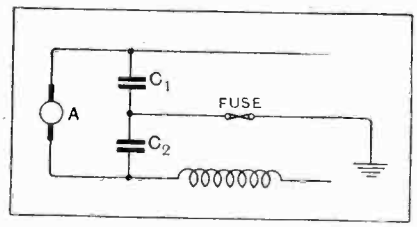

Fig. 1.—To prevent interference from the motor A, condensers are connected as shown.

this might lead to short circuiting the supply mains. As far as the earth connections to the centre of the condenser bank is concerned, this can be either a buried earth or the framework of the machine; generally, the last mentioned is satisfactory.

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.

Dry-cell L.T. and Economy.

It appears that the ampere-hour capacity of a dry battery falls off very rapidly with increase of current; accordingly, it seems to me that it would be a good idea to wire in series the filaments of the two valves in my proposed portable set, as dry cells are to be used for L.T. supply. Expense is a consideration, and I should like to know if it is possible to connect a four- and a two-volt valve together in this manner. They are each rated at 0.1 ampere. S. P. P.

The arrangement you propose has certain advantages, and there is no reason why two valves of different filament voltage rating should not be used together. The important point is that their current rating should be the same. With valve filaments connected in series the L.T. voltage must be equal to the sum of that required by individual valves—in your case it will be 6 volts.

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Overloading the Detector.

In "The Wireless World" for February 15th you advised "L. G. R." (who wished to increase the undistorted output of his receiver) to apply an increased H.T. voltage both to detector and output valves. I do not remember having previously seen in print any suggestion regarding the necessity for a greater detector voltage when output is to be increased, and am wondering if there was an error in your published reply. H. R.

Our reply was given after due consideration. "L. G. R." was using a 3-valve receiver with H.F. amplifier, anode bend detector, and one transformer-coupled L.F. valve. With such a circuit there is a possible danger of overloading the detector before the output valve is loaded up to its full capacity. Now, the application of more H.T. (and consequently of more grid bias) to this output valve will increase its voltage-handling capacity, so it is necessary at the same time to make provision for a greater H.F. voltage on the detector grid. This is done by increasing its H.T. voltage, a procedure which will permit of an increase in its negative bias, and consequently of the H.F. voltage which it can accommodate without running into grid current.

A Set for Two-volt Valves.

I notice with regret that the majority of the designers of sets described in "The Wireless World" apparently intend them primarily to be used with 6-volt valves. Now, on account of my difficulty in getting accumulators recharged, I prefer to use 2-volt valves, and am wondering if you could suggest a design which would be the best for them. If nothing has been issued, perhaps you would consider publishing the descripton of such a set, as I am sure that many situated as I am would prefer to use the more economical valves. E. M. T.

You are in error in supposing that *Wireless World* sets are primarily designed for 6-volt valves. Naturally, the designers always wish that constructors should get the best results from their receivers, and they are perhaps inclined to stress the advice that 6-volt valves should be used. Unfortunately, it is in the nature of things that the latter valves should give better results, all other things being equal. In making this statement we have in mind the more up-to-date type of receiver with neutralised H.F. amplification; there is little difference in performance when the set is of the kind which depends essentially for its sensitivity on the use of critically-controlled reaction.

We cannot see that any useful purpose would be served by attempting to design a set specially for 2-volt valves. Any of the more recent designs are suitable for this type of valve; the important thing is that they should be carefully chosen to have impedances approximating closely to that recommended, and, moreover, you should, generally speaking, choose a valve having the highest possible amplification factor for a given impedance. After all, the difference in effectiveness between the two types of valves is not very great.

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"Free" Grid Bias Again.

What should be the values of the fixed resistors R_3 and R_4 in an "Everyman-Four" receiver when a P.M. 5X. valve is used as a detector? I have tried a number of combinations, but cannot get results approaching those obtainable with my previous 2-volt valve. S. M. T.

The "free" grid bias arrangement is certainly not applicable when you use a "20,000 ohm" valve of this kind, which requires some 3 or 4 volts negative on the grid for detection when a normal H.T. voltage is applied. Even allowing for the fact that its filament may be run at a low temperature, it is unlikely that you would have at your disposal more than about two volts for bias purposes, which would certainly be insufficient with the H.T. voltage ordinarily applied.

If you wish to retain this valve, it will be necessary to abandon free grid bias, and we would recommend you to read an article entitled "Notes on the Everyman Four," which appeared in our issue of December 28th, 1927, and in which the question of detector bias was discussed at some length.

Eliminators and Earthed Positive Main.

My receiver derives the H.T. from a D.C. battery eliminator, and, although a choke-capacity output circuit has been fitted, it does not prevent my getting a shock every time I touch the L.S. terminals. If I connect another condenser between the L.S. terminal and L.T. negative, then these terminals can be touched without getting a shock as formerly. The feed condenser is not faulty, as this has been tested at a much higher voltage than the mains, and, as the extra condenser appears necessary, does this indicate a fault in the output circuit, please? F. G. B.

We do not think that the experiment you have made indicates that there is anything faulty with the output circuit, but it would appear from your description that the positive conductor of the supply mains is earthed.

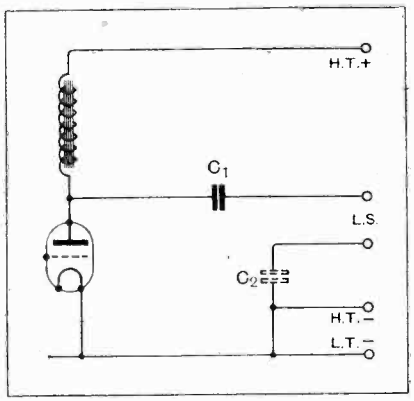

Fig. 2.—If the last valve of a receiver be fed from mains which are positive-earthed, the condenser C_2 is necessary to prevent the terminals L.S. from being live.

In Fig. 2 on this page we give a diagram showing the positions of the two condensers mentioned in your query, and from this it will be seen that, unless C2 is included, the loud-speaker terminals will be "live," for the reason that between H.T.− and earth there is a difference in potential equal to the supply voltage.

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A Fire Risk.

My loud-speaker extension is connected in the manner which you have advocated on several occasions in "The Wireless World"; I use a choke filter output with a single lead to the distant point and an earth return. Do you consider that there is any risk of fire introduced by the use of the gas pipes for this return circuit? I have already tried it, and results are quite satisfactory. W. A.

Your question is a difficult one to answer definitely. The voltages in the output circuit are quite small, and we consider that the production of a spark which might ignite a leakage of gas is almost impossible. However, it cannot be denied that there is a very remote chance that conditions might arise under which it would be possible to cause damage.

An Input Voltage Indicator.

What is the function of the Weston galvanometer used in the "South Kensington" receiver, which you describe in "The Wireless World" for January 26th, 1927? N. D. A.

We assume that you refer to the meter connected in the detector circuit. The set in question uses what is sometimes called parallel rectification, and no H.T. voltage is applied to the detector anode. Thus the mean rectified current due to the incoming carrier wave may be read directly on a sensitive D.C. instrument in exactly the same way as with a crystal detector, and the galvanometer affords a handy check of the adjustments of the H.F.-detector portion of the receiver. By adjusting sensitivity so that the reading on this instrument reaches a predetermined value, the operator of a set of this kind can rest assured that overloading will not be produced unless the percentage of modulation at the transmitting end increases very considerably.

A second galvanometer (indicated by M_2 in Fig. 1 of the article in question) serves as an overload indicator, its pointer being deflected by the flow of current in the grid circuit of the output valve.

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A Warning.

Will you please tell me how to add another H.F. amplifying valve to the receiver shown on the attached circuit diagram? For your information, notes regarding components used are added. T. J. A.

Your circuit diagram shows a modern high-efficiency four-valve receiver with one H.F. amplifier. We think it should be stated emphatically that the addition of a further high-frequency amplifier to a sensitive receiver of this sort is a matter which should not be undertaken lightly, and we feel certain that we should be doing you a disservice by attempting to treat the matter without entering fully into details.

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Reception Without Re-radiation.

It is my wish to build a two-valve receiver (0-v-1) capable of loud-speaker reception of at least four stations, and, to avoid the possibility of interfering with neighbouring listeners, I propose to dispense with reaction. Can you please refer me to a published design which will answer my requirements? W. F. A.

To obtain worth-while reception with a receiver not incorporating reaction it will be necessary to use at least one stage of efficient high-frequency amplification. At least one low-frequency amplifier will be necessary to give loud-speaker signals, so that, under these conditions, three valves would appear to be the minimum number that could give the results required.

The "Regional Three-valve Receiver," described in *The Wireless World* of August 17th and 24th last, would be the most suitable set for your purpose, both from the point of selectivity and sensitivity.

The Wireless World AND RADIO REVIEW

(16th Year of Publication)

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CONTENTS OF THIS ISSUE.

"POPULARISING" WIRELESS.

UNDER the above title, in a recent number of our well-known contemporary, "The Electrician," a reader contributes to the correspondence columns a letter in which he draws attention to a state of affairs affecting the popularising of wireless which probably has no parallel in any other industry, and we heartily endorse the point of view which he puts forward. His complaint is directed against the growing tendency on the part of manufacturers who are the owners of patents to publish advertisements containing threats and warnings against infringement of their patents. The announcements of this nature began with those addressed to the trade and to the public on the subject of basic patents on receiving sets, but the practice is now spreading to valves, loud-speakers, and other commodities, with the result that one gets the impression that some manufacturers are more concerned with attempting to frighten their competitors out of business than proceeding with the task of popularising wireless generally and selling their products. The general public are not expected to be versed in patent matters, and it is, therefore, not surprising that we find many of our readers hesitate to purchase certain components which are being advertised because they think these instruments may be infringing certain patents concerning which warnings have been issued, and they do not know to what extent they might themselves be involved in any resulting trouble.

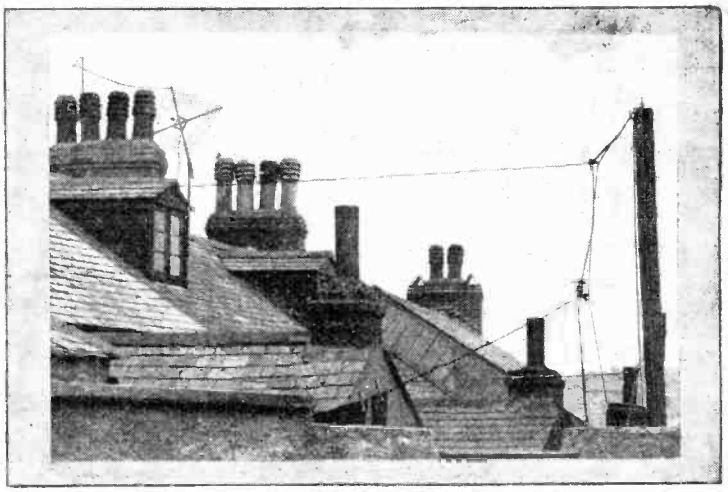
The Disquieting Effect.

Another point of view is that, in our opinion, it is very doubtful whether the publication of these warnings does any good to the owners of the patents concerned, for the reason that it is apt to imply that the patent position is obscure and that the announcement is made more in the nature of an attempt to "bluff" other manufacturers into accepting the claims than based on a sound patent position. Where the validity of a patent is beyond question there is surely no need for these threats and warnings to be issued in the form of public announcements, for direct communication with any manufacturer who is found to be infringing should be sufficient to clear up the matter as far as the owner of the patent is concerned. Probably the advantage in issuing warnings in a general way rather than addressing any suspected infringer directly is that the claimant to the patent or patents circumvents to a certain extent a provision of the Patent Act, which provides that "where any person claiming to have an interest in a patent, by circulars, advertisements, or otherwise, threatens any person with any legal proceedings or liability in respect of any alleged infringement of the patent, any person aggrieved thereby may bring an action against him . . . and may recover such damage (if any) as he has sustained thereby if the alleged infringement to which the threats relate was not in fact an infringement of the patent."

On the face of it, therefore, it would look as if those who issue these public warnings do not feel secure enough in their position to direct such warning to any specific person and feel that, so long as they confine themselves to a general announcement, they can at any time, if tackled by an individual who considers himself aggrieved by the announcement, always back out of the difficulty by stating that their warning was not directed against *him*. We realise, of course, that in any complicated patent situation manufacturers have their little disputes between themselves to settle, but is it necessary that they should "wash their dirty linen in public" and create such a very unpleasant tone in the wireless industry generally, leading, as it undoubtedly does, to a very definite set-back in popularising wireless and expanding the industry—two aims which should be ever before the progressive manufacturer and trader?

Wireless World

MILLIVOLTS PER METRE



The Unit of Field Strength Explained.

TO obtain a proper conception of any scientific subject one must get an idea of values. It is impossible to lay down any laws without specifying how they are to be used in practice. And in making progress one must rely on definite systems of measurement, to be able to know exactly what is happening in any series of experiments. Two of the most difficult problems that face the wireless experimenter are: first, the measurement of signal strength, giving a criterion of the strength of reception at a given point due to a given transmission. Secondly, the measurement of sound intensity or pressure, especially in connection with work on microphones or loud-speakers. The first problem has been solved, at any rate for normal wavelengths. In the second, great progress has recently been made, but results are not entirely conclusive. In this article we are concerned with the former problem.

Better Definition Required.

The time has come when the serious experimenter must change his conception of signal strength of reception from such vague standards as "phones on the table strength," or "good crystal strength at so many miles," to something more definite, expressed in terms of familiar units. Before going into this further, it would be as well to consider first of all the mechanism of electric wave radiation.

The simplest case of a wireless transmitter is that of the doublet or straight wire, in which electric oscillations are maintained by a generator of oscillations at its centre. The electromagnetic field set up by the process consists of two distinct parts. There is first of all the field due to electromagnetic induction. The strength of this field varies as $\frac{1}{r^2}$, where r is the distance from the centre of the doublet. Secondly, there is the field due to radiation which varies as $\frac{1}{r}$. In practice the induction field dies out rapidly as r is increased, and cannot be detected at more than a wavelength or so from the transmitter. The radiation field is the one that counts, and represents the energy of wave propagation. The meaning of this wave propagation is that electric and magnetic fields are propagated through the ether with the speed of light. An analysis of the problem shows that at any given distant point the electric and magnetic components of the field vary together in phase, with the frequency of the original oscillation. If E and H represent these respective components, their values and directions at any given instant can be represented as in Fig. 1. The electric field E is

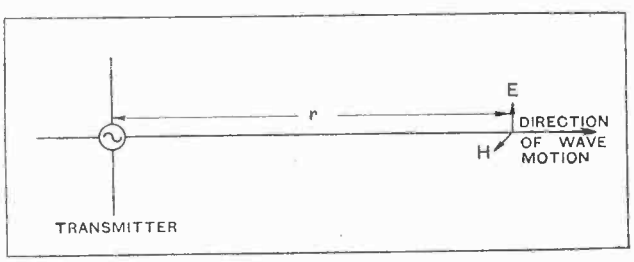


Fig. 1.—Electric and magnetic radiation fields set up by the doublet.

parallel to the doublet, or to the line of flow of current in the transmitting antenna. The magnetic field H is perpendicular to E, and to the direction of wave motion. As stated, the values of E and H at that point vary in phase as the wave progresses, and the amplitude of their effective values varies with $\frac{1}{r}$.

In the case of an ordinary transmitting aerial of any

Millivolts per Metre.—

type earthed at the lower end, the current in the aerial is a maximum at the bottom (say, I in value), decreasing as we go up to zero at the extremity.

The effective height of this aerial is defined as the height of a vertical single wire, having the same amount of current as above (I) flowing throughout its whole length, and giving the same field strengths at given distances. It is in general the aim of the wireless engineer to get the ratio of effective height to the actual height as great as possible to secure maximum radiation. In the "flat top" type of aerial (with maximum capacity located at the top) which, however, is not usually the most practical type, this result is almost attained.

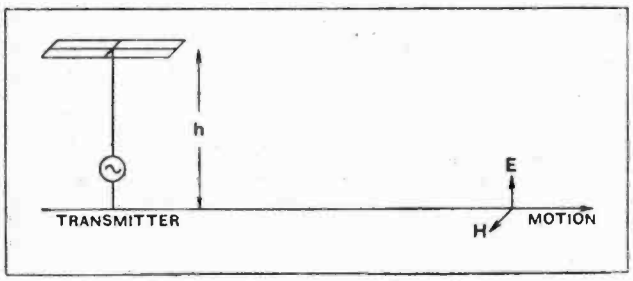


Fig. 2.—Field set up at a point on the earth's surface by a wireless transmitter.

Then the field set up at a distant point on the earth's surface is as in Fig. 2, with the electric force vertical and the magnetic force horizontal and perpendicular to the direction of wave motion.

The value of the electric field strength at a distance r in kilometres from the transmitter is given by the formula:

$$E = \frac{188hI}{\lambda r} \text{ millivolts per metre.}$$

where h = effective height in metres,
λ = wavelength in metres,
r = distance in kilometres,
I = current in aerial in amps.

We can obtain a similar formula for H (the magnetic component). These give the actual field strengths at any distance (where curvature of the earth can be neglected) from a transmitter, provided that there is no ground absorption of energy nor interference by waves reflected from the upper atmosphere.

The Cause of Fading.

Actually, there is, of course, absorption of energy by the ground, and a factor must be introduced depending on the wavelength, and on the nature of the ground (and what is on it) over which the wave passes. This may give very considerable reduction of field strength. And when the distance and time of the day are such that there may be a considerable amount of energy reflected from the upper atmosphere, the system of forces corresponding to the two fields is set up. The two fields may or may not be in phase, and the continual variation of phase causes the well-known fading effects.

What is the practical meaning of the term millivolts per metre?

It means that with a field strength of 1 millivolt per metre, the potential difference due to the field between two points situated on the same line of electric force, a metre apart, is 1 millivolt. Consequently, if we have a receiving aerial of effective height H metres in a field of strength N millivolts per metre, we shall obtain an E.M.F. of HN millivolts in this aerial, giving rise to a current in the aerial equal to $\frac{HN}{R}$ milliamperes, where R is the effective resistance in ohms of the aerial system, this being, of course, tuned to the wavelength of the incoming wave.

In the case of a frame aerial also, we can calculate the E.M.F. set up in the aerial circuit due to the field from a given transmitter.

Usually field strength measuring sets embody a frame aerial as being more convenient and more constant from the point of view of portability, and the measurement of field strength is usually made by comparing the received signal with a local oscillation of given strength.

Practical Considerations.

Let us consider now the practical results as regards field strength given by broadcasting stations.

Mr. Barfield has shown that the field strength at 10 miles from 2LO is about 10 millivolts per metre. At 30 miles, the limit of average crystal reception with a good outdoor aerial, the signal strength is about 3 millivolts per metre. Other comparisons with established approximate standards will occur to the reader, remembering that for a given transmitter, the field strength varies inversely as the distance, and that to multiply the field strength at a given point by n, the power of the transmitter must be multiplied by n^2.

If the field strength can be measured accurately, the effective height of a transmitting aerial can be worked out from the measurements taken near to it. The measurements taken further away, then, enable an estimate to be made of the absorption of energy due to the intervening ground.

It is important for the experimenter to get an idea of magnitudes with regard to field strengths, and to be able to assess the strengths of signals he receives in terms of the unit mentioned. For instance, how much better it is, in complaining to the B.B.C. about tramway interference, to be able to say "I get 3 millivolts per metre from my local station, and 4 millivolts per metre from each tram as it passes by. What are you going to do about it?"

THE "EVERYMAN PORTABLE."

IN next week's issue an efficient and eminently practical two-valve portable receiver will be described with full constructional details. Light weight, compactness, and sensitivity are features of the design which are certain to appeal to the majority of our readers.

CHOOSING YOUR CIRCUIT

THE POSSIBILITIES OF SOME STANDARD DESIGNS

By "RADIOPHARE."

THE sensitivity of every type of receiver is so completely governed by the excellence—or otherwise—of the associated aerial-earth system, by screening, and by more intangible factors generally referred to as "local conditions," that it is difficult, if not dangerous, to attempt to make definite statements as to the suitability of various circuits for different requirements and situations. Nevertheless, the writer will attempt to offer some suggestions as to the capabilities of well-known valve combinations, but would point out that the ranges to be quoted are liable to be halved or doubled if conditions are much worse or much better than the average. Only loud-speaker reception will be considered.

The ever-popular 2-valve set, with a grid circuit detector, reaction, and a transformer-coupled L.F. amplifier, can generally be depended upon to provide as much volume as the small loud-speaker customarily used with it can handle up to distances of twenty miles from a main station. Long-wave signals from Daventry are often receivable at a hundred miles, but a set of the kind under consideration should certainly not be relied upon to provide good reproduction at great distances or in circumstances where sufficient sensitivity is obtainable only by the use of critically adjusted reaction, which definitely impairs quality.

An Ideal Short-range Set.

The arrangement of a high-magnification detector without reaction coupled by a resistance to the output valve is excellent for purely local work, but requires a very strong signal; this is not generally obtainable at more than five or ten miles, and at slightly greater distances, or where "pick-up" is reduced by aerial inefficiency, an extra low-magnification stage, consisting of a power valve with a resistance in its anode circuit, may be added. Generally speaking, this latter combination is suitable up to fifteen miles; quite often at distances of this order it is possible to sacrifice some sensitivity and to gain in proportional amplification at the higher audible frequencies by substituting a "20,000 ohm" valve as a detector. It seems probable that this circuit will increase in popularity for high-quality local station work, as it is less likely to suffer from the ill effects of over-amplification than many circuits in more general use at the present time.

The detector-2 L.F. set with reaction is in many respects comparable to the same receiver with one low-frequency stage, although its range is very much greater; assuming a really good design with suitable valves and battery voltages, this may be approximately estimated at 100 miles. Great distances are seldom attainable without carrying reaction control to the point where distortion is produced, but 5XX is commonly received over the greater part of this country, on account of the comparatively small attenuation of its long wave.

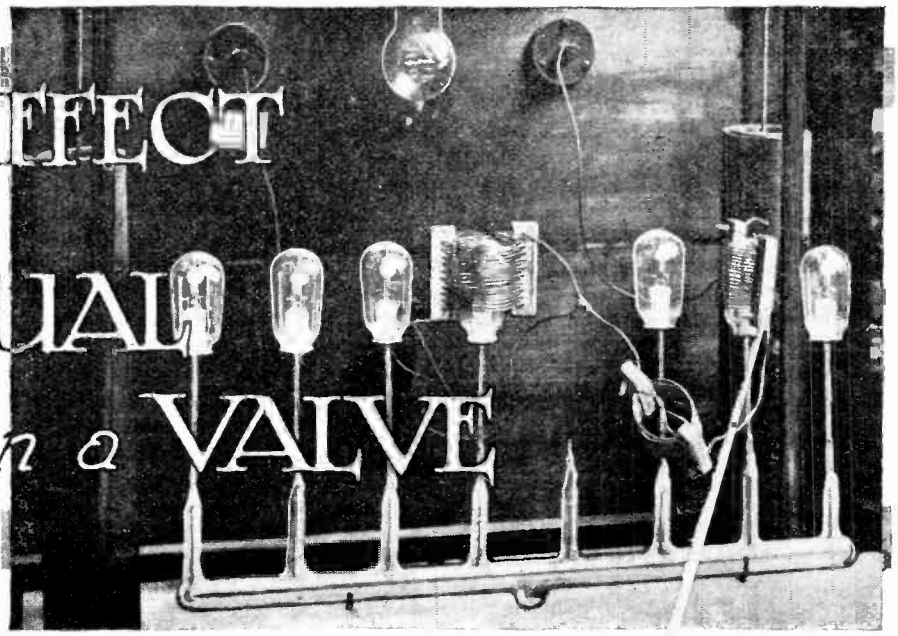
A detector-L.F. receiver is inherently lacking in selectivity, and accordingly it will inevitably suffer interference from a powerful nearby transmitter. It may well be compared with a modern H.F.-det.-L.F. set, which is certainly better in this respect. It is true to say, however, that the latter set has a slightly shorter loud-speaker range, but, on the other hand, it has an advantage in point of practical immunity from low-frequency oscillation—actual or incipient—which is generally met with in a two-stage amplifier.

Circuits for Long-distance Reception.

None of the foregoing receivers can fairly be considered as really suitable for long-distance reception, although it would be idle to deny that detector-L.F. circuits are capable, in skilled hands, of putting up a wonderful performance. We may now consider the popular H.F.-det.-2 L.F. circuit, of which it is not far short of the mark to say that the sensitivity is enough for loud-speaker reproduction of any signals which are worth while hearing. Occasionally, however, it is possible to take advantage of still greater sensitivity, particularly when the aerial-earth system is inefficient, or when atmospheric conditions are exceptionally favourable, but space does not permit of a discussion of more ambitious receivers.

Apart from the question of sensitivity, it would be wrong to close these notes without again touching briefly the matter of selectivity. Although a four-valve set may have sufficient sensitivity, it will be found that unless this quality is sacrificed unduly in favour of selectivity, signals from a station less than ten miles away will "spread"; this spreading at from two to five miles will be serious enough considerably to restrict the number of stations receivable without interference. The best remedy lies in the use of a second H.F. amplifier, even though the extra valve may not be strictly necessary from the point of view of sensitivity alone. It is seldom advisable to strive after maximum efficiency in a multi-valve amplifier; two moderately good stages give much more amplification than a single one of superlative excellence, and do not introduce troubles due to excessively sharp tuning.

The Effect of Residual Gas in a Valve



The Dangers of Reverse Grid Current.

By A. P. CASTELLAIN, B.Sc., A.C.G.I., D.I.C.

IN these days of dull-emitter filaments the residual gas left in the bulb may play quite a considerable part in the functioning of the valve—a part that does not seem to be at all generally realised.

This matter is becoming increasingly important now that high-plate voltages, obtained from the house mains supply, are being used, as it is due to high voltages and high mean plate currents that trouble is most likely to be experienced with gas. First of all, let us consider what happens in a three-electrode valve which is being used as an amplifier, and then consider the effect of a small amount of gas inside the bulb. Round the filament we have a cloud of electrons which have been evaporated from it, and which form the space charge. Electrons from the space charge are continually being accelerated towards the plate, the speed with which they strike the latter depending on the plate voltage. The energy associated with individual electrons depends on the speed at which they are travelling, and this, in turn, depends on their distance from the plate and on the accelerating force—the plate voltage.

The grid may be regarded as assisting or opposing the accelerating force due to the plate on electrons between the space charge boundary and the grid itself, according to whether its potential with respect to the filament is made more positive or more negative.

If the grid is actually at a positive potential with respect to any part of the space charge, then some of the electrons will actually strike the grid, and, flowing round the external circuit to the filament, constitute the grid current. If the grid is actually always at a negative potential with respect to the space charge, then no electrons will strike the grid, and there will be no grid current if there is no gas present. However, if there are a fair number of gas molecules present, some of the electrons travelling to the plate will collide with them, and if they are travelling fast enough will detach electrons from some of the gas molecules. These detached electrons will go to the plate like the other electrons, while the gas ions, as the molecules are now called, being positively charged by lack of an electron, will go to the grid or to the filament according to where they were generated and according to the grid potential.

If the plate voltage is fairly high, so that the initial electrons get up to sufficient speed to ionise the gas molecules fairly early in their path, and if the grid is kept negative with respect to the filament, quite an appreciable *reverse* grid current will flow round the external circuit with only a small amount of gas present in the bulb, so that the conditions prevailing in a valve amplifier are just those for causing a reverse grid current to flow if there is enough gas in the valve.

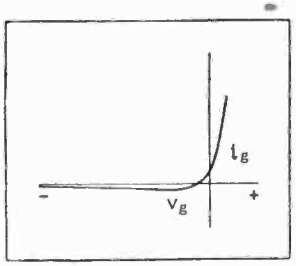


Fig. 1.—With increasing negative bias the reverse grid current first increases and then slowly decreases.

If the grid is made very negative so that the plate current of initial electrons is very much reduced, then the number of ions produced by collision will, of course, be less, since there are fewer electrons to produce them, and therefore the reverse grid current would be expected first to increase and then slowly decrease as the grid is made more negative, and in practice this is found to be the case, as is shown in Fig. 1.

The Effect of Residual Gas in a Valve.—

The reverse grid current has two main effects, which may be undesirable. First, inside the valve some of the ions produced between grid and filament may return to the latter when they are generated, and, being relatively massive, may in time damage the coating of a dull-emitter filament—the effect being cumulative, since the bombarded part gets hotter, emits more electrons, and produces more ions. Secondly, the external grid current will have some resistance, R, across which a potential v_1 will be developed by a grid current i_g such that $v_1 = i_g.R$—see Fig. 2.

In the case of ordinary grid current, this potential will be such as to make the grid more negative, but in the case of reverse grid current the grid will tend to become more positive than it was. If the grid bias ap-

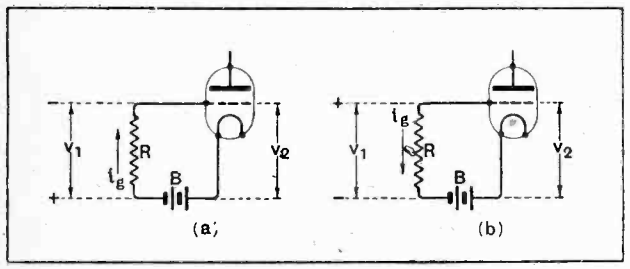


Fig. 2.—If the grid bias applied by the battery is B., then the mean negative grid potential will be $B+V_1$ for normal grid current (a), and $B-V_1$ when reverse grid current flows (b).

plied by battery be B, then v_2, the mean negative grid potential, will be $(B + v_1)$ for the case of normal grid current (Fig. 2*a*), and $(B - v_1)$ when reverse grid current is flowing (Fig. 2*b*).

Since the reverse grid current is moderately constant over a range of grid voltage, its effect on the quality of the output from the amplifier *may* be very small, and be merely limited to a reduction of grid bias on the valve. On the other hand, if transformer input is being used, the loading effect of a grid current of even a microampere or so on the transformer secondary may be quite sufficient to cause some distortion of output, especially when large voltage amplitudes are occurring.

Reverse Grid Current May Cause Loading.

The foregoing remarks apply to valves with a small amount of residual gas only, in which the reverse grid current is of the order of one or two microamperes.

There is one beneficial effect that may occur with a *small* amount of gas present in the valve, which is the improvement in its mutual conductance owing to the reduction of the space charge due to the presence of positive ions in the neighbourhood of the filament. If more than a small amount of gas is present, then this advantage is lost for an amplifier valve, since, although the effective mutual conductance increases, the plate current ceases to be directly proportional to the grid voltages, owing to a large variable proportion of the electrons forming the plate current being the result of collisions, and not coming directly under the influence of the grid; and in any case the much larger reverse grid currents obtained due to the extra gas preclude the use of any ordinary input coupling.

The effects of a small amount of gas in a three-electrode valve may be summarised as follows:—

(1) Distortion due to loading the input circuit may occur.

(2) The life of the filament, especially if of the coated type, will be reduced.

(3) The effective bias potential on the grid of the valve may be much less than that due to the bias battery—thus the valve may apparently be capable of handling a given input, but actually this will not be the case. For example, if the bias battery is 9 volts, reverse grid current 2 microamperes and the grid leak 2 megohms, the negative potential on the grid will only be $9-4=5$ volts.

(4) The mutual conductance may be increased.

The disadvantages of gas—even a very small amount—in a three-electrode valve used as an amplifier with ordinary circuits and components certainly outweigh the possible advantage; besides, there is always the possibility of the amount of gas increasing and rendering the valve useless as an amplifier.

How the Valve is Evacuated.

To understand why there should be gas present in a modern valve, which has presumably been well exhausted, it is necessary to examine the exhaustion process in some detail. Setting aside definitely faulty exhaustion, or the possibility of an actual small leak, since in both these cases such a valve should not reach the public but should be rejected in works tests, there are several places in the valve whence the gas can come—the glass bulb, the electrodes, including the filament, and the gettering on the bulb.

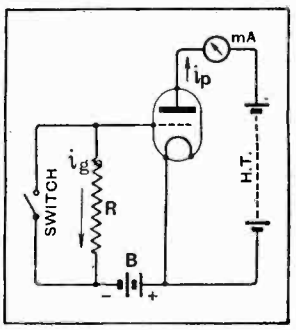


Fig. 3.—The circuit of the vacuum tester using an H.T. battery.

In pumping the valve the glass bulb is baked in an oven to a high temperature to free it as far as possible from gas, and the grid and plate—especially the nickel plate—is usually made from metal which has been pre-heated in a bulb on the pump so as to reduce the amount of gas produced at the second pumping when the material is made up into the electrode. The grid and plate are then joined together and a large positive potential applied to them. The filament is usually over-run for a short time, and the resulting large plate current heats up the grid and plate by the electron bombardment until they are at a bright red heat. Since the valve is still on the pump, any gas evolved from the filament, grid, and plate, is thus removed, and the valve sealed off.

Attached to the plate is a small piece of nickel to which little squares of magnesium have been welded, and when the valve has been sealed off this piece of nickel is made red-hot, usually by means of large eddy currents induced in a high-frequency field, and the magnesium volatilised and deposited on to the cold surface of the glass, giving the familiar silvered appearance.

The purpose of using the magnesium is to provide an

The Effect of Residual Gas in a Valve.—

enormously large surface which will *adsorb* any residual gas which may be present, thus "finishing off" the high vacuum process. Some valves—notably some of those using the very dull-emitter filaments—do not go through the bombarding process at all, possibly owing to the filaments being seriously injured by it, and the electrodes are heated up by the eddy current process after the valve has been sealed off, the magnesium "getter," as it is called, being relied on to deal with any gas evolved in this process. The magnesium is usually welded on to the plate, and is volatilised in the eddy-current heating of the latter.

Testing the Hardness of a Valve.

Some residual gas is therefore trapped by the gettering, and, although it is quite safely held under normal conditions, yet some proportion of this trapped gas may be released if the valve bulb gets too hot, and may not be completely reabsorbed on cooling. Now that H.T. eliminators are being increasingly used, providing high voltages for the amplifier valves, the power dissipated on the plate of the last valve (i.e., plate volts × plate current) may heat up the plate considerably. This heat has got to be dissipated by the bulb, and if the latter is small, it will get quite warm, and perhaps hot enough to release a little gas from the getter or even the glass itself. Of course, if this happens the valve is being overrun, but certainly the same electrode assembly could be made to deal with more power by using a larger bulb, which would keep cooler.

In the course of testing large numbers of new valves the writer has sometimes come across valves which do contain enough gas to show a few microamperes of reverse grid current, and, as it has been pointed out that such valves are on the whole unsuitable as amplifiers—L.F. amplifiers, at any rate—a simple method of test for gas which does not involve the use of a sensitive and expensive microammeter will probably be of interest.

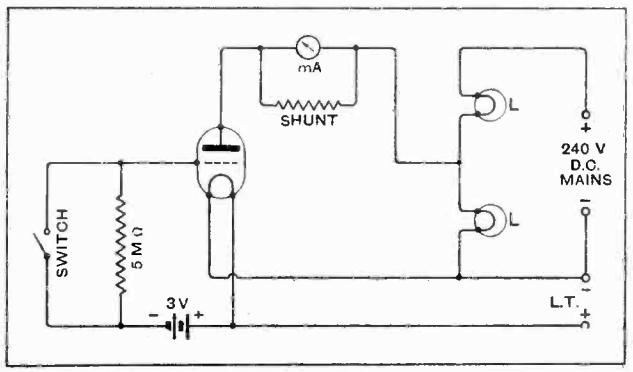
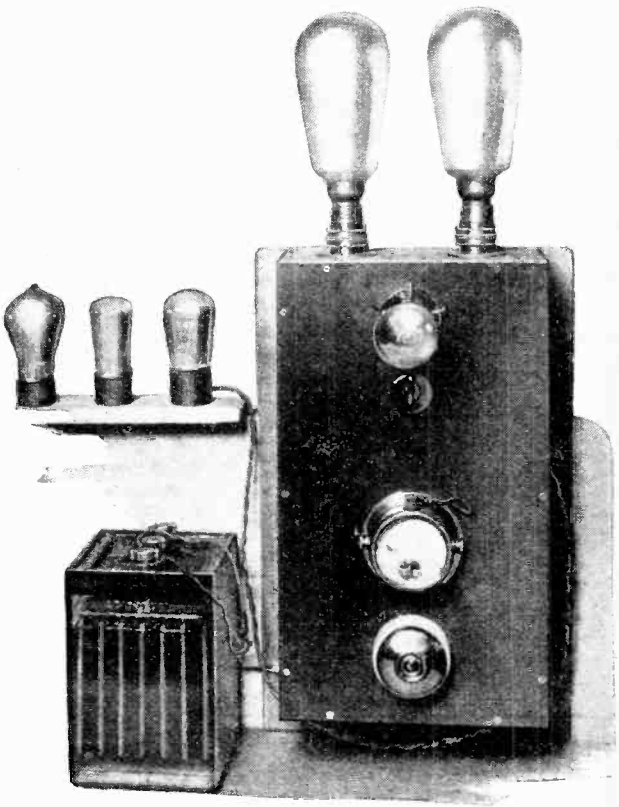


Fig. 4.—Circuit of mains-operated vacuum tester shown in photograph. L L, 40 watt, 240-volt lamps. The switch should be of the anti-capacity type and have good insulation.

Incidentally, this method lends itself to the construction of a piece of apparatus which is useful for very rapid testing of valves, in large quantities if necessary, for gas. Such an instrument is almost indispensable in any laboratory using valves for measurement purposes, where hard valves are essential, and also will be found extremely useful for the testing of valves wherever they are used or produced in large quantities for commercial purposes.

The principle on which the instrument works may be explained with the aid of Fig. 3. The valve is supplied with a suitable filament heating current and H.T. voltage, and in the grid circuit is connected a resistance R



Laboratory tester for rapid measuring of the hardness of valves.

and a grid bias battery B, provision being made for short-circuiting R by means of the switch.

When the switch is closed, the grid potential will be − B volts, and the plate current i_p will be indicated on the meter M. If the valve is quite hard, i.e., if there is no appreciable gas, there will be no reverse grid current.

On opening the switch, if there is no reverse grid current the grid potential will still be − B volts, and the plate current as indicated by the meter M will be unchanged. However, if there is a reverse grid current i_g, then the potential of the grid will not be − B when the switch is open, but $(-B + i_g.R)$, so that the plate current will change as the switch is opened and closed.

By choosing a suitable high value for R, and paying attention to insulation of the grid circuit, it is possible to make the instrument sensitive to currents of the order of fractions of a microampere while using a very cheap or insensitive meter in the plate circuit.

(For a universal instrument mA should preferably have two ranges, so as to cover RC and power valves as well as the general-purpose class.)

As an example, suppose a valve with a mutual conductance of 0.8 mA. per volt is being tested, and that R

The Effect of Residual Gas in a Valve.—

is 5 megohms. A movement of the pointer of the meter will probably be able to be detected easily for a change of 0.1 mA. in a 5 mA. full scale, which corresponds to a change of $\frac{0.1}{0.8}$ volts on the grid.

A change of one-eighth of a volt on the grid corresponds to a current of $\frac{1}{8 \times 5}$ microamperes, or *one-fortieth of a microampere.*

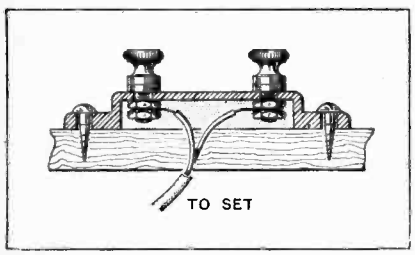
Valves required for measurement purposes should certainly pass this test without producing any visible indication on the meter.

A three-volt battery is used for the grid bias B in order to ensure the grid being more negative than the position where normal grid current is likely to start in any valve. Reverse grid current is also usually a maximum somewhere about this voltage under normal conditions, and a 1½-volt battery will be found insufficient.

The circuit of the actual tester illustrated in the photograph is given in Fig. 4. The instrument is adapted for running from D.C. mains for simplicity.

LOUD-SPEAKER EXTENSION POINTS.

The enthusiastic amateur probably has several old fixed condensers in his scrap box which, from various causes, have developed defects, rendering them useless for the performance of their original function. A simple operation will enable these discarded components once more to be



Using discarded fixed condenser cases as loud-speaker extension points.

pressed into service. By simply removing the mica and foil, having first scraped away the wax, it is possible to convert these into neat and unobtrusive loud-speaker extension points, the wiring from the loud-speaker being connected to the underside of the terminals by means of the usual nut and bolt. F. A. D.

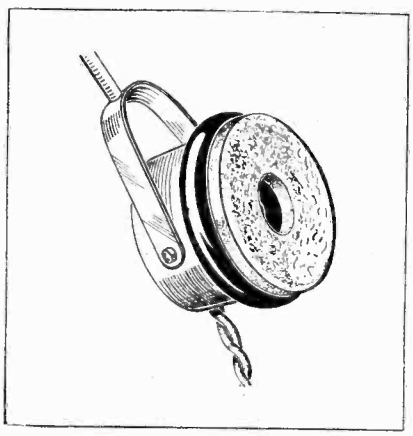
oooo

A LONG-FELT WANT.

In spite of the popularity of loud-speaker receivers, crystal sets and one valve instruments which necessitate the use of headphones are still popular among many readers. As is well known, the pressure on the ears becomes uncomfortable if headphones are worn for any length of time, and although many devices are sold for fitting over the ordinary headphone's ear-cap in order to counteract this discomfort, it will be found that in many cases the device causes the diaphragm to be at too great a distance from the ear, and signals are therefore not sufficiently strong.

NOVELTIES FROM OUR READERS.

An inexpensive and simple method of procuring the advantages of comfort supplied by these devices without incurring the concomitant loss of signal strength is shown herewith. All that is necessary is to obtain a piece of felt or other suitable material, to cut it roughly to the shape shown, not forgetting the hole



Making the earphone more comfortable.

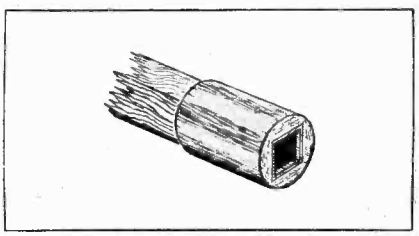
in the centre, and then to attach it lightly to the ordinary ebonite ear-cap by means of "seccotine" or some similar substance. It will be found that this arrangement has also the effect of excluding, or at least mitigating to some extent, any external noises, such as the rustling of newspapers by other people, which is usually a prolific source of annoyance to headphone users. A. W.

oooo

EXPONENTIAL HORNS.

Real difficulty is found in connecting the loud-speaker unit with the throat of a horn which is of square section. Rubber does not make an airtight junction round a square section throat and a metal tube adaptor offers similar difficulties. The following has been done with complete success:—

Roughly mould plastic wood (sold in tins) firmly round the throat of the horn for about 1½in. as shown in



By the use of plastic wood the square throat of a loud-speaker horn can be adapted to fit the circular orifice of an electromagnetic movement.

diagram. Allow this to harden for about 24 hours, when it will be practically part of the wooden horn. File and sandpaper until the outside is cylindrical, care being taken to make the outside diameter the required measurement. A stout rubber connection will now take both unit and throat of horn, easily making a thoroughly airtight join.—H. M. C.

VALVES FOR IDEAS.

Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A dull emitter receiving valve will be despatched to every reader whose idea is accepted for publication.

Letters should be addressed to the Editor, "Wireless World and Radio Review," Dorset House, Tudor Street, London, E.C.4, and marked "Ideas."

The CABLE WIRELESS MERGER

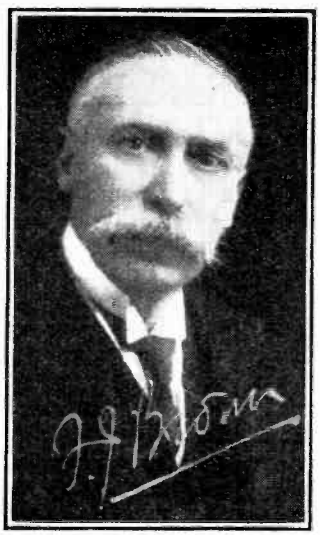
By F. J. BROWN, C.B., C.B.E., M.A.
Director of the International Cable Companies Association, formerly Assistant Secretary General Post Office.

The recent announcement that an agreement has been reached between the Marconi Company and the Eastern Group of Cable Companies with a view to amalgamation is an event which is destined to have far-reaching consequences which will affect materially the future development of wireless in this country as a means of communication.

Mr. F. J. Brown, who contributes the present article discussing the character and probable effects of the merger of cable and wireless interests, has had a very long administrative experience in connection with communications and is the author of "The Cable and Wireless Communications of the World," a book the study of which is recommended to any reader who desires to become familiar with the course of events which have led up to the present position.

FOUR years ago the Donald Committee on Imperial Wireless Telegraphy, of which the writer was a member, recommended "that the State, through the Post Office, should own all wireless stations in Great Britain for communication with the overseas Dominions, Colonies, Protectorates and territories"; and "that the Post Office should operate directly, under an improved business organisation, all the Empire stations in Great Britain."

The principle of State ownership and operation was accepted by the British Government, and has since been acted on so far as the stations in this country are concerned; but the question of an improved business organisation, on which my colleagues laid great stress, was allowed to lapse. The corresponding stations in South Africa and India are owned and worked by subsidiary Marconi Companies; that in Australia is owned and worked by a company in which the Commonwealth Government has a preponderating interest; while that in Canada is owned and worked by a company which was originally a Marconi subsidiary but is now controlled by other interests.



As regards the general policy, much has occurred since the Donald Committee reported; and it is by no means clear that the policy which recommended itself to the Committee in 1924 is the best for to-day. In the first place, the beam stations which the Marconi Company, as contractors, erected in this country to the order of the Post Office for communication with Canada, South Africa, India and Australia have proved successful. The Post Office, while maintaining the rate for the Anglo-Canadian beam service at the same level as the cable rate, adopted substantially lower rates for the South African, Indian and Australian services; and these low rates, combined with a fairly efficient service, attracted a considerable amount of traffic from the cables to the beams. In the case of the State-owned Pacific Cable, the loss of traffic was so serious that some at least of the Governments concerned began to doubt whether the cable, which had just been duplicated at a cost of more than £2,500,000, could continue to pay its way. This cable is owned by Great Britain, Canada, Australia and New Zealand jointly, and the somewhat absurd position had thus arisen that a wireless service, in which the British and Australian Governments were interested, was undercutting and even endangering the efficient future maintenance of an important cable in which the same Governments, along with Canada and New Zealand, were interested. In the circumstances, the Imperial Wireless and

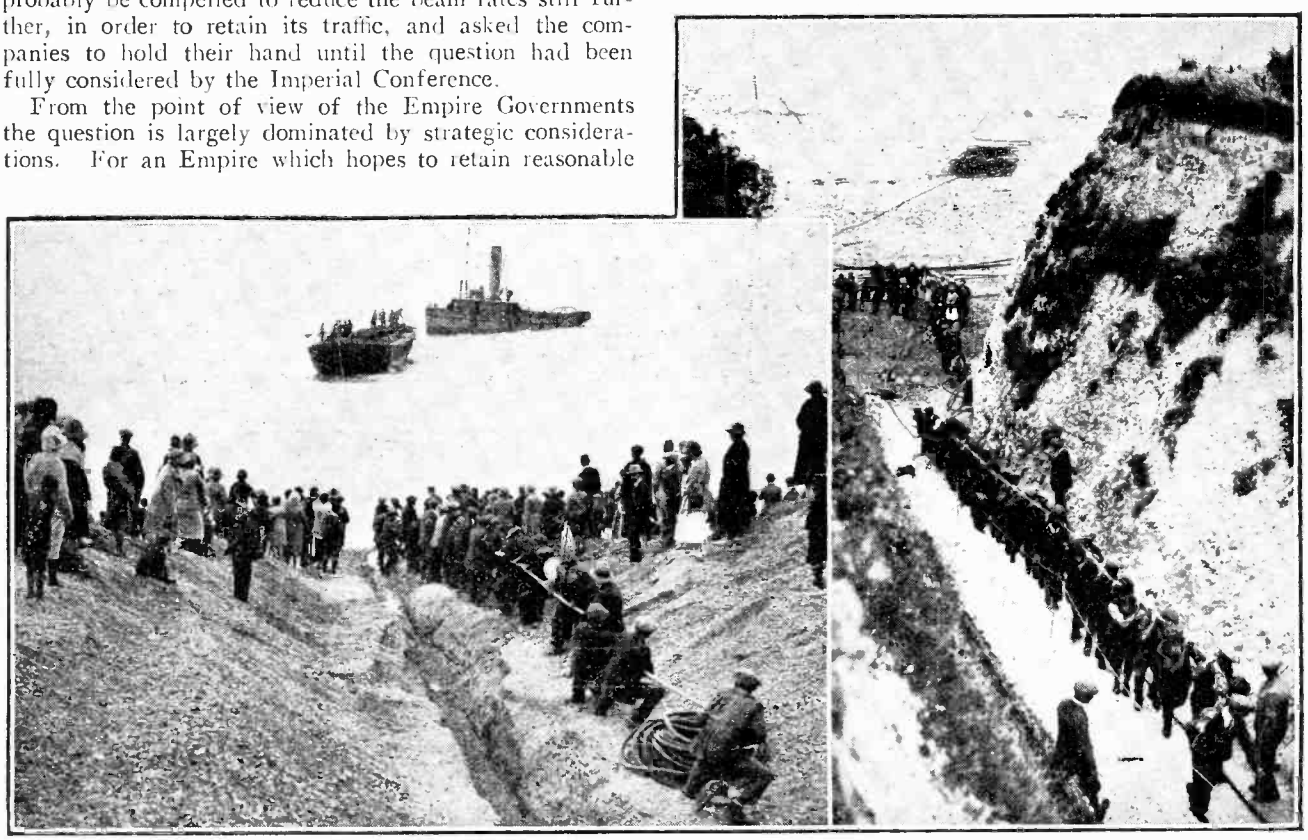
The Cable Wireless Merger.—Cable Conference, which has been sitting in London for some months past, was convoked to consider the whole question.

But the question obviously concerned the Eastern and Associated Telegraph Companies (which serve the whole Empire, except Canada and the West Indies) in much the same way as the Pacific Cable Board. The Companies, however, proposed to deal with the matter in a different way. They recognised that it was the "rate differential" which was attracting traffic from their cables; and they are understood to have informed the Post Office last autumn that they proposed to reduce their rates to the same level as the beam. The Post Office is understood to have replied that in that case it would probably be compelled to reduce the beam rates still further, in order to retain its traffic, and asked the companies to hold their hand until the question had been fully considered by the Imperial Conference.

From the point of view of the Empire Governments the question is largely dominated by strategic considerations. For an Empire which hopes to retain reasonable command of the sea, cable communication is the ideal method of telegraphy between fixed points in time of war or strained relations. During the recent war only one main line cable belonging to the Allies was interrupted by the enemy; and this was partially restored within a few days, and completely restored within two months. The Allied cables generally carried an enormously increased traffic with great efficiency, and—what is of extreme importance in war—with absolute secrecy. The Germans, on the other hand, were compelled to rely on their long-wave wireless stations for their long-distance telegraphic communications. These could have been interrupted by the Allies (at some expense, possibly, to the efficiency of their own long-wave communications), but the Allies found it more advantageous to intercept the German messages than to stop them. The beam services, quite apart from air-craft attacks on the aerial systems, could easily be interrupted by any small station of corresponding frequency on the line of route which chose to concentrate its waves on the beam receiving stations, and this could be done by an enemy without interfering with his own wireless communications. If, therefore, an enemy preferred to allow our beam communications to go on, it could only be because he found it more advantageous to read our messages than to stop them.

Cable communication may thus be regarded as an Imperial necessity for strategic reasons; and the next point is, What is to be done to ensure the effective maintenance of the cables in the face of beam competition? Is the Post Office to go on undercutting the cables in order to ensure traffic to its beam services, traffic which, if the rates are further reduced, may not be remunerative; or is some reasonable arrangement to be made which, while ensuring to the telegraphing public the benefit of low rates, will also ensure the Empire at large against any risk of its losing its cable system?

To ask such a question is surely to answer it. Incidentally, also, such an arrangement will ensure to the commercial public the secrecy of their more important telegrams; and a continuity of service under all atmospheric conditions which wireless cannot yet give. On



Landing and hauling ashore the end of a submarine cable. In this instance the weight of the cable is 25 tons to the mile.

The Cable Wireless Merger.—

the latter point, the Secretary of the Post Office stated in a recent volume on the work of his Department[1] that

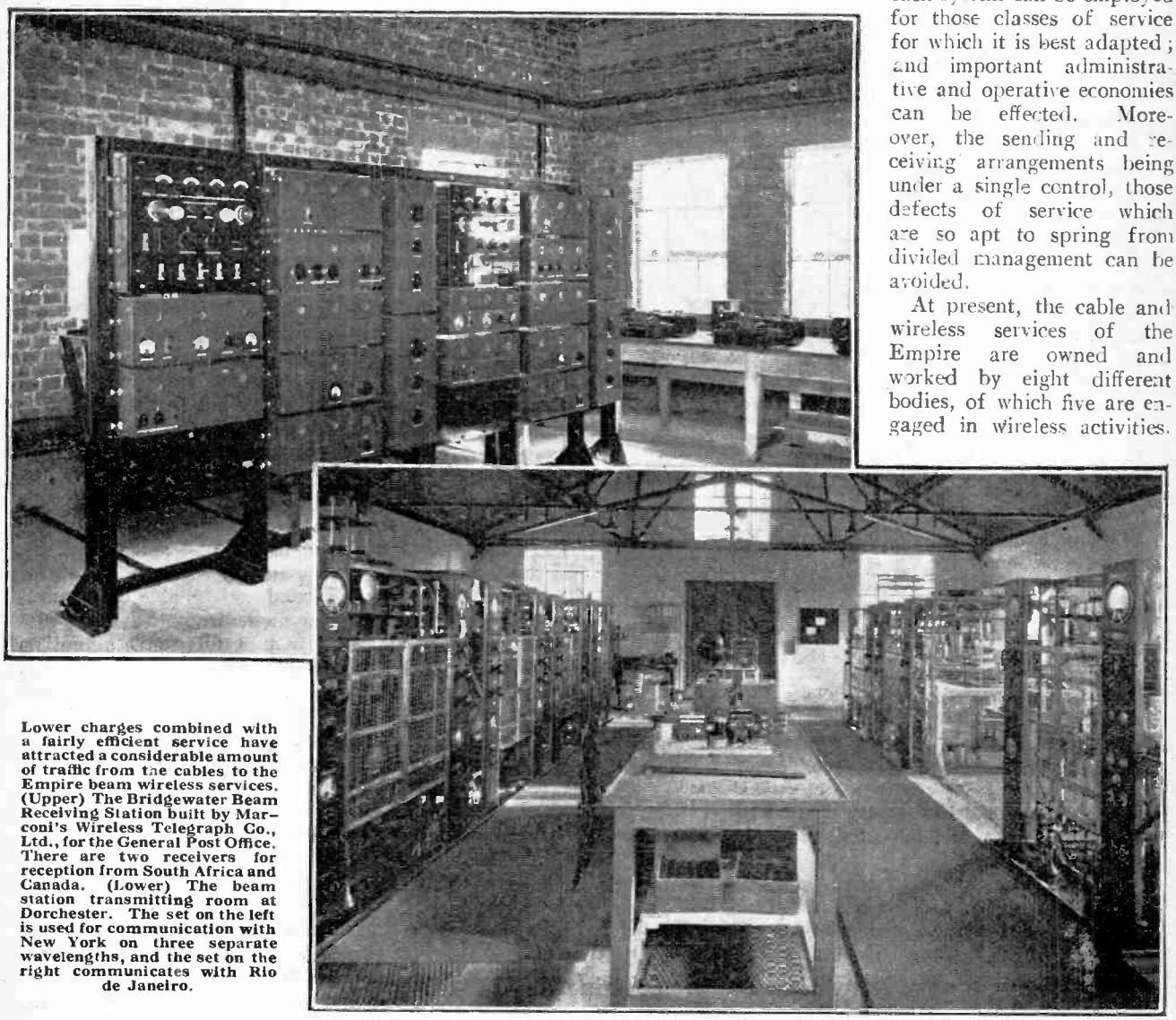
> " for a varying number of hours each day the (beam) " signals are unreadable owing to ' fading ' or " atmospheric conditions, and no means have yet " been found to predict either the incidence or the " duration of the blank periods."

And this has still more recently been confirmed in the annual report of the American Radio Corporation, which, while emphasising the success of the beam and of the American " projector " system, stated that, in the view of the Corporation, high-power long-wave stations are still necessary to ensure continuity of service.

In a system which employs both cables and wireless such continuity is, of course, ensured by means of the cable; and thus on all grounds we are driven to the desirability of an arrangement between the two methods of communication.

The simplest and best arrangement, other things being equal, is obviously a general fusion of the two systems, under common management and operation. In this way each system can be employed for those classes of service for which it is best adapted; and important administrative and operative economies can be effected. Moreover, the sending and receiving arrangements being under a single control, those defects of service which are so apt to spring from divided management can be avoided.

At present, the cable and wireless services of the Empire are owned and worked by eight different bodies, of which five are engaged in wireless activities.



Lower charges combined with a fairly efficient service have attracted a considerable amount of traffic from the cables to the Empire beam wireless services. (Upper) The Bridgewater Beam Receiving Station built by Marconi's Wireless Telegraph Co., Ltd., for the General Post Office. There are two receivers for reception from South Africa and Canada. (Lower) The beam station transmitting room at Dorchester. The set on the left is used for communication with New York on three separate wavelengths, and the set on the right communicates with Rio de Janeiro.

Such an organisation, or want of organisation, cannot continue indefinitely, and the present appears to be the psychological moment for introducing a radical improvement.

Fortunately, while the Empire Governments have been deliberating, the chief British cable and wireless companies have got together and have evolved a fusion of interests which seems to promise the *desiderata* for which the Governments are seeking. With the financial details of the proposed fusion we are hardly concerned. The capital (nearly £54,000,000) is large; but it is understood to represent no more than the present value of the assets (cables, plant, buildings, investments, and cash) of the combining companies. The distribution of the shares is

[1] " The Post Office," by Sir Evelyn Murray, K.C.B., p. 107.

The Cable Wireless Merger.—

such as to give a steady and moderate income to the established cable interests, while affording a more speculative, but perhaps eventually high, return to the wireless side of the combination, whose possibilities are still mainly in the future.

But the parties have stated emphatically that the merger is contingent on suitable arrangements being made with the British and Dominion Governments. They have allowed it to be understood that it is part of their proposals that the Government beam and cable services should enter the merger, subject, of course, to suitable financial provision as between the Governments and the companies, to adequate protection to the public in the matter of low rates, and to suitable control in time of war or emergency.

Without the inclusion of the Post Office beam stations, which, as we have seen, are the source of all the difficulty which the State-owned and private cables are experiencing, the proposed merger would be of practically no value, so far as the Empire communications are concerned. This view is that of Sir Robert Donald himself, who wrote as follows in a letter which appeared in *The Times* of March 24th :—

> "Nothing will come of the proposed merger of "cable and wireless interests without the co-opera- "tion of the various Governments. . . .
> ". . . . No such combination, however, is possi- "ble unless the Post Office beam wireless and cables "come within it for operation. . . . It is essential "that they (the beams) should be included in an all- "Empire system so far as operation is concerned. "They should be worked in conjunction with the "corresponding stations in the Dominions and under "the same management."

Mr. Baldwin has stated that the details of the merger are being considered by the Imperial Conference, and the Government is apparently keeping an open mind on the question of the transference of the Post Office stations until the report of the Conference is received.

Meanwhile, a new and important factor has come into play. This is the great American merger between the International Telephone and Telegraph Corporation and the Mackay Telegraph Companies, with a capital of, roughly, £60,000,000, or about £6,000,000 more than that of the British merger. Both of the American organisations have extensive cable systems, and both own important wireless patents and have expressed their intention of establishing transoceanic short-wave telegraph and telephone services as an adjunct to their cable systems. Mr. Clarence Mackay, the President of the Mackay Companies, has stated very emphatically that the American merger is not to be regarded as in any sense a reply to the British proposals. It had been under consideration for some time and its consummation has taken place entirely without reference to the British merger. But the American merger must undoubtedly be considered in conjunction with the British merger. If the Government should put any serious obstacle in the way of the latter, it would be open to the British cable interests to dispose of a large part of their system to the American Corporation—not perhaps their Empire cables, but other cables which are of hardly less importance from an Imperial point of view. And, in any case, if the British companies are to speak on equal terms with their foreign friends, it is necessary that they should be comparable in standing and resources.

We live, in short, in times of big mergers, and it is essential that we should approach the question of the British cable-wireless fusion in a broad spirit, with the object of securing for the scattered communities of the Empire the best means of rapid and reliable communication that science can place at their disposal, at the lowest possible charges consistent with a reasonable return on the capital expended. If the Eastern-Marconi proposals do not, in the opinion of the Empire Governments, adequately meet the needs of the situation, it is now for the Governments to propose such modifications as they may consider necessary, or to produce some other scheme as boldly conceived as those proposals, as fair to all parties, and as likely to facilitate ready intercourse between the various parts of the Empire

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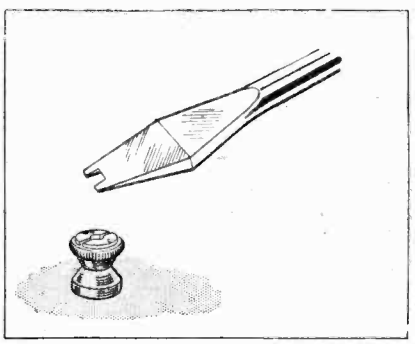
Tightening Inaccessible Terminals.

THERE is a general tendency nowadays for various wireless components, such, for instance, as valve-holders, to be provided with small terminals instead of soldering tags. In such cases it is usual either to pass a wire under the head of the terminal or to solder it to a soldering tag, this latter device afterwards being slipped over the shank of the terminal, and the top screwed on. It is often difficult in these cases to tighten a small inaccessible terminal sufficiently to obtain a good connection in a receiver

The difficulty can, however, be very easily overcome. First, a slot should be sawn with a hack-saw in the top of the terminal, as shown,



Slotted screwdriver for use with inaccessible terminals.

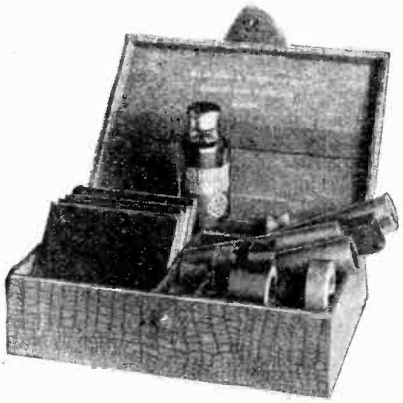
the terminal top being held in a small vice or a pair of pliers. Were it not for the fact that the shank always protrudes through the centre of the terminal, it would be possible, when once the slot had been cut, to tighten up the nut by means of a long, narrow-bladed screwdriver, for of course, access to it could be had with such a screwdriver, when, owing to the position of the nut, it would be extremely difficult to use the fingers or a pair of pliers. Screwdrivers are not expensive, and this final difficulty may be overcome by cutting a slot in the centre of the screwdriver blade, as shown. This slot should be just wide enough and deep enough to clear the terminal shank. E. B.

NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

IOCO INSULATING PRODUCTS.

A wide range of impregnated insulating materials, many of them suitable for wireless work, are made by the Ioco Rubber & Waterproofing Co., Ltd., Netherton Works, Anniesland, Glasgow, W.2. Of particular interest to home constructors are the "Formapex" panels, which are built up of paper laminations impregnated with Bakelite under hydraulic pressure. All standard sizes up to 48in. × 24in. in any thickness are available. The price of a panel 7in. × 21in. × ¼in. is 8s. 10s. in black and 12s. 3d. in mahogany finish, and other sizes are supplied at pro rata prices.



Specimens of Ioco insulating products.

Other materials made by this company are the "Miocarta" laminated tubes, which are obtainable in round and square section, and the "Linapex" series of varnished silks and tapes which should prove useful in power transformer construction.

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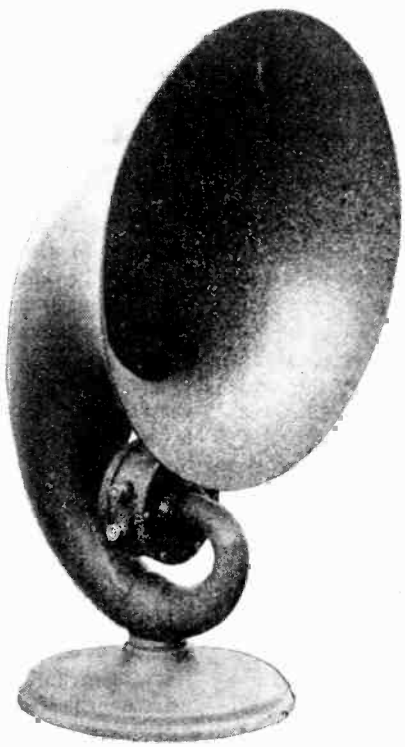
THE FERRANTI SPEAKER.

When used in conjunction with the average three- or four-valve set this loud-speaker will give pleasing results in which none but the hypercritical could trace any deficiency. The makers admit that the reproduction of low notes is not equal to that of a properly designed coil-driven cone, but they claim with some justification that the reproduction in the upper region of the musical scale is superior to that of the majority of cone speakers. The expansion of the sound conduit follows the true exponential law and is coiled to reduce the space occupied. It is 2ft. 6in. in length, and has, therefore, according to theory, a fairly high "cut off" frequency. In other words the sound amplitude at the mouth of the horn ceases to be strictly proportional to the diaphragm amplitude below this frequency. The term "cut off" is a piece of loose technical slang which is being interpreted quite seriously by the general public who labour under the misapprehension that all tones below this frequency must fade to a whisper. A practical test with the Ferranti shows this to be nonsense. Low tones are most certainly reproduced and in very satisfying volume. Indeed, the balance of tone will be preferred by many people to the over-emphasis of bass notes peculiar to many types of loud-speaker.



Ferranti exponential horn loud-speaker with new pedestal base.

It should not be forgotten that a reduction in amplitude of 30 per cent. must be made before the ear notices a distinct change in volume, and the "cut off" would have to be extremely well defined to produce the necessary reduction.

Due to the special non-resonant material of which the horn is made the speaker will handle considerable volume without vibration. The movement is of the iron diaphragm type and is adjustable, the windings having the comparatively low resistance of 1,300 ohms.

Since the Show the base has been redesigned to give greater stability and improved apearance; the price remains at £3 3s.

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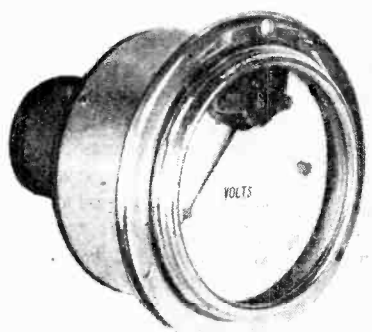
SIFAM "ELIMETER."

The current taken by a meter must be exceedingly small if it is to be used to measure the voltage output of a mains eliminator with any degree of accuracy. In other words, its internal resistance must be of a higher order than that usually associated with moving-coil measuring instruments.

In the "Elimeter," made by the Sifam Electrical Instrument Co., Ltd., 10a, Page Street, London, S.W.1, the resistance is over 100,000 ohms, and the sensitivity of the moving-coil system has been increased so that a full scale deflection (220 volts) is obtained with a current of only 2.0 m.A.



Sifam "Elimeter" for reading eliminator output voltages.

After correcting for zero error the scale was checked with the meter both horizontal and vertical. In both posi-

tions the scale reading was 4 volts low at all points between 80 and 200 volts; the percentage error in the particular instrument tested is, therefore, 2 per cent. at 200 volts. The price is 30s.

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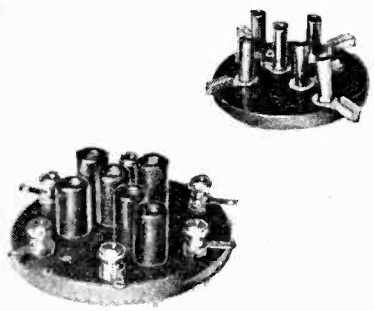
"DUCO" COIL BASES.

In these bases the sockets are spaced to take standard six-pin coils, in which four of the contact pins are arranged in line with the remaining two mounted



"Duco six-pin coil bases.

laterally. The bases are marketed by Messrs. Brown Bros., Ltd., Great Eastern Street, London, E.C.2, and two types, "A" and "B" are available.

Type "A," which sells at 2s. 6d., is fitted with terminals and recessed connections under the base, the sockets being ebonite-shrouded to prevent the possibility of short-circuits. In Type "B," soldering tags only are provided, and the sockets are not shrouded; the price is 1s.

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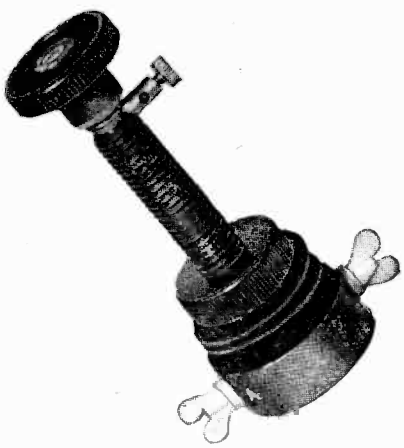
MARCONIPHONE LEAD-IN AND EARTHING SWITCH.

Insurance companies require that the aerial shall be disconnected and earthed outside the house, and receiving installations must comply with this regulation before a policy can be issued. When high-tension current is derived from the mains it is also essential that the receiver should be isolated from the aerial before the latter is connected to earth; unless this precaution is taken there is a possibility that the fuses will be blown.

The Marconiphone switch complies with both the above conditions. The aerial and earth contacts are bridged by a short-circuiting blade which is insulated from the aerial connection to the set, and the switch contacts are contained in a moulded Bakelite box which is outside the house when the switch is mounted on the window-frame. For this purpose a hole $\frac{5}{8}$in. in diameter is required, and sufficient thread is allowed on the fixing screw for thicknesses between $\frac{5}{8}$in. and $2\frac{5}{8}$in. With suitable packing the switch could be fixed through the window pane itself, leather packing washers being provided to give a tight grip.

The switch contacts are substantial



In the Marconiphone lead-in switch the aerial is disconnected from the set before being joined to earth.

and smooth in action, and the "outside" portion is well protected from the weather, the wing nut terminals being zinc plated.

COIL CALCULATIONS.

Useful Design Data for 2,000 and 3,000 Microhenry Coils.

IN a recent issue two sets of curves were published giving design data for coils of 200μH and 325μH which tune over the normal broadcast band with condensers of 0.0005 mfd. and 0.0003 mfd. respectively in parallel.

The curves shown here give similar information for coils of 2,000μH and 3,000μH, which, with the same values of capacity in parallel, cover the band of wavelengths between 1,000 and 1,800 metres.

In the case of these coils it was found that for the smaller diameters the ideal winding length of 8/15 × diameter affords insufficient space for the necessary turns of the ideal diameter wire, and so the most efficient coil has a somewhat greater winding length. For diameters less than $5\frac{1}{2}$in. there is only sufficient space for enamelled wire, but above this figure it will be found that single silk-covered wire may be used.

A word of warning is necessary if it is intended to use one of these coils in the aerial circuit. With a 3,000μH coil the resonant capacity at 1,000 metres is only 90$\mu\mu$F—a figure sufficiently low to be difficult of realisation unless special precautions are taken.

The capacities actually in parallel with the coil are:

(1) That due to the capacity of the aerial;

(2) The self-capacity of the coil and its associated wiring;

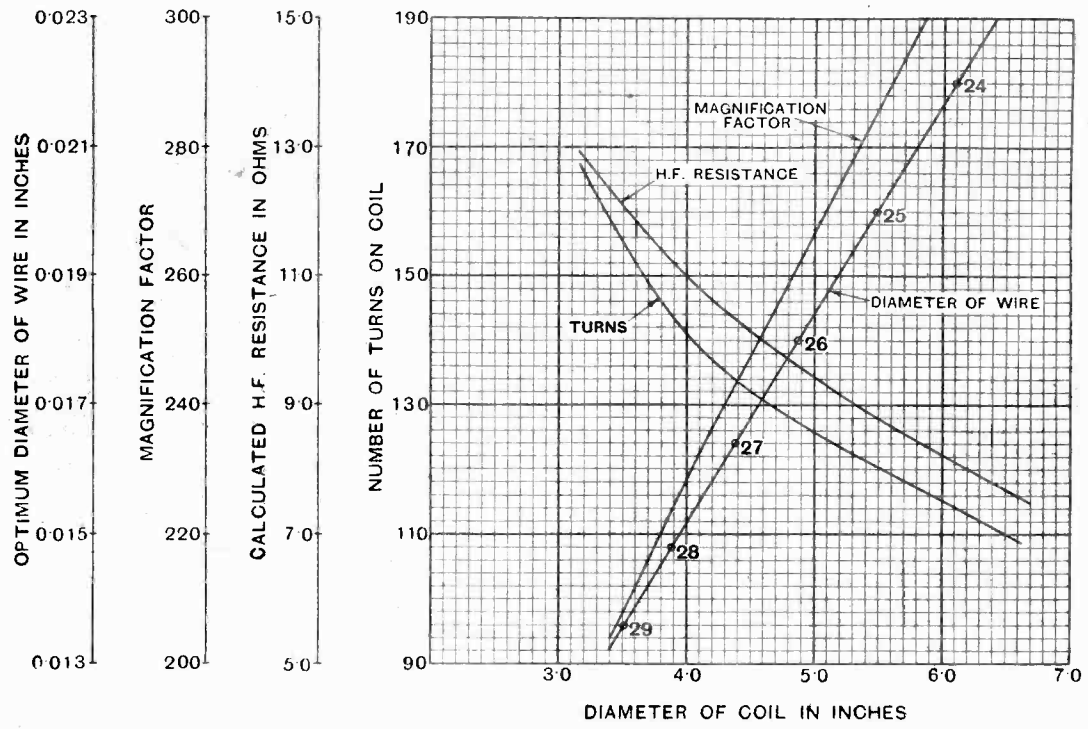
(3) The inter-electrode capacity of the valve following the coil; and

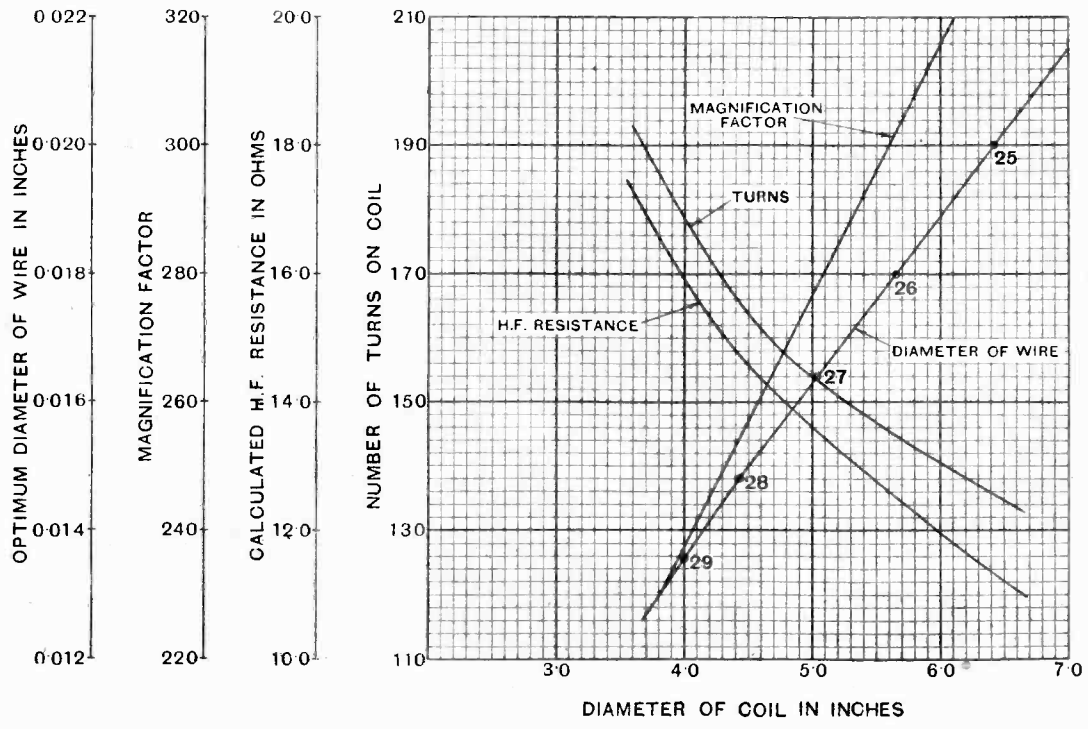
(4) It must also be remembered that the tuning condenser itself possesses an appreciable minimum capacity. For any particular valve (3) is unalterable, and (2) and (4) may be minimised by careful workmanship and the use of high-class tuning condensers respectively, but (1) may quite easily have a serious effect, since the normal capacity of a P.M.G. aerial is of the order of 0.0003 mfd.

The effect of the capacity of the aerial may be reduced very considerably by the use of one or more of the following devices, viz., by coupling the aerial with the coil by a relatively small number of turns, by tapping the aerial across only a small portion of the coil, or by inserting a small fixed condenser in series with the aerial. Reducing the inductance of the coil instead of making use of any of the above methods is not a satisfactory solution of the problem, since the presence of a large minimum capacity would shorten the tuning range considerably, and so it would not be possible to receive both Hilversum and Radio Paris on the one coil. For these wavelengths it will be found preferable to use a 2,000 μH coil in conjunction with a 0.0005 mfd. condenser, as the difficulty is less acute.

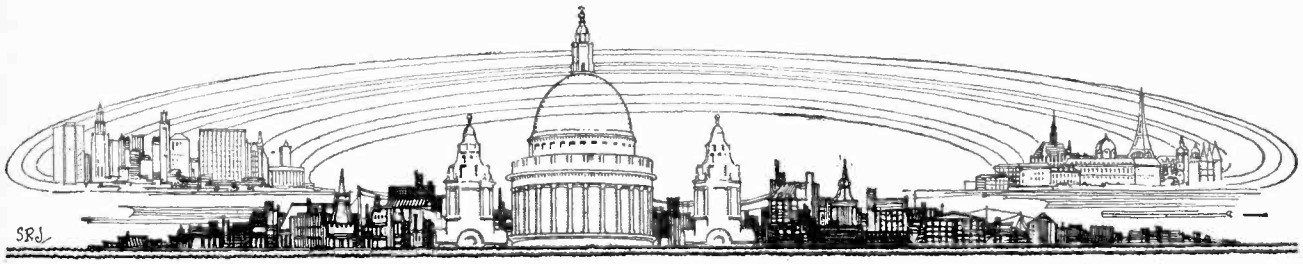
The necessity for minimising the effect of the aerial capacity applies equally to the 200 μH and 325 μH coils, but for these the ideal method is to couple the aerial to the tuning coil by a small number of turns. Generally about one-seventh of the number of turns on the coil will be found satisfactory and will give a good degree of selectivity without any appreciable sacrifice of signal strength.

F. J. A. P.





The upper curves give the design data for 2,000 microhenry coils in which the winding length above 4in. is 8/15 × diameter and below 4ins. 2.1ins. The lower curves give the data for 3,000 microhenry coils; the winding length above 4¼ins. is 8/15 × diameter and below 4¼ins. 2.4ins.



CURRENT TOPICS

Events of the Week in Brief Review.

BIRMINGHAM AND BATTERY ELIMINATORS.

Amateurs in Birmingham are notably up-to-date, and a considerable number of them have doubtless been taking the supply for their receivers from the lighting mains. Considerable dismay was therefore caused when it was decided to change over a large district from D.C. to A.C. We understand that the City Electric Supply Department will render every assistance to those whose apparatus is at present only intended to work off D.C. mains, and that this will either be changed or made to work on an A.C. supply by the department, and that this arrangement will apply both to wireless sets and domestic motors.

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TELEARCHICS.

The control of machinery at a distance by means of wireless is gradually coming into more general use. We understand that the old man-of-war destined to be used as a gunnery target by the Mediterranean fleet will be controlled and steered by wireless from an accompanying destroyer, and we hear that at Glen Falls, in the State of New York, arrangements have been made to switch the street lamps on and off from a central control station by similar means.

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LUXURY OR NECESSITY?

Broadcasting has now become almost a necessity in our daily life, and it is therefore somewhat a matter of wonder to discover that there are still two countries in Europe, viz., France and Spain, where wireless sets are still classified in the official taxation schedules under "luxuries" and subject to special taxes on that account.

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A WIRELESS AND GRAMOPHONE AMALGAMATION.

Big amalgamation of interests seems the prevailing epidemic on both sides of the Atlantic. The Union of the Marconi Company with the Cable Companies was quickly followed by the announcement from the United States of a similar amalgamation of the Mackay Radio and Telegraph Co. with the International Telephone and Telegraph Co., and hard on the heels of these two important unions comes a report that the Radio Corporation of America is seeking an alliance with the Victor Talking Machine Co. Wireless and gramophone interests have many points in common, and the long experience of gramophone companies in the successful reproduction of music should certainly prove invaluable in the development of sound amplifiers and other such apparatus.

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EXPEDITION TO CENTRAL EAST AFRICA.

Major and Mrs. Court Treatt, accompanied by Mr. E. S. Hinds, are now on their way to explore a practically unknown part of Central East Africa covering an area of 60,000 square miles. They intend keeping in touch with London by means of a short-wave set designed by the Marconi Co. having an input of about 20 watts to the anode of the single valve and working on a wavelength of 30 metres. The power is obtained by a hand generator.

THE SCEPTIC AND SELECTIVITY.

A poetical correspondent sends us the following verses with apologies to Lewis Carroll:—

"You're not old, father"; William (the young man) said,
"And broadcasting's still in its youth,
"Yet you say you can separate Stuttgart from Köln,
"Do you think that your set tells the truth?"
"In my youth," said his father, "ere motor cars came,
"I spent most of my time in the stables
"Where I learned to split straws; so a wavelength or two's
"But a trifle—just pass my log-tables."

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ONLY ELEVEN YEARS MORE!

The report of the directors of the Marconi International Marine Communication Co., Ltd., reminds shareholders that

THE HARD-WORKED CRYSTAL. Soldiers of the Russian Red Army listening in barracks to a Government programme from the Kremlin in Moscow. Crystal sets are specially favoured in Russia, possibly because they do not pick up foreign programmes.

the recent International Radiotelegraph Conference decided that spark installations of more than ¼ kilowatt power are to be eliminated from ship use by the end of 1939.

This will involve the company in a certain amount of compulsory obsolescence, and the directors have accordingly decided to set aside from the profits of 1927 a sum of £25,000. The policy to be pursued in future years is to receive further consideration.

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NO VIOLENT CONTROVERSY AT PRESENT.

The removal of the ban on controversial matters has not as yet justified the alarm that listeners would immediately be shocked by heated polemics. The subjects announced for debate—"Payment of Wages According to Need or Ability," "The Surtax," and "Economic versus Political Functions of the Trade Unions"—seems more likely to lead to academic and rather boring discussion than to violent argument and blows.

WHEN SILENCE IS GOLDEN.

A Coventry listener seeks an explanation of the fact that his crystal set works perfectly without the crystal. While diagnosis of this particular case offers difficulties, we recall that listeners to certain broadcast programmes have obtained enhanced satisfaction by removing the cat-whisker from the crystal.

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A MISSOURI INVENTOR.

The following letter has, we understand, been received by the Radio Commissioners at Washington D.C. :—

"Dear Sir,—Ask for information message. If you pleas I have a new ideas one a wireless typewriter. I have all my blue prints made. I want to know where I can have my part of the aire to experiment with my work. I am trying to invent a wireless typewriter. I'm not using no keys or microphones.

"P.S. The experimenters rite to cover all experimenter rits and works. I have severl moor new idaay in wireless experimenters works I would like to test out some day."

WIRELESS AT WESTMINSTER.

(From Our Parliamentary Correspondent.)

Mr. W. Baker asked the Prime Minister if he would state what guarantees exist to prevent the transfer of privately-owned cable and wireless companies, which formed integral parts of the system of Imperial Communications here and in the Dominions and elsewhere, to foreign ownership and control, and whether he was satisfied that the terms of the existing licences and agreements were sufficient to safeguard the national interest Mr. Baldwin replied that he could not answer as regarded the position of the other Governments concerned, but that all licences for cable or wireless services granted by His Majesty's Government in Great Britain contained a provision that the licensed company should not assign or dispose of the licence or of any benefit arising from it without the consent of the Government. The question whether any further safeguards were necessary would be considered when the report of the Imperial Wireless and Cable Conference had been received.

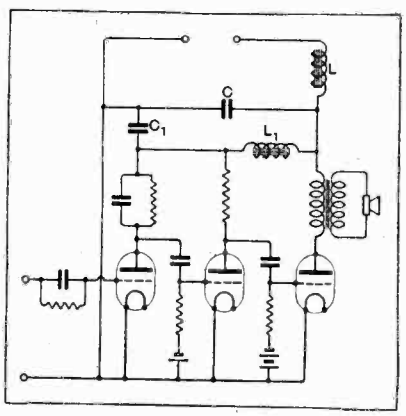
RECENT INVENTIONS.

The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings London, W.C.2, price 1s. each.

Mains-fed Receivers. (No. 279,202.)

Application date: August 21st, 1926.

In a resistance or choke-coupled receiver, drawing high-tension anode current from the mains, the ordinary filter circuit comprises an iron-cored choke L and by-pass condenser C. This is now supplemented by an additional choke or impedance L1, and a by-pass condenser C1, arranged as shown.



Method of preventing "motor boating" in a resistance-coupled amplifier when the anode supply is derived from the mains. (No. 279,202.)

If the last stage is a power valve of low impedance, any change of anode current may be sufficient to produce a back E.M.F. across the filter circuit L, C, which will react, in turn, through the anode resistances and condenser couplings on to the grids of the preceding valves. This leads to "motor boating," or the generation of local oscillations having a frequency corresponding to that of the filter circuit. The high impedance of the inserted coil L1 balances the system and prevents any feed-back action between the circuit L, C and the valves. For a choke-coupled set, the value of the impedance L1 should be of the order 10 to 20 Henries, while the condenser C1 may vary from 2 to 10 microfarads. A similar arrangement may be used to minimise low-frequency disturbances set up by the common coupling-resistance inherent in a partly-exhausted dry-cell H.T. battery. Patent issued to British Thomson-Houston Co. and T. H. Kinman.

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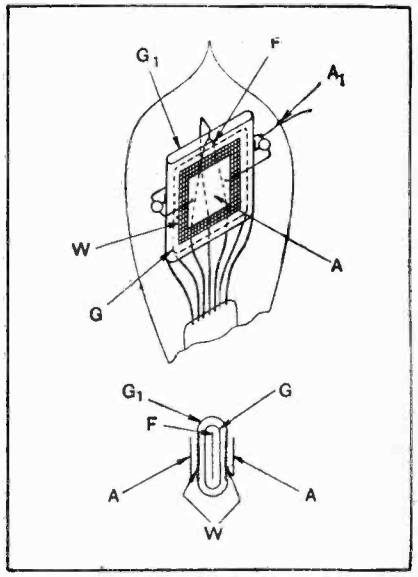
Screened-grid Valves. (No. 279,171.)

Application date: July 22nd, 1926.

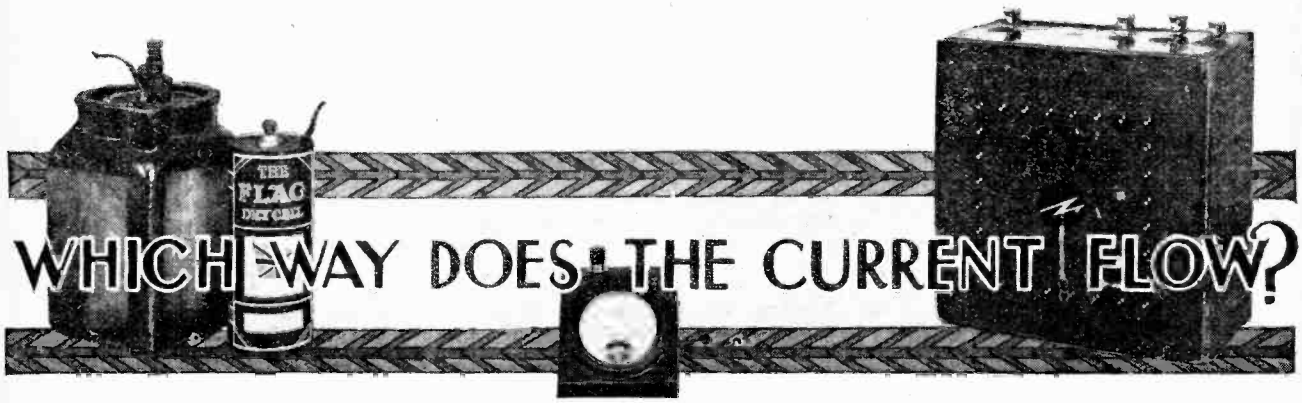
In the original form of the Round screened-grid valve, the electrode terminals are brought out to both ends of the tube, so that a special holder is required when fitting the valve in a set. The present invention describes a modified construction which conforms more closely to the standard type of valve. In particular the anode connection A^1 is sealed into the side of the glass, whilst the remaining electrodes are taken to a standard four-pin base.

The arrangement of the electrodes is shown in elevation in the top diagram and in plan in the lower. The hairpin filament is shown at F and the inner or control grid at G. Surrounding the latter is the screening-grid G1, which is made in the form of a flattened cylinder provided with a pair of oppositely-disposed windows W, which are filled-in



Arrangement of electrodes in screened-grid valve to allow of the use of an ordinary valve holder. (No. 279,171.)

with wire meshing. A pair of anodes A, connected to the common lead A^1, are mounted close to each window, and are of slightly smaller area as shown. Patent issued to H. J. Round.



WHICH WAY DOES THE CURRENT FLOW?

A Simplified Explanation of the Modern Electron Theory.

By N. P. VINCER-MINTER.

THERE appears to be a considerable amount of confusion in the minds of various people concerning the correct answer to this question, which, if we get down to rock-bottom facts, is quite simple and straightforward. In order to get down to the basis of things, we must understand a little of the modern theory of electricity which is nowadays accepted generally by the scientific world.

Theory of Atomic Structure.

This theory, which is popularly known as the electron theory, teaches that all atoms consist of a definite positive electric charge around which several small particles of negative electricity revolve; these negative bodies are called electrons. Each atom possesses a certain definite number of electrons *permanently* revolving round its positive nucleus; these electrons are considered as revolving in concentric circles around the centre of the positive nucleus of the atom. They do not necessarily revolve in the same plane, nor in the same direction. It is supposed that, *inter alia*, the number of these electrons determines the nature of the atom, that is, whether it is an atom of copper or of some other element, such as lead. In substances such as the various metals there are certain electrons on the extreme outer shell or orbit of the atom which are known as valency electrons. Some of these appear very loosely attached to the atom, and, in fact, move from atom to atom quite freely and in any mass of metal this constant and irregular motion is going on continuously, it being quite in order to visualise the movement of these particular valency electrons as being similar to that of a swarm of gnats, with their constant irregular motion. If an electrical pressure be applied to, say, a copper wire from some source such as a dry cell, it will be found that there will be a general drift or flow of these special valency electrons which we may now call "free" electrons through the wire from that end of it connected to the zinc or negative electrode of the battery to the end which is connected to the positive or carbon electrode. This drift is called an electron current, or, more commonly, a current of electricity, or electric current. The irregular atom-to-atom motion of these "free" electrons constantly takes place during the time that they are travelling along the wire, under the influence of the dry cell, just as when there was no general drift of flow along the wire; and taking once more the analogy of the gnats, with their constant irregular motion, we can imagine them at the same time drifting along in a certain direction under the pressure exerted by a gust of wind.

Owing to certain chemical actions in the dry cell, which we cannot deal with here, these electrons are propelled around the circuit from the negative terminal of the battery, around the external connecting wire to the positive battery terminal, and thence through the interior of the cell to the negative terminal again, and so on. In certain metals, such, for instance, as German silver, it is found that there are far fewer "free" electrons associated with each atom than is the case of copper. Under these circumstances, if we apply the same electrical pressure the electron flow will be much smaller. This must not be confused with the speed of the electrons. The rate of flow only deals with the number of electrons which will flow past a point in a given time. If we take a substance such as glass we shall find that the number of electrons is infinitely small, and if we once more apply our electrical pressure from the dry cell no current flow can be detected. Now it is found that the atoms of all substances vary in the number of "free" electrons associated with them; those having a very large number, such as copper, we call good conductors, and those having a smaller number, such as damp wood, we call poor conductors, or, alternatively, very poor insulators. Those which appear to show a total deficit of free electrons are called very good insulators.

Electrons and Ions.

A current of electricity, therefore, consists of a movement of free electrons along a conductor, such movement being caused by an electrical pressure of some sort, such, for instance, as the dry cell already mentioned, in which it is produced by chemical action on zinc. But what of

Which Way Does the Current Flow?

positive electricity? Does this not flow along the wire? No! it definitely does *not*. The positive charge resides in the centre of the atom, and there it stays; there are no "free" positive particles associated with the atom as in the case of the negative particles or electrons as we call them. It may be mentioned that the positive charge resident in the centre of the atom is presumed to be made up of a number of particles which are actually positive charges of electricity. They are sometimes called protons, or in some cases positive electrons. Electrons are assumed (yes, "assumed," for no man has yet proved this) to be somewhat more than 2,000 times the size of protons. If an atom is caused to receive a larger number of electrons than its normal complement, then it is called a negative ion. If, on the contrary, it is caused to receive a larger number of protons than its normal complement, it is *not* called a positive ion for the simple reason that, as already explained, the protons form the absolute core of the atom, and we cannot cause any of them to move from atom to atom as in the case of certain electrons or negative particles. There are no "free" protons. A positive ion consists, therefore, not of an atom to which extra positive charges have been added, but of an atom holding its normal positive nucleus, but from which some electrons have been withdrawn, thus causing a deficiency of negative charges or electrons, and upsetting the electrical balance. The atom is then said to be positively charged (although the actual positive charge cannot alter), and so it is called a positive ion.

Now, in Fig. 1(b), if we have compressed air in tank A and the reverse in tank B, it is obvious that immediately the cocks are open, there will be a current of air along the rubber pipe to tank B until the pressure is equalised. The reason of the flow of air along the pipe is that there was a superabundance of air in tank A compared with tank B, or, to put it in another way, tank A was at higher air pressure relative to tank B. In all walks of life, quite apart from mathematics, we are accustomed to regard the terms positive and negative as relative terms, positive indicating, in one sense of the word, something in excess of negative. It will not be amiss, therefore, if we labelled tank A positive and the tank B negative. Now Fig. 1(a) is the electrical equivalent of Fig. 1(b). Here we have two metal plates A and B (this arrangement is usually called an electrical condenser) suspended in mid-air, and capable of being joined together by an electrical conductor when switch S is closed. Plate A has the excess of electrons, and plate B the deficit. Plate A, therefore, is at higher electrical pressure (the word "potential" rather than "pressure" is customarily used in electrical work), and an electric current flows from A to B through the switch. A strange thing at once strikes us, and that is, that the plate having an *excess* of electrons is labelled negative, and the plate having the deficit is labelled positive. Similarly, we shall find that in a dry cell the "excess" terminal is marked negative and the "deficit" terminal positive.

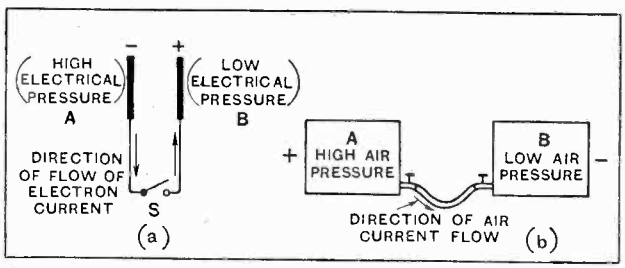


Fig. 1.—(a) Mechanical analogy illustrating electrical pressure and current flow. (b) The corresponding electrical system.

The reason for it is quite simple, but before going on to explain, let us pause for a moment in order to make quite clear why one terminal of a battery is marked positive, and the other negative. It is not because negative particles (electrons) emanate from one terminal and positive particles (protons) emanate from the other, because we have already seen that the positive charges cannot be dissociated from the atom, so that there are no free protons. Although, therefore, negative particles called electrons and positive particles called protons both exist as separate entities in the atom according to the modern electron theory, it is only the negative electrons that we can obtain from our dry cells. Therefore, battery terminal markings are purely relative and serve to indicate the terminals at which the electron pressure is high compared to the other one, that is to say, the terminal from which electrons will emanate if a suitable external conducting path be provided and the terminal at which they will again enter the dry cell.

New Wine in Old Bottles.

We can now consider the reason why battery terminals, dynamo terminals, etc., are wrongly marked. In the early days of electricity, it was thought that bodies which we now know have an excess of units of electricity (electrons) actually had a deficiency, and so the ancients labelled them wrongly, and when it came along the ordinary electrical battery was marked wrongly also, the zinc, which is really the high pressure terminal being labelled negative, and the usual centre terminal connected to the carbon electrode being marked positive.

Why, then, is not this taken in hand and changed by those in authority? The reason is simply because it is thought that too much confusion would be caused among those who were brought up to consider the zinc as being the seat of the "excess" electrons. Even the best text books, therefore, still use the terms positive and negative wrongly. Perhaps, however, there will come a day when some bold spirit will venture to tell his pupils that the zinc is really the "positive" or "excess" pole of a dry cell, and perhaps he will even write it in a book. His fate is as certain as is the writer's, after penning these words.

Now the same text books go even further and try to cover up the incorrectness of labelling the zinc pole negative by postulating a theory that the *electron* current and the *electric* current are quite different, and that whilst an electron current flows from zinc to carbon, there is a flow of positive electricity in the reverse direction, and, therefore, the usual markings on a battery are correct. But we know by the electric theory that the positive charges never leave the atom. Others say that an electron current is the same as an electric current, but that the electrons flow from zinc to carbon *inside* the cell, and from carbon to zinc outside the cell. A closer study

Which Way Does the Current Flow?

of the electron theory than we have been able to make in this article will also prove this wrong. Then we get another class of people who state that nothing actually flows, but only a "strain" in the ether exists. This means jettisoning the whole electron theory, and such people have no right to do this until they can definitely prove it wrong.

But now we come to a fourth class of people, namely, those who invade our own realms of wireless and try to meddle with the valve. Nobody will deny that electrons are thrown off from the hot *negative* filament and attracted by the *positive* plate. This surely ought to prove to anybody that the direction of flow is from negative (so-called) to positive (so-called). These latter people, however, trying to cover up their iniquities, state that when the valve filament is cold the space between filament and plate is an insulator, and that when the hot filament starts to throw off electrons, which are attracted by the positive plate, a conducting path of "free" electrons is formed. We are in perfect agreement with them until they go on to say that this conducting path of electrons allows the H.T. battery to push out an electric current from its positive terminal to plate, and from plate across to valve filament. Positive charges of electricity, therefore, clamber over the backs of the electrons! But the electron theory teaches that positive charges never leave the atom. Therefore, this is not true.

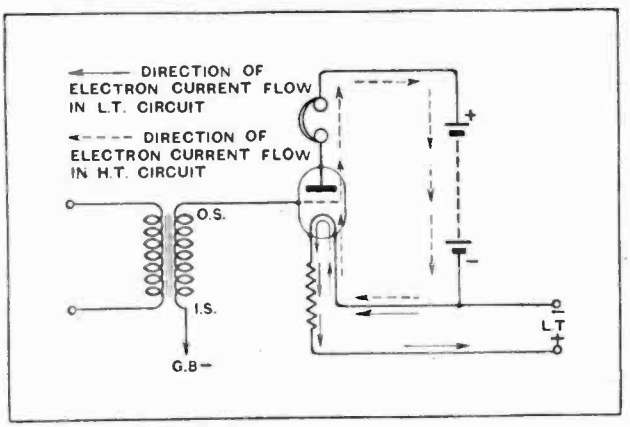


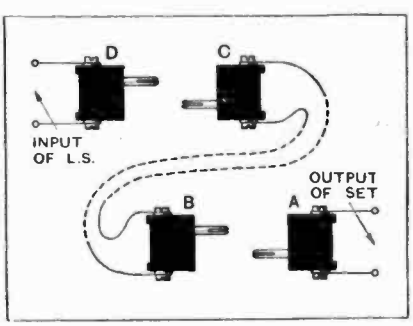
Fig. 2.—Customary valve circuit arrangement demonstrating direction of H.T. and L.T. current flow.

What actually happens is this. When the filament is cold the space between filament and plate possesses no atoms of matter, because it is a vacuum. Since there are no atoms there are no "free electrons," and this space, therefore, is an insulator. Heating the filament in *any manner* causes it to throw off electrons which are attracted by the positive plate. We cannot explain here why the hot filament emits electrons; time and space do not permit. Thus, so long as the filament is hot it emits electrons and gives us a chain of free electrons between filament and plate, and this path, therefore, becomes a conductor. Under pressure from the H.T. battery electrons continually pass across from filament to plate, into the H.T. battery at the terminal marked positive, and out again at the terminal marked negative; this constitutes the plate current of the valve. This explanation is crude, but nevertheless it will suffice. In a valve, therefore, the H.T. current flows from filament to plate. Fig 2 indicates by arrows the direction of the passage of both the L.T. and the H.T. current in a typical valve circuit arrangement.

L.S. Extension Leads.

CIRCUMSTANCES often arise in which it is desired to use the loud-speaker at a distance of three or four yards from the receiver, that is to say, to use the loud-speaker at one end of a room when the set is permanently installed at the other side of the room near to the aerial lead-in. On other occasions it may be desired to use the loud-speaker in a position adjacent to the set. It might be thought that in order to cover both these cases the loud-speaker leads could consist of ordinary lighting "flex." This is not so, however, as although no serious effect on quality would occur when using this extension lead to the other side of the room, or even a short distance to another room, very detrimental effects on quality would arise at times when the loud-speaker was used on the same table as the receiver. The reason for this is that if the long extension wire were coiled or bunched up by the loud-speaker and receiver, the self-capacity of the wire owing to its being coiled or bunched up would be greatly increased, resulting in serious attenuation of the upper musical frequencies.

The difficulty can be obviated in a very simple manner by the use of ordinary single coil mountings, as shown; these coil mountings are very inexpensive. Thus, when not desiring to use the loud-speaker away from the table on which the receiver is situated, plug "D" would be united with plug "A," and only a short length of wire would be connecting the loud-speaker to the receiver. If it was desired to move the loud-speaker temporarily to the other side of the room for any special reason, it would be only the work of a moment to unplug "D" from "A" and to unite them by means of the plugs "B" and "C" which would have a suitable length of wire attached to them. If sometimes it was desired to use the loud-speaker at the far side of the room, and sometimes in an adjacent room, it would be convenient to make up several connectors of varying length, which could be chosen to suit the particular distance from the receiver at which it was desired to use the loud-speaker.



Use of coil plugs with extension leads to loud-speaker.

E. D. D.

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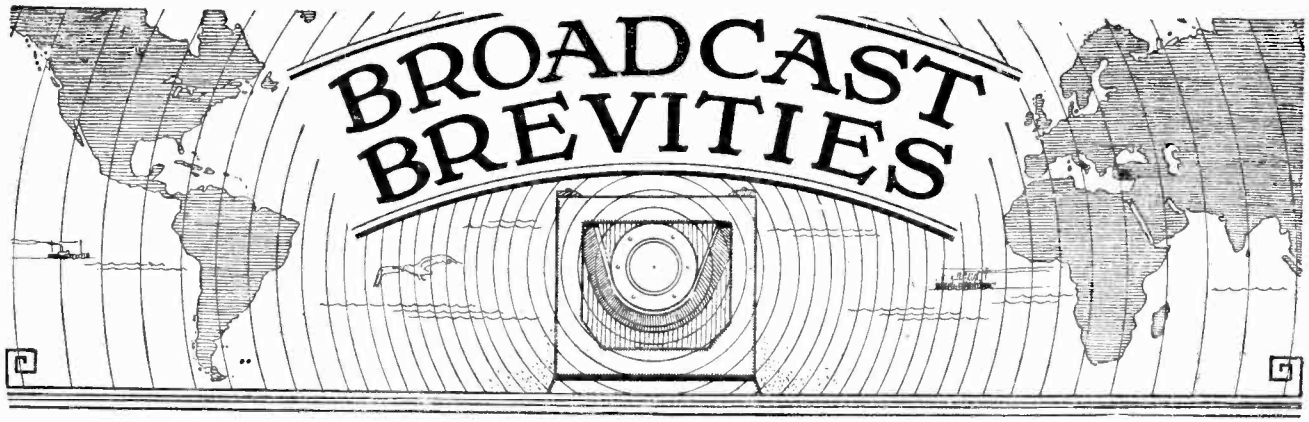

News from All Quarters: By Our Special Correspondent.

Royal Broadcasters.—Controversial Questions.—An Enthusiast.—An Amicable Settlement in the Antipodes.—The Nightingale's Complaint.

Royal Broadcasters.

The Prince of Wales and the Duke of York will both be heard again in the near future by broadcast listeners. H.R.H. the Duke of York's speech on April 28th, when he will lay the foundation stone of University College, Hull, will be transmitted from 6XH.

H.R.H. the Prince of Wales will unveil the National War Memorial in Cathay's Park, Cardiff, on June 12th, when the Band of the Welsh Guards will play and there will be community singing. In addition to the Prince's speech and the music there will be a running commentary on the ceremony and a general description of the scene.

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The Nightingale Again.

"In the spring a young man's fancy lightly turns to thoughts of love," and the B.B.C. turns its attention towards the nightingale. While arrangements for this popular outside broadcast have not yet been made, it is pretty certain that this year the engineers will not go to Oxted woods. It was probably a mistake to give so much publicity to the locality whence the relay would take place, as with each succeeding year the number of motorists who have disturbed the peace and solitude of the spot has increased and the transmissions have not been nearly so successful as might otherwise have been the case; the lights and noise of the cars frightened the birds away.

At various intervals during the last fortnight in May the B.B.C. will be seeking for other spots more remote from London, where the nightingale may yet be heard singing.

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Grand Opera.

The opera season at Covent Garden will open on April 30th, and the B.B.C. has arranged to broadcast a number of excerpts probably twice in each week. The opening opera will, of course, provide the first relay. This is expected to be the "Rheingold," conducted by Bruno Walter.

FUTURE FEATURES.

London and Daventry (5XX).

APRIL 15TH.—Italian National Programme.

APRIL 17TH.—Sybil Thorndike in "Medea," by Euripides.

APRIL 18TH.—"Armide," a grand opera in five acts by Gluck.

APRIL 20TH.—National Symphony Concert.

Daventry Experimental (5GB).

APRIL 17TH.—A Military Band Concert.

APRIL 19TH.—Somerset dialect play.

APRIL 20TH.—"The Old Folks at Home," a plantation scena.

Cardiff.

APRIL 16TH.—The National Orchestra of Wales.

APRIL 17TH.—The Super Six in Sea Dogs.

APRIL 21ST.—A popular concert relayed from the Assembly Room, City Hall.

Manchester.

APRIL 16TH.—Modern Musical Comedy.

APRIL 17TH.—Besses o' th' Barn Band Concert.

APRIL 20TH.—"The Lady Concerned," a play in one act by Harold Owen.

Newcastle.

APRIL 21ST.—Brass Band Concert.

Glasgow.

APRIL 19TH.—A Neapolitan Programme.

APRIL 20TH.—Vandeville Programme.

Aberdeen.

APRIL 16TH.—A modern Scottish Programme.

APRIL 19TH.—Humorous Scottish Programme.

Belfast.

APRIL 17TH.—"Way Back," old time variety.

APRIL 21ST.—"Sister Helen," a dramatic ballad. "The Brass Door-knob," a playlet.

The Controversial Question.

Careful consideration has been given by the Governors of the B.B.C. to the situation consequent on the removal of the ban on controversy. The new material will be introduced gradually and experimentally, and no fundamental change in programme policy is intended in the immediate future. Controversy, political and economic, will be admitted on clearly defined occasions with adequate safeguards for impartiality and equality of treatment, the subject being dealt with in such a way that the main opposing views can be presented on occasions clearly contrasted and linked as closely as possible. Debates and discussions will be the normal procedure, and the removal of the restriction is not to be interpreted to mean the immediate introduction of indiscriminate controversy in talks and outside broadcasts.

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Another Question.

And now that the ban has been lifted and the bitter fruit is within our grasp there comes the question, "Who Wants Controversial Broadcasting?" Each political party has been offered an opportunity, but I doubt whether there is any frantic eagerness to take advantage of what, when unavailable, was regarded as a golden opportunity. Very heated discussions are unlikely, as in many cases it is probable that the opponents will not be brought face to face. Selected champions of opposite points of view will be able to state their cases from their local stations. We may have a speaker in London arguing the point with an opponent in Glasgow, and the intervening distance may tend to deprive us of the fiery sparkle of a face-to-face encounter.

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A Co-Optimist.

Wolseley Charles, one of the band of Co-Optimists whose performances gained a wide popularity, is broadcasting from the Newcastle station on April 16th, when he will be heard both as singer and instrumentalist

Harpsichord Music.

The harpsichord, the forerunner of the piano, is seldom heard in public nowadays; there are, indeed, few really expert performers on the instrument. One of the leading players is Mrs. Violet Gordon Woodhouse, who is to give a 17th century recital of harpsichord music from 2LO and 5XX on April 15th.

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The "National" and the Boat Race.

The absence of "crowd noises" in the broadcasting of the Grand National and the Boat Race was very noticeable, and generally ascribed to the use of a new type of microphone measuring only 2in. by 1½in., intended to be held by the commentator in the palm of his hand and less sensitive than the type generally used on these occasions, so that there would be less liability of it picking up outside noises, though the speaker might have to raise his voice when using it. The B.B.C. had announced their intention to use this new type of microphone, but on testing it at Aintree before the great race it was not considered so satisfactory as the ordinary type; consequently both the big events were broadcast with the older type of microphone. Possibly the bad weather and general disappointment of the crowd at Aintree may account for the diminution in outside noise on that occasion. The description of the Boat Race is regarded by the B.B.C. as one of the most satisfactory of outside broadcasts yet accomplished, both from a technical and descriptive point of view.

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An Enthusiast with a Portable.

The early hour of the Boat Race and the inflexible call to duty which drew the workers of London to their accustomed offices and business on that Saturday morning probably lessened the crowd of spectators on the river banks, and certainly affected the number of those listening to the animated description of the race by Mr. J. C. Squire and Mr. G. O. Nickalls. I encountered one enthusiast walking to business down the Strand in the direction of *The Wireless World* offices carrying a portable set of the suitcase type with the headphones fixed to his ears and well-nigh oblivious to the passing traffic. Before he reached his destination he was able to give the result to the policeman on point duty and to one or two enterprising newsvendors, who were thereby able to forestall their less fortunate brethren.

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Oscillation and Appreciation.

Terrific bursts of oscillation are generally noticeable whenever an important programme is being transmitted, as, for example, during the Bernard Shaw play, George Robey's entertainment, the Symphony Concert which Sir Henry Wood conducted at Bristol, some of the National Symphony Concerts, and the recent broadcasting of the Prince of Wales' speech. I touched on this subject last week, and now am told at Savoy Hill that of late the number of complaints has increased and oscillators appear as much in evidence as during last season's Promenade Concerts. It would therefore appear that the better the programme the worse becomes the oscillation trouble. It is inconceivable that anyone should deliberately spoil another's pleasure, so the most probable solution of this phenomenon is that when the programme is specially attractive all sorts and conditions of listeners are trying to pick it up, including those who have not had much practice in tuning their sets and those who are trying to get the utmost from their receivers.

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Horse Guards to Broadcast.

The Royal Horse Guards Band (the Blues) will broadcast from the Kingsway Hall through 2LO and 5XX on April 14th, special permission having been accorded by Lieut.-Col. Lord Innes-Ker.

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"Cosi Fan Tutte."

Mozart's comic opera, "Cosi fan tutte" (The School for Lovers) will be broadcast from 2LO on April 27th.

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Birmingham Listeners and 5GB.

Birmingham listeners have complained for some time past about the difficulty in receiving 5GB, and the B.B.C. engineers have been doing useful work in visiting a large number of the complainants' houses to inspect their receivers and to give advice. In many cases it was found that the receiving sets were very antiquated; but one of the most amusing instances of a listener's "difficulty" was that of a Birmingham citizen who complained that he could not get 5GB on his crystal set. When, however, his headphones were replaced by an ordinary pair by the B.B.C. engineers he could hear perfectly, and was then forced to admit that the headphones he had been using were purchased by him five years ago for a few shillings, and that it had not occurred to him that their efficiency might have become impaired.

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Rivals Co-operate.

From the point of view of listeners to the Sydney broadcasting stations, considerable advantages are offered as the result of an agreement just concluded between the two leading broadcasting stations, 2FC and 2BL.

In the past the competition between the stations to give the better programme has been as keen as that between rival newspapers, and while this fact has kept each station up to the scratch in giving listeners of their best it has frequently happened that each station has been broadcasting the same thing at the same time, neither being willing to give way to the other.

On Saturday afternoons, for instance, sporting information has been broadcast simultaneously from each station, and during the evening each station may have been broadcasting dance music, lecturettes, classical music, weather forecasts, and so on at exactly the same moment. Listeners who did not happen to fancy the particular fare being offered them often switched over their sets from one station to the other, only to find that the same or similar matter was being broadcast by the other station.

All this is now being altered, and although probably a month will elapse before the new arrangement is in full working order, the agreement entered into will ensure that while one station is describing, say, the horse races, the other may be giving musical selections, and while one station is describing a cricket or football match the other will keep off that particular theme. This will undoubtedly be a great boon to listeners, some of whom have in the past become quite annoyed when they have tuned into 2BL to find a classical concert in progress and, being lovers of jazz, have hastily switched over to 2FC only to find grand opera on the air. Others have loudly complained that whenever they want high-class music they have found both stations broadcasting fox-trots and one-steps.

However, by a simple act of co-operation the broadcasting stations will now be able to give listeners a much wider variety of programmes.

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George Robey Appearance.

On Sunday, April 22nd, Mr. George Robey will again address the microphone in an appeal for subscriptions for the Princess Louise Hospital in Kensington.

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Mind Triumphs Over Matter.

A fortnight ago I was lamenting the regular habits of the "broadcasting machine" and the absence of untoward accidents to bring "copy" in the way of the sorely tried journalist. I was then inclined to attribute this lack of incident to the increased efficiency of the apparatus, but now find that it is to the human element that the greatest praise is due for the manner in which the B.B.C. stations keep the "even tenor of their way" (I apologise to the shade of Thomas Gray for this not unusual misquotation: "noiseless tenor" would not be quite so applicable to broadcast transmissions).

Valves do blow out, grid mats do get overheated, and various stations do close down temporarily while adjustments are made, but the B.B.C. engineers have become so skilful in effecting repairs that a stoppage of three or four minutes is about the maximum, and the recalcitrant station carries on happily once more before listeners have become aware of anything going wrong.

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Easily Startled.

The musical public of Haydn's day was far more easily moved than a modern audience, for it is on record that he said, when he was composing the Andante of his Symphony No. 3 in G, that it was intended "to startle the audience." Pointing to the well-known explosion of drums, he said, with a laugh: "There all the women will scream."

This Symphony, which has been nicknamed "The Surprise," will be broadcast from Belfast on April 23.

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.

QUALITY OF TRANSMISSION.

Sir,—May I be allowed to record my complete agreement with Mr. Kyrle Leng with regard to 2LO's distortion? Mr. George H. Tozer again suggests that all who find fault with the transmissions from 2LO should "look to their sets," and also advises us to visit the South Kensington Museum.

I should think that everyone who lives in London and who is interested in pure reproduction has heard this receiver; but without casting any reflection upon it, I confess that I have heard better in private houses, and in every case the owner has had something to say on the subject of distortion from 2LO. In fact, it has been my experience that the more perfect the receiver, the less satisfied is the owner. A good receiver will indicate every overload on the valves used in either receiver or transmitter, and if one adjusts H.T., etc., so that the valves in the former are working correctly (a condition easily checked), then the fault must rest with the latter. These overloads are particularly evident when the music or speech is coming over some miles of land line, and the B.B.C. do not seem to be able to guard against them.

In my own case, I cannot use a moving coil loud-speaker on some occasions, and use either a Celestion or "Kone."

Another cause of distortion, namely, frequency response, could be improved by 2LO, as shown by Capt. Eckersley's curve, published some time ago.

A. S. BROWN,
Member R.S.G.B., A.R.R.L.

London, S.E.16.
March 28th, 1928.

ANODE AND GRID RECTIFICATION.

Sir,—Mr. Sowerby's article in your issue of March 21st is very interesting, and completely confirms some measurements which I made some time ago of the same general nature. But curiously enough, I am inclined to draw an opposite conclusion from both his results and my own.

As I read his concluding paragraphs, it appears to me that he is inclined to favour the anode rectifier on the ground of quality; but reference to his Fig. 4 will show that for an A.C. input of from 0.2 to 0.7 volt in his particular case, the sensitivity of the grid rectifier was approximately constant; or, alternatively, looking at his Fig. 5, for the same range, the L.F. output was proportional to the H.F. input for this range, then the grid rectifier gives distortionless rectification. But the anode rectifier has an increasing sensitivity for the whole of its range, and there is no part of its curve which shows constant sensitivity. It is for this reason that I have always recommended a grid rectifier for first-class rectification, provided always that (as Mr. Sowerby suggests) the L.F. amplification is adjusted so that, when the set is giving its proper output, the input to the rectifier is correct. My own experience is that, roughly speaking, the proper input to the rectifier is inversely proportional to the magnification of the detector valve. In his case the best input was about 0.4 volt and the magnification 30; and I have found that with a magnification of about 15 the best input was about 1 volt.

P. K. TURNER.

Crofton Park.
March 21st, 1928.

Sir,—I was very interested to see the copy of Mr. P. K. Turner's letter that you so kindly forwarded to me, especially as I had, in considering the general behaviour only of the two types of rectifier, completely overlooked his point.

There are, however, some difficulties in putting Mr. Turner's suggestion into practice, because of the necessity for keeping the detector input always within a very narrow range on penalty of getting really bad quality if the limits are overstepped.

It is clear, for one thing, that changing a valve in the L.F. amplifier for one of a different amplification factor would permit the detector input to stray beyond its proper limits while the output valve remained fully loaded. But even if this possibility is ruled out, we are still faced with a difficulty owing to the fact that the B.B.C. transmit different items at quite the wrong relative strength. Thus if a receiver is correctly adjusted for music, speech is far too loud; or, conversely, if adjusted to reproduce speech at the proper level, music is absurdly faint. It therefore becomes more or less impossible to design the L.F. amplifier so as to ensure a fixed input to the detector, because the output required from the set is not constant, but is continually varying.

It is quite true that in the hands of a listener who appreciates the necessity for correct loading of the detector a volume control in the form of a potentiometer in the L.F. amplifier, or of a variable shunt resistance across the loud-speaker, can be employed in such a way as to fulfil the necessary conditions; but the introduction of any such device obviously has its dangers in permitting very wide variation of the amount of L.F. amplification, and so making it possible for the unskilled to work with quite the wrong input to the detector.

After all, it is not every set that reproduces so far below the correct level that it needs to be worked "all out" on every item.

It seems then, and I think Mr. Turner will agree with me so far, that unless these difficulties can be surmounted it is safer to keep to the anode rectifier, which gives a constant, and quite small, distortion at all loads.

A. L. M. SOWERBY.

London, W.2.
March 28th, 1928.

DISTORTION.

Sir,—I should be glad to learn whether the present vagaries of 5GB are purely local, or, if universal, whether it is beyond the capabilities of the B.B.C. engineers to rectify them.

Having just returned after two months abroad, I now find recurring distortion and fading takes place during the evening concerts, generally marring an otherwise excellent reproduction. The fault lasts for about a couple of minutes and then rights itself and repeats at varying intervals. Incidentally, I am finding very much less Morse interference on this wavelength.

BM/BLDN.

March 23rd, 1928.

ARE THERE TOO MANY TYPES OF VALVES?

Sir,—May I trespass on your space to enter a plea for the 4-volt valve?

In the first place, if any of the 2-, 4-, or 6-volt types is to be dropped in the interests of standardisation, why take a half measure and drop only one type? Surely it would be policy to "go the whole hog" and retain only one type, even if this necessitated some sacrifice in efficiency. As a matter of fact, the retention of the 4-volt series represents, to my mind, by far the best compromise.

In a modern set there are really only three classes of valve needed, viz., R.C. or high magnification factor valves, H.F

or valves of medium magnification factor and super-power valves of low impedance.

H.F. amplification requires R.C. or H.F. valves according to whether tuned anode or tuned transformer coupling be used.

Detection requires R.C. or H.F. valve according to circuit used.

First stage L.F. amplification generally calls for an H.F. type valve.

The output valve should be a super-power valve.

Now if we consider these three classes of valves as now marketed in 2, 4, and 6 volts we find :—

(1) R.C. High Magnification Valves.—Very little to choose between them in mutual conductivity. Two-, 4- and 6-volt will all meet our requirements.

(2) H.F. Medium Magnification Valves.—Here we find that whereas the 6-volt offer no advantages over the 4-volt, the mutual conductivity in the 2-volt series is approximately half that in the 4- and 6-volt series.

(3) Super-power Valves.—All voltages produce valves capable of dealing with large grid swing, but, generally speaking, in the 2-volt class this entails a heavier filament current, which in turn means a larger accumulator, which nullifies the only advantage claimed by the 2-volt adherents. From the above it would appear that there is little to be gained by using 6-volt instead of 4-volt valves, but a good deal to be gained by using 4-volt valves instead of 2-volt valves, from the point of view of radio efficiency.

From the points of view of cost and weight, the 4-volt scores over the 6-volt, though the 2-volt does not score to the same extent over the 4-volt owing to the greater consumption by the super-power valve and extra H.F. stage necessary to compensate for its inherent deficiencies.

London, W.9. PHILIP H. A. MATTHEW.

March 28th, 1928.

VALVE MARKINGS.

Sir,—I wish you would use your influence to induce manufacturers to put whatever distinguishing marks they may employ in a clear and permanent form upon the valves.

I have now a number of 2-volt and 6-volt valves, the values and characteristics of which I must find out by experiment, as there are no legible marks upon them. Some have had a paper band, which has become detached and lost, and some have had markings upon the bulbs which have become quite indistinguishable. For this reason alone I shall be chary of purchasing these makers' valves in future, although the valves themselves are quite good ones. G. L.

Liverpool.

March 26th, 1928.

"SATISFIED," "ELECTRIC SUPPLY."

Sir,—Respecting your editorial paragraph in your March 21st issue, my impression is that most of the electric light bodies do make it their rule to rectify any existing apparatus upon charge of their supply. It is so in Exeter, and without being asked.

Apparently "Satisfied" is so satisfied as to be bubbling over with glee at the fine profit he appears to have made out of the generous action of the Barnet Co. To get £10 10s. worth for what, I suppose, did not cost him one-tenth of that is very splendid, no doubt, but my impression is that "Satisfied," as he thinks of his fellow-ratepayers having to pay it, will be very anxious to make quite a handsome rebate, and I hope he will write and tell us so that we may be encouraged.

March 22nd, 1928. JOHN BULL.

MAINS INTERFERENCE.

Sir,—In connection with your reply to a query under the above heading in the March 21st issue, I should like to point out that the occurrence of crackling noises in the loud-speaker does not necessarily indicate the presence of a fault either in the insulation of the system or in fittings, although such a fault would, of course, be quite sufficient to produce these noises.

In a case which was recently brought to my notice, loud crackling noises at irregular intervals were produced in a set, immediately following on a conversion of the district lighting supply from D.C. to A.C. An insulation test and an examination of fittings for loose contacts failed to reveal the cause. The wiring had been carried out in lead-sheathed cable, and it was found that on making an efficient connection between the lead sheath and the nearest water pipe the noises ceased.

It would appear, therefore, that, owing to the fact that one of the incoming mains is at or near earth potential, the capacity existing between conductors and sheath is sufficient to induce on the latter a potential above earth. An intermittent contact between the sheath and some earthed conductor, such as might occur when the building vibrates, will cause sudden fluctuations of the sheath potential and consequent interference with radio reception.

The remedy is obviously to ensure that the sheath remains at zero potential by making an efficient earth connection.

The University, Leeds. W. S. STUART.

March 22nd, 1928.

CONTINENTAL BROADCASTS.

Sir,—As a keen radio amateur and enthusiast of the technical merit of your paper, I write in protest of your editorial, "Continental Broadcasts." I think in your eagerness to preserve the romance of Continental (or shall we say foreign reception?) you have erroneously assumed (so has the writer of "Broadcast Brevities," "Why Enthusiasm Is Lacking," issue of March 21st) that the "average man (*i.e.*, the greater number of listeners who are entitled to be called average) has a set capable of receiving these foreign broadcasts satisfactorily."

Now I maintain that the average listener has not these facilities, and so why try to condemn on what you admit was a success, at least from Cologne, and deprive the average listener from enjoying a really good rendering of these concerts (*i.e.*, assuming the B.B.C. take notice)?

Now a word about these giants of amateurs who regularly write you of their prowess on the ether and of their wonderful reception of world-wide transmissions.

If these people assume the average listener who reads their literary efforts believes that with their resources and capable engineers the B.B.C. cannot get the same results at will as these giants say they can, then let me assure them they are quite wrong.

For the B.B.C. have never given us anything like a first-class retransmission of ether received foreign transmission on either long, medium, or short waves, so how can what I call the "*dabblers carried away by intermittent partial success*" hope to make the poor average people believe their vivid pictures. In Capt. Eckersley's well-known words, "Please don't do it." It's a waste of valuable space in *The Wireless World*, which could be used much more usefully. By the way, what about our short-wave writers: have they suddenly found out that the B.B.C. engineers know the best policy to follow? W. H. CHIPPERFIELD.

Northampton.

March 25th, 1928.

COPYRIGHT AND WIRELESS.

Sir,—As this society receives from the British Broadcasting Corporation head office the weekly programmes of all material broadcast from the various stations, any sleuthing such as your contributor suggests may be necessary will not be quite so elaborate an affair as he implies.

It is only fair to the British Broadcasting Corporation to mention that in the few cases where payment has been overlooked (such oversights occur in all large organisations) adjustment has been made immediately attention has been called to the omission. This society has recently concluded a new minimum terms agreement with the British Broadcasting Corporation, and we have every confidence that our relations will be as satisfactory in the future as they have been in the past.

G. HERBERT THRING.

The Incorporated Society of Authors, Playwrights and Composers.

March 26th, 1928.

READERS' PROBLEMS ANSWERED

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

The Service is subject to the rules of the Department, which are printed herewith; 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.

An H.T. Eliminator with Trickle Charger

Can you tell me if the combined H.T. eliminator and L.T. trickle charger described in the attached pamphlet is likely to be satisfactory and economical? My electric light mains are 230 volts D.C. W. F.

Full technical information concerning the combined unit in question is not given in your pamphlet, but we think it quite possible that it will work satisfactorily. It seems impossible, however, that it can be reasonably economical; there is no simple way of overcoming the inherent inefficiency of charging a low-voltage accumulator from high-voltage D.C. mains, as the majority of the energy consumed is wasted in heating a resistance.

It is possible that arrangements are made to pass the current which normally flows through the potential divider included in the H.T. eliminator through the accumulator, but unless this potential divider passes a much heavier current than that strictly necessary for H.T. purposes, the charging rate will be so low that it will not compensate for the drain imposed by the filaments, and the trickle charger will have to be left in operation when the set is not working.

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A Neutralising Problem.

I am puzzled by my failure to neutralise a high-frequency circuit using transformer coupling, but in place of the neutralising winding I have connected the balancing condenser to a tapping on the secondary winding. I should be obliged for any advice you can give which will enable me to stabilise the circuit, a copy of which I enclose. P. M.

The neutralising arrangement you propose to adopt is quite practicable, but it is essential with this system that the sense of the primary winding should be opposite to that of the secondary; that is to say, if the primary winding has been put on in a clockwise direction, then the secondary must be wound in a counter-clockwise direction. In the second case the primary and secondary coils should be as close together as facilities will permit, the spacing between coils not exceeding $\frac{1}{32}$ of an inch. The secondary winding is tapped so that the neutralising portion has the same number of turns as the primary, counting, of course, from the low potential end; however, this is not essential, as in some cases the neutralising winding has more turns than the primary, which enables the circuit to be stabilised with a smaller balancing condenser than would be used normally.

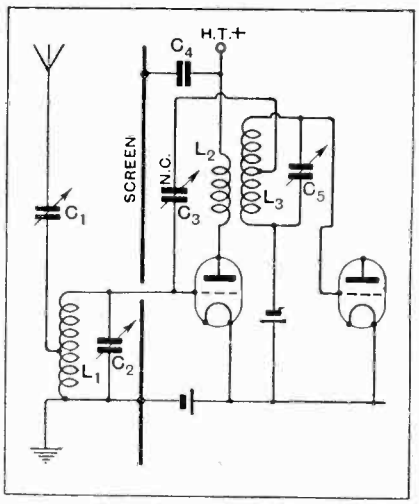

Fig. 1. Neutralised H.F. stage in which the neutralising condenser is connected to the secondary of the transformer.

The selectivity of the receiver could be improved by connecting the aerial *via* a semi-fixed variable condenser to a tap on the grid coil, rather than to the grid end of this coil; this modification is shown in the circuit diagram reproduced in Fig. 1.

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A.C. Mains Unit for Moving-coil Speaker.

I have a good H.T. battery eliminator for A.C. mains and would like to use this to supply the pot winding of a moving coil loud-speaker. Do you consider this suitable, please? J. W. C.

An H.T. battery eliminator will not be suitable for the purpose you require, as this type of unit is not designed to deliver current much in excess of that required for an average receiver.

In *The Wireless World* of February 1st last we described a rectifier unit designed for the purpose of supplying the field current for the pot magnet of moving coil speakers, and your best course would be to consider the construction of a unit on these lines.

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An "Everyman Three" Conversion.

Is it possible to use my "Everyman Three" transformers in building an "Everyman Four"? I notice that there are slight differences in the windings, etc., but they do not seem to be important enough to warrant the purchase of new coils. T. R. W.

The "Everyman Three" coils will do quite well for an "Everyman Four" receiver. You will, of course, ignore the tapping on the secondary of the inter-valve transformer, and you could also ignore either the "A_2" or the "A_3" tapping on the primary winding of the aerial-grid transformer. There would be no harm, however, in retaining this extra tapping, if you are willing to go to the trouble of fitting an extra terminal for the aerial connection

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.

Effect of Stray H.F. Currents.

I have a 1-v-0 receiver for telephone reception of distant stations, and find difficulty in stabilising the H.F. valve. By experimenting with various adjustments of the neutralising condenser, the set can be made stable, provided the condenser dials are not touched, but when tuning in the set is oscillating uncontrollably. Can you suggest a remedy, please?

N. B. M.

Your difficulty would appear to be due to a feed back of H.F. energy from the detector stage to the high-frequency amplifier, the medium through which this is taking place being the telephone leads and the operator. To mitigate this a high-frequency choke must be connected between the plate of the detector valve and the 'phones, with an H.F. by-pass condenser of about 0.001 mfds. between the anode of this valve and L.T. minus.

○○○○

A "Quality" Receiver.

It occurs to me that the "Gramophone Amplifier" described in "The Wireless World" for March 14th would make an excellent receiver for my local station (2LO, fourteen miles distant) without the addition of another valve, but with the present first amplifier converted to function as an anode bend detector. With this circuit, could I rely on getting sufficiently strong signals fully to load up a super-power valve in the output position with 150 volts of H.T.?

E. A. F.

Yes, the arrangement you propose should be highly satisfactory for your purpose, and, assuming that your local conditions and aerial-earth system are moderately good, the amplification obtainable would be more than ample. We give in Fig. 2 the circuit diagram of the complete receiver, and have shown a directly coupled aerial; you may, of course, modify this by using a coupled circuit if desired. It is suggested that the detector (V_1) should be of the medium-amplification type, with a voltage factor of from 15 to 20. Moreover, we may point out that it will be found of advantage to reduce the value of the grid leaks from 3 megohms to 2 megohms. This applies particularly to the second (that connected in the grid circuit of V_3). We recommend this modification because the effects of intermittent overloading due to atmospherics or other causes are more likely to be harmful in a wireless receiver than in a gramophone amplifier. In addition, you will observe that a grid resistance has been inserted in order to restrict the application of H.F. impulses to the L.F. amplifier.

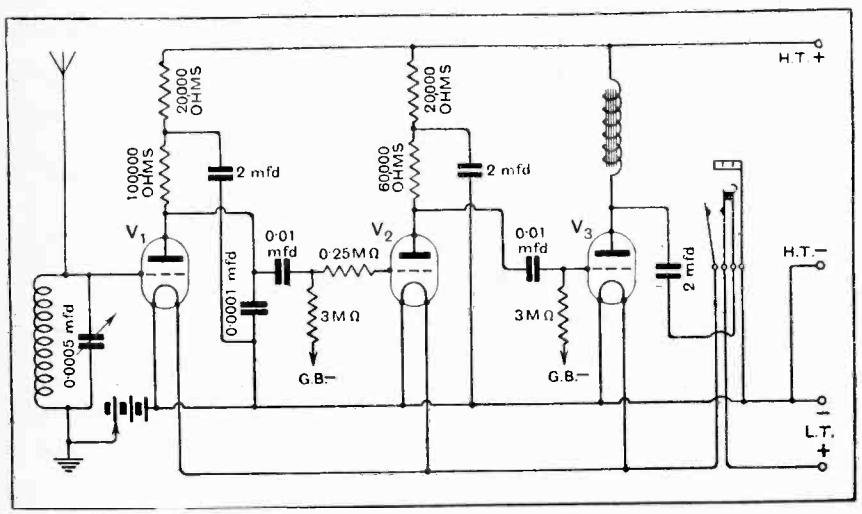

Fig. 2.—How to modify the "gramophone amplifier" for wireless reception.

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Mutual Interference Between Frame Aerials.

A portable receiver with built-in frame aerial for both long and short wavelengths functions satisfactorily on the long waves, but the results obtained on the short waves are poor. If outside frames are used separately the receiver performs well on all wavelengths, but when the frames are assembled in the lid the performance on the lower wavelengths is unsatisfactory. Can you explain this effect, please, and indicate how to overcome the difficulty experienced with the short wave frame? A. T.

It would appear that your trouble is due to the fundamental wavelength of the long wave frame aerial, when this is open circuited, falling within the tuning range of the short wave frame. This question was discussed in the article describing the "Experimenter's Frame Aerial" in our issue of July 27th, 1927, and to overcome the detrimental effect of the unused portion of the frame aerial a sectional winding was adopted. When short waves are being received the long wave portion is open circuited in three sections; this overcomes the "wipe-out" effect often encountered if this precaution is not adopted.

We suggest you make provision for at least a double disconnection of the long wave frame, so that when short wavelengths are being received the idle frame can be open circuited in two sections. If this arrangement is adopted the fundamental wavelength of each section will be below that of the tuning range of the "live" frame.

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Unequal Transformer Windings.

Through an error in counting, I find that the secondary Litz. winding of my aerial-grid transformer has 72 turns, while the intervalve coupling has 68 turns, as specified. The performance of the set (a 1-v-2 combination) seems to be beyond reproach, but I am wondering if there would be any advantage in rewinding the transformers to give an equal number of turns in each secondary. W. St. G. P.

This is not a matter of very great importance. Probably, however, you will notice that the reading of the condenser connected across the aerial-grid transformer is considerably lower than that of the other, and it is certainly an advantage that the two dials should be approximately "in step" over the majority of the tuning range. If you go to the trouble of making the alteration, it would be as well to remove one turn at a time from the winding having a surplus, until the two dials show the same reading when the set is tuned to a station operating on a wavelength in the middle of the broadcast band.

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Is My Set Oscillating?

I have a 1-v-2 receiver, using a neutralised H.F. transformer coupling, which has been stabilised according to particulars published in "The Wireless World." My difficulty is that when the aerial terminal is touched a "click" is heard in the loud-speaker, which would appear to indicate that the receiver is oscillating. If this is correct, can you advise me how to remedy the trouble, please? V. P. G.

This is no indication that the set is oscillating, and, provided the familiar heterodyne note is not heard when the tuned circuits are in resonance and adjusted to the wavelength of a broadcast station when this is transmitting, it is safe to assume that the receiver is correctly neutralised.

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No Smoothing required.

My D.C. high-tension eliminator, constructed from information recently given in your journal, is working satisfactorily, but I now wish to modify it in order that the field winding of the moving coil loud-speaker which I am now constructing may be fed through it. Can you give me a hint as to the modifications necessary? D. W. A.

You will find that there is no need to pass your mains current through the eliminator for the field windings, and thus it will be unnecessary to modify it. Generally speaking, it is satisfactory to join the D.C. mains through fuses and a switch direct to the field windings.

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MAINS UNITS AND ELECTRIC SUPPLY.

IN our issue of March 21st we commented editorially on a letter appearing in the same issue in which a reader expressed his satisfaction at the treatment he had received from the Barnet electric supply authorities, who had supplied him with A.C. apparatus to replace the D.C. mains supply equipment which he had in use at the time that the electric supply was changed over from D.C. to alternating current.

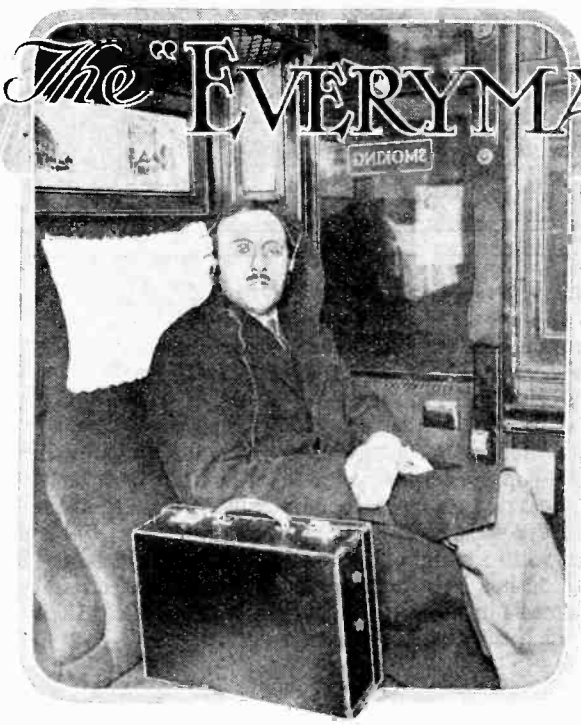
In this issue we publish a letter from a correspondent, signing himself "K.O.," who sends us an extract from a daily newspaper which records a decision of the Bangor (North Wales) Electric Supply Corporation, which is likely to have the effect of discouraging the use of units for supplying current from the mains in that district. It would seem to us that the Bangor Corporation has decided upon the pursuit of a policy which it has no legal authority to enforce. We expressed our own satisfaction at the action of the Barnet supply company (which is typical of the policy adopted by many other supply corporations) because we felt that the treatment towards the consumer had been on the generous side, but we did not forget that electrical suppliers are under an obligation to the consumer if the character of the supply is changed. We interpret the meaning of certain clauses in the Electricity Acts which protect the interests of the consumer, as intended to ensure that when, for the convenience of the supply company, or in order that their service may be carried on more economically, a change in the nature of the supply is decided upon, then the consumer can expect as a right that he should enjoy the same facilities as he has been accustomed to without additional cost to himself in the way of changes to his electrical equipment which may become necessary.

The Official View.

Our interpretation of the position was substantially confirmed in an interview with an official of the Electricity Commission, who explained to us that it is customary for the supply company to make good any such changes in consumers' electrical equipment as may be rendered necessary with a change in the nature of the supply. Due notice of the pending change has to be given to the consumers, and they, on their part, are required to notify immediately what electrical equipment they have which might require to be changed. If any dispute arises as between the consumer and the supply authorities, such dispute is referred to the Electricity Commission, who, in turn, arrange for it to be settled by arbitration, and it would appear that up to the present there has been no instance of resort to arbitration having been necessary in the case of any wireless equipment.

There is another side of the question to be considered where the supply authorities are entitled to make certain stipulations to be observed by the consumer, these being in relation to the way in which subsidiary electric apparatus shall be connected to their mains. It is here that the Institution of Electrical Engineers has proved of very special assistance. A committee appointed by the Institution prepared a report which constitutes the wiring rules now universally adhered to in this country by electricians in carrying out the electrical wiring of buildings. A sub-committee of the Wiring Rules Committee of the Institution is at present sitting with a view to preparing rules which shall govern the design and use of electrical equipment operating from the mains and intended to be used in conjunction with wireless apparatus. When the report of this sub-committee has been approved, apparatus which conforms to these rules can be installed with the approval of electric supply authorities and fire insurance companies generally. It is expected that the report of this sub-committee will shortly be available, and the new rules published for general information.

The "EVERYMAN PORTABLE"



A 12-lb. Set in a 15-inch Attaché Case.

By N. P. VINCER-MINTER and H. F. SMITH.

IT is a strange but none the less well-founded fact that man has always endeavoured to make portable all the instruments of music invented by him; so great, apparently, is his love of music that he seeks to have the means of producing it always at hand. The result is that every instrument capable of producing musical sounds can be had in portable form. The organ is portable, and so also is the piano—who has not, at some time or other, encountered one of the swarthy descendants of the mighty Cæsars deftly operating his gang-controlled piano with one hand and at the same time extending the other in salutation to passing citizens in a manner perhaps not quite in accordance with the present-day custom of his native land?

Beating the Tic-tac.

The gramophone first appeared in distinctly non-portable form, as also did the wireless set, but in both cases portable counterparts were hard on their heels. The ostensible reason for the production of self-contained loud-speaker receivers was the provision of solace for those who go down to the river in punts and have their business in quiet backwaters, and to augment the "picnickers'" customary load of kettles and cakes. It is a fact, however, that *Wireless World* readers demand such a high standard of reproduction that a loud-speaker portable set, in order to satisfy them, must be too bulky and heavy for any means of transport other than a car, or perhaps for moving from room to room of the house.

Are there no occasions, however, when the need for a real portable set is felt; that is to say, for a receiver without a loud-speaker and its concomitant heavy batteries, which is light enough for an ordinary man or woman to carry about without fatigue; an instrument ready to give instant service anywhere, at any time, and which is cheap and easy to construct? Most assuredly there are.

What of the man whose calling demands that he should travel the country endeavouring to sell people things they don't want? Does he not feel the need at times for musical solace in the morgue-like environment of the provincial hotel bedroom? What of the sportsman who desires to listen to the broadcasting of the Derby, the Boat Race, or the Grand National, and who finds that at the time these events will take place he will be in his office, in the train, or in a car? What of the weary member of the theatre queue? What of the anxious "outside" bookie at the Derby? Does he not desire to know instantly which horse has passed the post first, so that he may stand his ground or flit lightly o'er Epsom Downs with lightweight portable and bulging satchel as expediency and the state of his book may dictate? Lastly, what of the typical *Wireless World* reader, who surely must feel himself cut off from the world if he has to pass many days without access to a receiving set?

Light Weight and Compactness.

What then shall be the design of the ideal light-weight receiver? It is submitted that the instrument described in this article, which weighs some 12 lb., and which is contained in a 15in. attaché case, will meet the needs of the average reader. In the first place, it was decided that the set must be capable of being tuned with the lid closed, and that the external appearance of the receiver should be such as not to

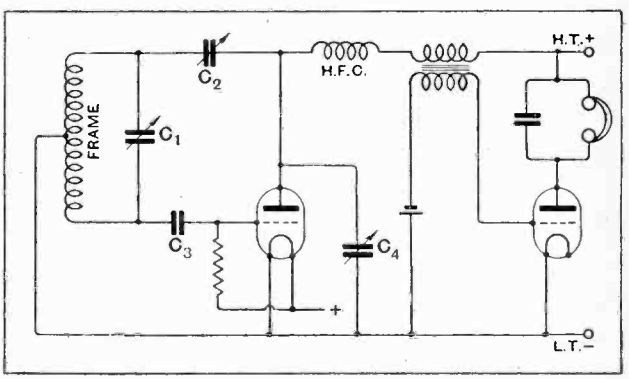


Fig. 1.—The fundamental circuit, without switching. C_1, tuning condenser; C_2, reaction feed condenser; C_3, grid condenser; C_4, reaction control condenser.

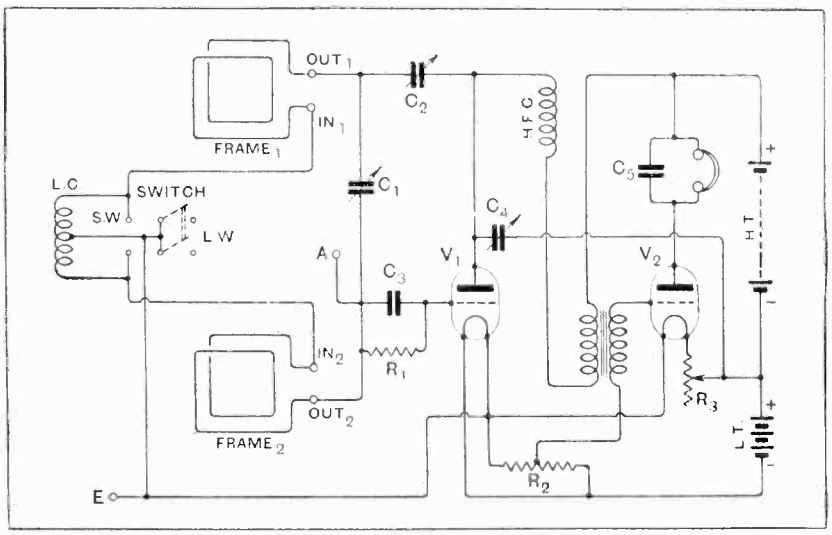
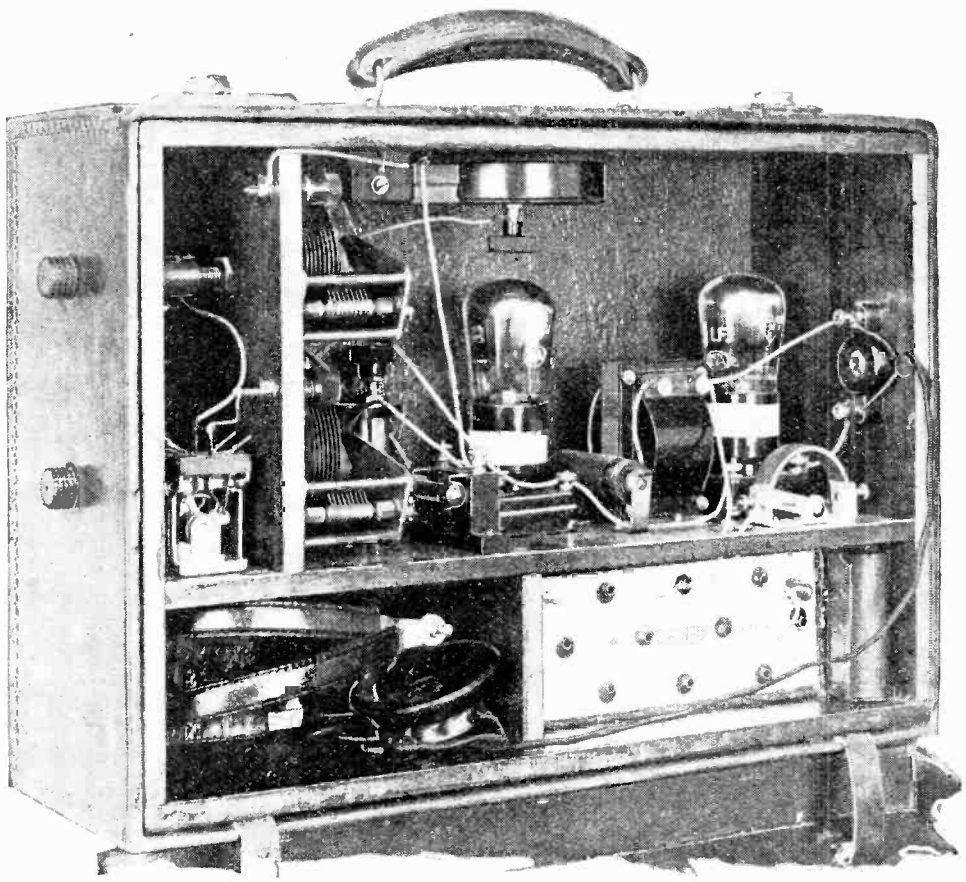


Fig. 2.—The circuit diagram. Outer and inner ends of the double frame are shown. C_1, C_3, C_4, 0.0003 mfd.; C_2, miniature condenser, 0.00003 mfd.; C_5, 0.001 mfd.; R_1, 2 megohms; R_2, potentiometer; R_3, 10 ohms; L.C., long-wave loading coil.

suggest that it is anything but an attaché case. In the various photographs the control knobs are shown projecting about ½in. in order to make their position clear. Actually, however, they can be set back further than this. H.F. amplification was ruled out, owing to the trouble and expense involved in this type of circuit, and the detector-L.F. combination was decided upon. Such an arrangement depends essentially for its sensitivity on critical control of reaction; the Hartley circuit is perfectly effective on the normal band, but it is far from easy to make it operate satisfactorily on long-wave signals. Now it would be ridiculous to expect a two-valve portable to receive Daventry (or any other station) on the frame in *any* part of these islands, so provision is made for connecting an improvised aerial. Thanks to the fine control of reaction, sensitivity on long waves is good, but only when an external aerial is used. As the "pick-up" of a small frame is in any case small as far as long-wave signals are concerned, no attempt has been made to improve the reception of them by providing a separate frame; instead, a loading coil with a short-circuiting switch is inserted in series with the short-wave winding.

The Battery Bugbear.

Thirty or forty volts of high tension was found to be ample, and to simplify the L.T. problem it was decided to connect the filaments of two 2-volt valves in series. Thus, the current consumption of two valves is not greater than that of one, and this, coupled with the fact that 4 volts are required, enables us to use an ordinary 4½-volt flashlamp battery, while at the same time automatic negative grid bias for the L.F. valve is made possible; the necessary one volt (or slightly less) is obtained by returning the L.F. grid circuit to a tapping on the potentiometer connected across the detector valve filament. The great convenience of this type of L.T. battery lies in the fact that they are obtainable almost everywhere; admittedly it has not a long life when supplying 100 milliamperes, but it must be remembered that a portable set is seldom used for continuous listening, and a



The complete receiver. The potentiometer winding round the detector valve-holder can be seen.

The "Everyman Portable."—flashlamp battery is quite capable of supplying the necessary pressure for a number of quarter- and half-hour periods. Experience shows that an accumulator is almost invariably neglected and ruined during the time that the portable set is out of use; nevertheless, there is no reason why this type of battery, or larger dry cells, should not be substituted if minor modifications in the layout are introduced.

The circuit is in essence the popular Hartley arrangement, but has been modified to overcome the trouble previously mentioned by including what may be called a "parallel" or "throttle" reaction control. The fundamentals of the circuit are shown in Fig. 1, while Fig. 2 indicates the actual connections. Referring to Fig. 1, it will be seen that anode impulses are passed back to grid through a feed condenser C_2. The extent of this feed-back is determined by the setting of the main reaction condenser C_4; reaction is thus controlled by the ratio between these two capacities. In practice the arrangement works well on both wavebands, even exceeding the writers' most sanguine expectations in giving that delicately smooth control of reaction so vitally necessary for a sensitive set without H.F. amplification.

The L.F. side of the receiver calls for no special comment, as a conventional transformer-coupled valve is included, its negative bias being obtained by utilising a part of the voltage drop across the detector filament in the manner described above. It may be added, however, that bias is hardly essential, and construction may be slightly simplified by omitting the potentiometer and connecting "I.S." of the transformer to the negative side of the L.F. valve filament.

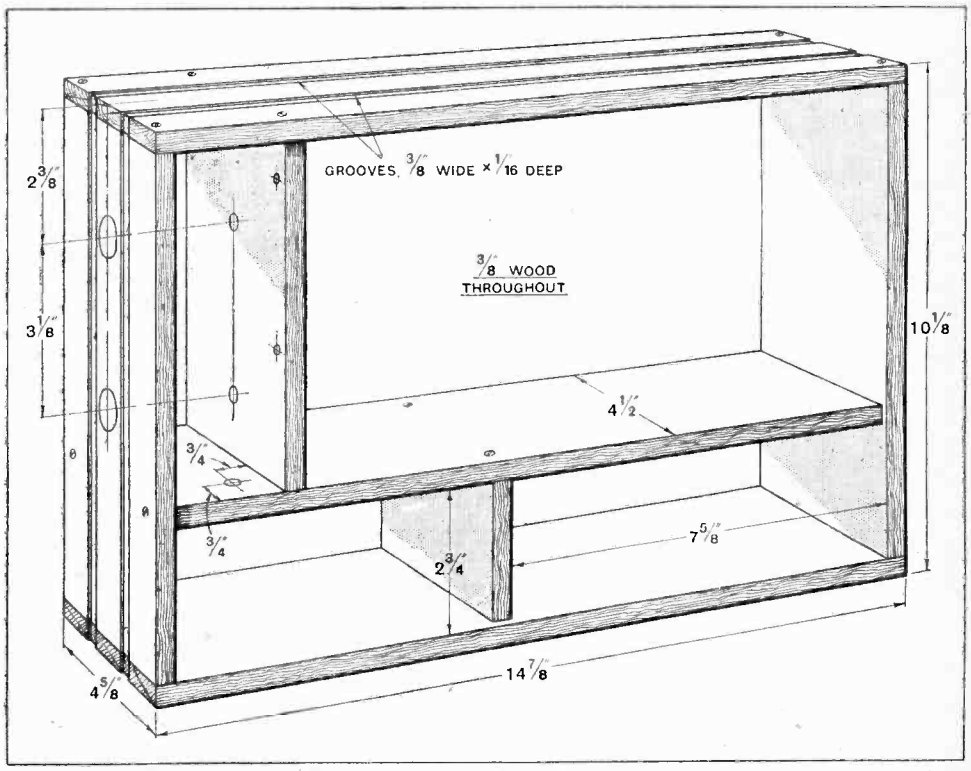


Fig. 3.—Details of the wooden framework.

Constructional Details.

A reduction gear for the condensers is a virtual necessity, and with outside controls this means that the reduction gear must be included in the condensers themselves. Moreover, we are restricted in our choice of suitable components by the fact that small size is essential, in view of the space available.

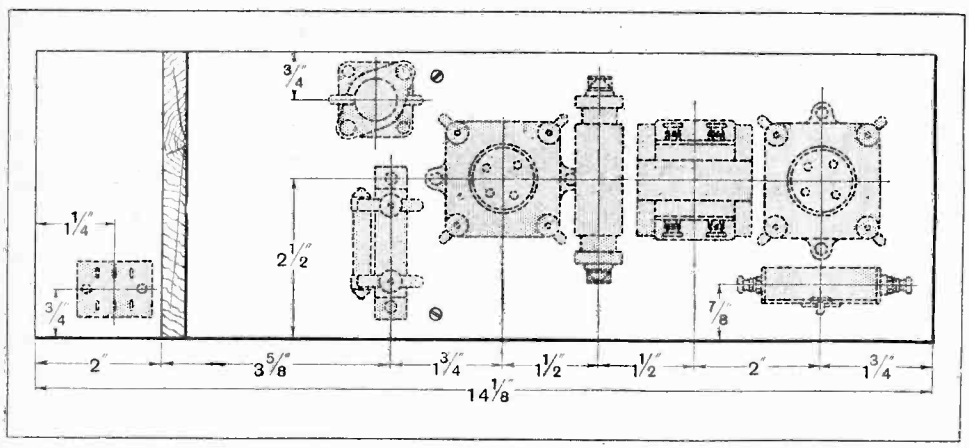


Fig. 4.—Layout of components on baseboard. Position of the vertical strip supporting C_1 and C_3 is indicated.

It will be observed that separate compartments are provided for the phones and for the batteries; the operating knob of the change-over switch projects into the former compartment, but this is not a drawback, as in the component used the rod and clamping nut are completely insulated from the contacts; thus there is no risk of a short-circuit. The telephones are joined direct to the terminals of the by-pass condenser, which is mounted on the side of the framework. A holder for the long-wave loading coil

LIST OF PARTS.

2 Variable Condensers, 0.0003 mfd. (Brandes).
1 Condenser, Type 620, 0.0003 mfd. (Dubilier).
1 Condenser, 0.001 mfd. (C.D.M.; C.D. Melhuish, 8, Great Sutton Street, Goswell Road, London, E.C.1).
1 Neutralising Condenser, 0.00003 to 0.00005 mfd. (J.B.).
1 D.P.D.T. Switch (Utility).
2 Valve-holders (Benjamin).
1 L.F. transformer ("Ace"; Telsen Electric Co., Ltd.).
1 Filament Rheostat, 10 ohms ("Varistor"; Bedford Electric & Radio Co., Ltd.).
1 H.F. Choke (Cosmos).
1 H.T. Battery, 36 volts (Siemens).
¼ lb. No. 24 D.C.C. Wire.
1 Grid Leak, 2 megohms (Dubilier).
2 Shrouded Terminals (Igranic).
1 Coil, No. 200 (Lewcos).
2 Miniature Wander Plugs (Eelex).
1 Single Coil Holder.
1 Attaché Case: inside measurements 15" × 10¼" × 4⅝" (Grays Inn Trunk Stores, Ltd., 9, Grays Inn Rd., London W.C.).
Wire, Screws, Ebonite rod, etc.
Approximate cost, excluding phones and valves, £4 17s. 6d.

In the "List of Parts" included in the description 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.

is mounted on the underside of the upper horizontal member of the framework.

The building of the wooden framework is the first step in construction, and the only one likely to present any difficulty. No doubt, however, the completed framework will become available from the manufacturers of cabinets. It should not be made or purchased before the containing case is obtained, as the necessity may arise for slight modification of the dimensions given in Fig. 3. Mahogany of ⅜in. thickness was used throughout; care should be taken to see that the wood is perfectly dry, as at some points we depend on it for insulation. The two slots for the frame aerial winding may well be cut before assembly; these can be made with the help of a chisel and penknife if proper wood-working tools are not available. The slots need only be deep enough comfortably to accommodate the wire, and the corners should be rounded off. The various pieces of which the framework is composed are held together with ¾in. No. 4 brass wood screws, and the whole should be shellacked after finishing off with sandpaper.

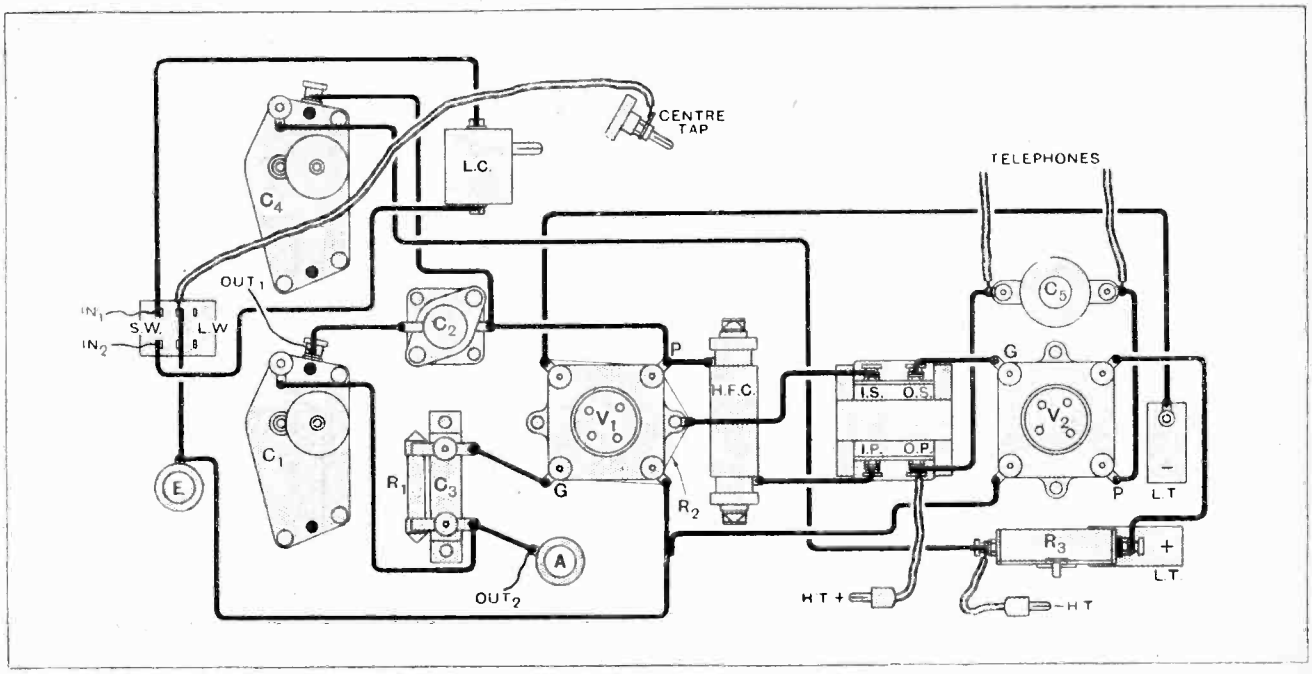


Fig. 5.—The practical wiring plan. Lettering on components corresponds with that in Fig. 2, where values are given. Note that the adjacent inner ends of the two frame windings connect to the switch, and the outer ends to points as indicated. Correct polarity is shown on the metal strips which make contact with the L.T. flashlamp battery spring clips.

The vertical strip on which the two variable condensers are mounted must be drilled to accommodate the "one-hole fixing" bushes before it is finally screwed in position; it may with advantage be used as a template for marking off the positions for the holes which pass the condenser extension rods, thus ensuring

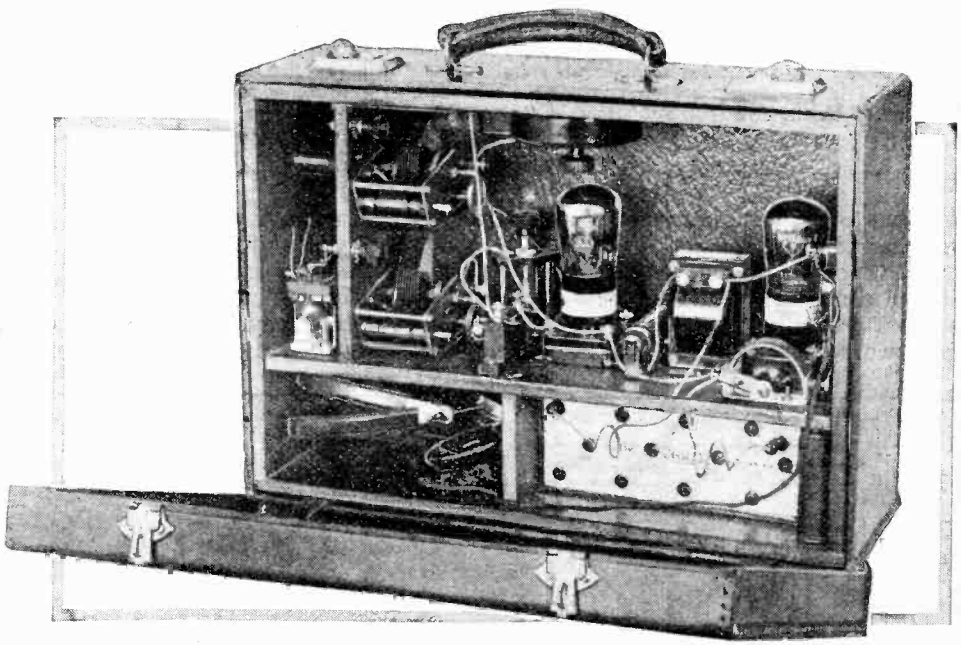
The "Everyman Portable."—

that they will be truly in line with the condenser spindles. The rods themselves consist of 2⅜in. lengths of ⅜in. ebonite rod, knurled or roughened at the outer ends (which project through the case), and drilled with a longitudinal hole to take the condenser spindle. At right angles to this hole is another, tapped 4 B.A., for a steel grub screw which grips the spindle. For those who have no facilities for making tapped holes, it is useful to know that an iron wood screw, previously heated and driven into a hole of a diameter giving a tight fit will hold perfectly well. It will be obvious that the holes drilled through the outer vertical member of the framework should afford a clearance for the control rods, to accommodate which two more holes must be cut in the end of the attaché case. Naturally, these rods will not be finally fitted till the set proper is completed and placed in its container.

The L.T. Battery.

Two pieces of copper or brass strip should be fitted to the underside of the horizontal partition in the manner shown in the accompanying sketch, to act as contact clips to the flash-lamp battery which supplies L.T. current. One of these clips is connected direct to the metal frame of the filament rheostat by the brass screw which passes through the wood and secures it in position. The brass springs on the battery should be bent in such a way that they make good contact with the clips, and at the same time are under sufficient tension to retain it in position. It must be remembered that the positive battery spring is always the shorter of the two, and that it should connect with the front clip (that which is joined to the rheostat).

The grid potentiometer R_2 is wound round the base of the Benjamin valve-holder (V_1), the wire being held in position by a shallow saw cut at each corner. Its resistance is not critical, and may be anything between some 200 and 400 ohms. A suitable winding consists of four yards of No. 45 silk-covered Eureka wire, tapped at the centre point by twisting the wire. The ends are connected directly to the "filament" terminals of the valve-holder, while the tapping (to which "O.S." of the L.F. transformer is ultimately joined) is soldered to a tag held in position by the screw which secures the valve-holder to the baseboard.



Another view of the set with lid opened. The left-hand lower compartment will accommodate ordinary phones and a length of wire for use as an aerial when required. Spare L.T. batteries may be stored in the other compartment.

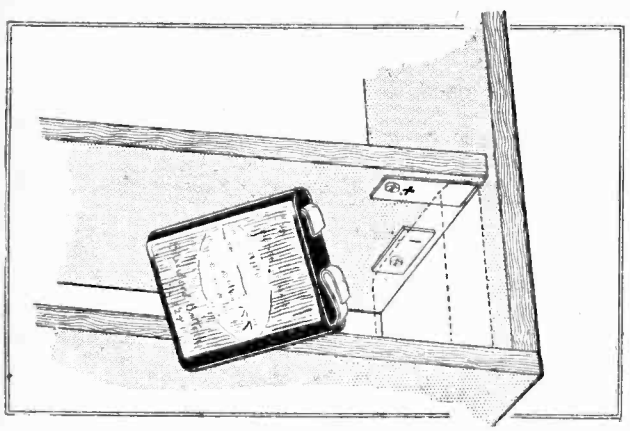


Fig. 6.—Details of the L.T. battery contact clips.

Economical Valves Essential.

The frame aerial is in two sections, with a single layer winding having approximately 10⅘ turns of No. 24 D.C.C. in each; they are, of course, wound in the same direction. The two outer ends are passed through holes in the upper horizontal strip of the framework, immediately above the variable condenser terminals, while the "inners" are brought out opposite the change-over switch.

A consideration of the various diagrams will clear up any other difficulties likely to arise in assembly or wiring. All the connections in the set illustrated were made with flexible rubber-covered wire, which would appear to be more suitable than rigid leads for a portable receiver.

The detector should be of the "H.F." type, while an "L.F." valve of some 15,000 ohms impedance is suitable for the L.F. position. It is essential that the filament

The "Everyman Portable."—

rating of each should be the same, and if a flashlamp battery is to be used for L.T. purposes, this should certainly not exceed 0.1 amp. Mullard P.M.1 H.F. and P.M.1 L.F. (in that order) were used in tests.

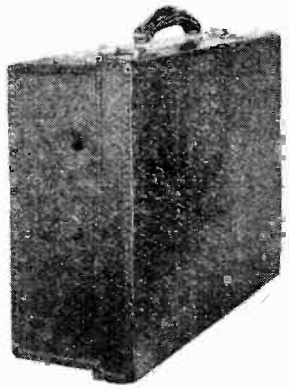
A small three-cell dry battery gives 4½ volts when new, but this pressure quickly drops to slightly under 4 volts on load; thus, when switching on, the rheostat may be set at maximum, and after a few minutes adjusted to the all-out position if signals show signs of weakening. With a battery which has been in service some time, it is necessary to operate the valves with no external resistance in circuit.

When making initial adjustments it is recommended that the small auxiliary reaction condenser C_2 should be set at maximum, at which position it should be found that oscillation is produced over the greater part of the tuning scale with the main reaction condenser C_4 at a little more than half its full capacity. If the valve tends towards oscillation with C_4 at nearly maximum, the capacity of C_2 should be reduced. Once adjusted, this latter need not be touched again. Clearly a semi-fixed condenser of low capacity may be substituted.

Those who are accustomed to more conventional methods of control should be warned that an increase of sensitivity is brought about when the capacity of the main reaction condenser C_4 is decreased (in direct opposition to the ordinary procedure). Thus its knob should be rotated in an anti-clockwise direction to bring the set up to a state of maximum sensitivity.

With this exception, the operating procedure is the same as that applicable to any other regenerative receiver having one tuning control.

With regard to results, the writers find themselves in their usual quandary; a too conservative estimate of the receiver's possibilities may lead the reader to decide erroneously that it is unsuitable for his requirements; while, on the other hand, a tinge of over-optimism may lead to his disappointment. It seems safe to estimate the range as between twenty and thirty miles from a main station, and fifty miles from 5GB and the projected regional stations—this, of course, on the frame aerial. These ranges will be exceeded when conditions are exceptionally good, particularly when the pick-up of the frame is aided by re-radiation from near-by earthed metallic bodies, but may be greatly reduced by local screening. The set has been tested very thoroughly in various localities and under widely different conditions, and has seldom failed to put up a good performance. Volume is sufficient for signals to be audible over the noise of a moving train or car at quite considerable distances.



Two small black knobs suggest the contents of this attaché case; however, they need not project more than 1/4in., and are quite inconspicuous.

Club News.

Fancy Dress Ball.

The Golders Green and Hendon Radio Society will hold a Fancy Dress Ball in the ballroom of the Club House, Willifield Way, Hampstead Garden Suburb, on Thursday, April 26th, at 8.15 p.m.

At a recent meeting a hearty welcome was given to representatives of the new Hampstead Institute Radio Society.

Hon. secretary, Lt.-Col. H. A. Scarlett, D.S.O., 357a, Finchley Road, N.W.3.

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South Manchester Society to "Carry On."

Owing to the falling off in the attendance of members since Christmas, the Committee of the South Manchester Radio Society recently held an extraordinary general meeting to decide whether the Society should carry on or close down. Twenty members attended the meeting, and it was unanimously decided to carry on.

The hon. secretary of the Society is Mr. G. A. F. Mercer, 5, Ruabon Road, Didsbury.

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Everyman Four Demonstrated.

The *Wireless World* Everyman Four Receiver and *Wireless World* H.T. Eliminator were demonstrated at the last meeting of the Radio Experimental Society of Manchester, the demonstrator being Mr. J. P. Walmsley. Various members brought micro-ammeters, relays, and other apparatus for test and calibration.

The annual general meeting of the Society will be held after the annual dinner at the Grand Hotel, Manchester, on Friday, April 27th. Tickets for the dinner (price 5s.), are obtainable from Mr. W. Stott, 29, Blackfriars Street, Manchester.

Acting hon. secretary, Mr. R. M. Kay, B.Sc., 82, Daisy Bank Road, Victoria Park, Manchester.

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Wireless in Finland.

The wireless stations of Finland were among the topics discussed in a lecture dealing with that country given by Mr. A. Barratt at a recent meeting of the Tottenham Wireless Society. Among the lantern slides shown were those of broadcasting studios and transmitters, and also of the commercial and military stations in the country. A high-power broadcasting station is now in course of construction, and is intended to serve the whole of Finland.

Hon. secretary, Mr. F. E. R. Neale, 10, Bruce Grove, Tottenham, N.17.

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Wireless Measuring Instruments.

Measuring instruments used in wireless were discussed by Mr. S. Matthews, of the Cambridge Instrument Co., Ltd., at a recent meeting of the Sheffield and District Wireless Society. Among the instruments dealt with were the Monlin Voltmeter, the Thermionic Galvanometer, and the Eccles Frequency Source.

Hon. secretary, Mr. T. A. W. Blower, Cannonfields, Hathersage, Sheffield.

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"Pick-Ups."

At a meeting of the Kensington Radio Society to-morrow a representative of the Igranic Electric Co. will lecture on "Pick-ups." New members will be warmly welcomed.

The hon. secretary is Mr. G. T. Hoyes, 71a, Elsham Road, W.14.

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Old Club with a New Title.

In accordance with a general desire on the part of the members, the North Middlesex Wireless Club will in future be known as the North Middlesex Radio Society.

It is interesting to note that this Society, one of the earliest formed in the country (it was founded early in 1914) was also among the first to resume activities after the war, and has continued its fortnightly meetings without intermission up to the present time.

It is with great regret that the Society has received the resignation of its popular secretary, Mr. H. A. Green, who has so ably and successfully filled the position for the past five years. His place is taken by Mr. E. H. Laister, whose address is "Endcliffe," Station Road, Winchmore Hill, N.21.

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The Maintenance of Accumulators.

"Accumulators for Radio Work" was the title of a lecture given recently before the South Croydon and District Radio Society by Mr. J. McBurnett, of the Tungstone Accumulator Co., Ltd. The lecturer described the troubles which attended the charging of accumulators and explained the methods adopted to ensure the perfect holding of the paste in the plates. When a quick discharge was needed the plates were made thin, whereas for a slow discharge thick plates were necessary. The lecturer concluded with some hints on maintaining the acid strength in a cell.

Hon. secretary, Mr. E. L. Cumbers, 14, Campden Road, South Croydon.

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Loud-speaker Design.

The principles of loud-speaker construction were ably explained by Mr. R. M. H. Lucy, of Messrs. S. G. Brown, Ltd., at a recent meeting of the Hounslow Wireless Society. During the following week members visited the X-Ray Department of the Hounslow Hospital, where the new apparatus recently installed was described and demonstrated by a representative of the makers, Messrs. Watson and Son. During the demonstration several members of the society acted as "patients."

Hon. secretary, Mr. C. N. Yates, 21, Witham Road, Isleworth.

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A Visit to Rugby.

Members of the Coventry Transmitters' Association spent an interesting afternoon on Saturday, March 24th, when they visited the Rugby radio station. A thorough inspection was made of both the telegraphy and telephony plants and also the power house.

Hon. secretary, Mr. L. W. Gardner (5GR), 10, Ludlow Road, Coventry.

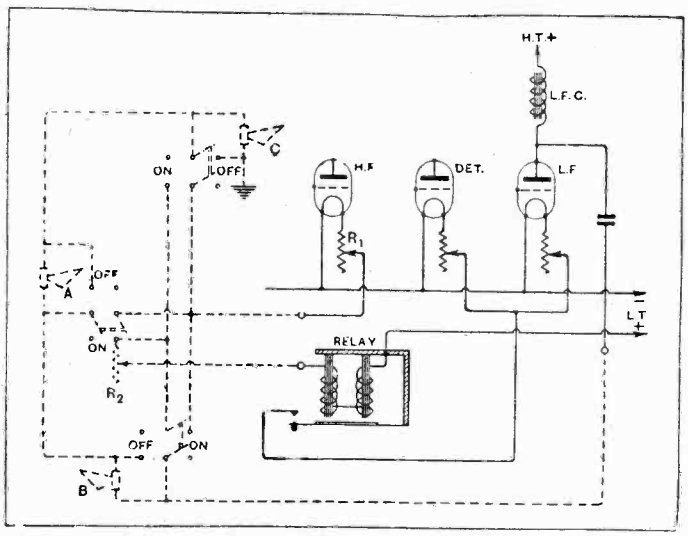
A HOUSE WIRING SUGGESTION.

Remote Control with a "Master" Volume Adjustment.

By "RADIOPHARE."

THE inspiration for this note was supplied by a published reply to a reader's query which appeared in *The Wireless World* for March 21st. The problem was a simple one, as it was desired merely to modify the system of remote volume and "on-off" control in which the H.F. valve filament current is passed *via* the windings of a relay and extension leads through a rheostat at the distant listening point. The querist, however, did not require any provision for adjusting signal intensity, and was shown how his needs could be met by wiring in parallel a switch in each of the three rooms in which a loud-speaker was to be fitted; at the same time it was justly pointed out that in any case volume control on this plan would be impossible unless those listening to each loud-speaker were of the same mind as to how loud signals should be.

Now most of us who customarily do our listening in a room other than that in which the receiver is installed are more exacting than "M.F.B.," who propounded the above question; we *do* feel the need for means whereby volume can be adjusted to a satisfactory level without having to move from our chairs. In an idle moment, the writer considered as to whether the rather attractive method which has been described could not be made more generally useful to those who have two or more loud-speakers installed in different parts of the house. Control of volume from more than one point is clearly out of the question, but surely we need not worry about that? One can imagine the domestic despot who is at the same time owner of the wireless set will be in full agreement: "I pay the piper, and mean to call the tune," he will say. "In the kitchen and nursery they must be satisfied with my interpretation of proper loudness." Seriously, it is submitted that a house-wiring system with volume control at one point and on-off switches at each of the others is likely to be generally satisfactory. The accompanying diagram shows how the arrangement already published may be modified to enable this object to be achieved; extension leads are shown in dotted lines in order that they may not be confused with the wiring of the receiver proper. The scheme is applicable to any set having an H.F. stage, but it is necessary that the valve performing this function should have a filament voltage rating some two volts lower than that of the others. The "points" are marked A, B, and C, the first being the "master" at which the volume adjustment is made.



A simple method of controlling a receiver from three distant points.

The action of the controlling devices is best appreciated if we trace out the H.F. valve filament circuit and assume the switches at B and C to be "off." Starting at the negative L.T. terminal, current passes through the H.F. valve filament, rheostat R_1, relay winding, rheostat R_2, the switch at A, and so back to L.T. positive. The relay armature is attracted, and its closed contacts pass current to the remaining valves in the set, but only that for the H.F. valve passes through the extension leads. It will be seen that the second blade of the switch is arranged to short-circuit or open circuit the loud-speaker, depending on whether it is in the "off" or "on" position.

If the switch at point B or C (or at both points together) is now moved to the "on" position, the filament circuit is not affected (we have assumed that it is already switched on from the "master" position A), but the loud-speaker short-circuits are removed and signals will be heard.

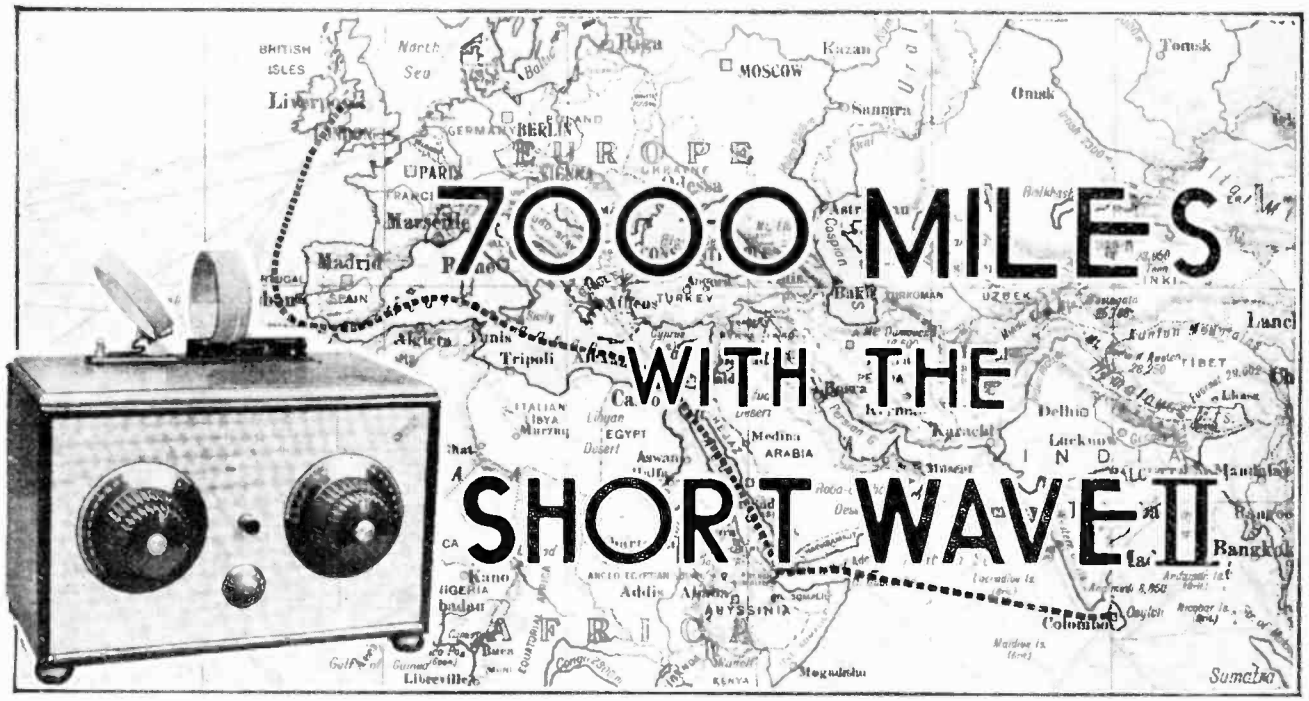
Safety Precautions.

When the master control switch is set at "off" it will be seen that the closing of either of the other two switches will energise the relay and thus complete the filament circuit of the detector and L.F. valve (or valves—there may, of course, be more than one). The current passing through the H.F. valve, and consequently the volume of reproduction, will, however, still be controlled by the setting of rheostat R_2 at point A; it is assumed that the resistance of this will be set at a value giving a good average intensity.

When first connecting up the apparatus, it is advisable to set the H.F. rheostat R_1 (in the receiver) to a position which will result in the application of the full rated voltage when the distant rheostat R_2 is "all out." If this precaution is observed there will be no danger of over-running the valve, even if the volume control is operated by an unskilled person.

The relay may be constructed from the parts of an electric bell; as it is often necessary for it to operate on a current as low as 50 milliamperes, certain modifications, which have already been described in this journal,[1] must be introduced. Alternatively, a ready-made instrument may be obtained for a few shillings.

[1] "Distant Control Relay," July 27th, 1927.



Random Notes on the Range of Reception during a Voyage to Ceylon and Back

By "WANDERPLUG."

IS long-distance short-wave broadcasting really practical? That is the question I asked myself last autumn, and, quite unexpectedly, a chance presented itself of investigating the matter personally. I was despatched by my doctor on a voyage to India, and, with a view to combining pleasure with a certain amount of semi-serious experimenting, I took with me on the *City of Poona* "*The Wireless World* Short Wave II," of the design described and illustrated in *The Wireless World* of September 14th, 1927.

Short Waves Preferred.

The coils I carried gave me a wavelength range from about 9 metres to rather over 100 metres, but my chief concern was with reception between 17 metres and 46 metres. I proposed to do a certain amount of listening on the 23 and 44/46-metre bands for British amateurs, but primarily I was concerned with telephony reception from the British short-wave station 5SW on 24 metres and the two American stations 2XAD on 21.96 metres and 2XAF on 32.79 metres. Naturally, I also spread my net for any other phone stations that happened to come within range.

Let me put the cart before the horse and give my conclusions before I produce my reasons for them. Now that I am back in England I am exceedingly glad that the Short Wave II accompanied me, for I derived a great deal of pleasure from it, and the results I obtained were, I think, very promising. There is still obviously much experimental work to be done before world-wide short wave telephony becomes truly reliable, but that rapid advances are being made is evident from the greatly improved reception of the two American stations mentioned as compared with, at any rate, my own reception of them when they first started in business. That the short wave is a little erratic in its behaviour is true, but it seems to be, on the whole, more consistent than the very long-wave stuff, such as the 18,740 continuous wave transmission from Rugby.

Long Waves and Atmospherics.

In this connection certain types of screening which seem very seriously to affect the long-wave transmissions have little or no effect on the short wave. As an example, in the Red Sea one is badly screened from Rugby by the mountains on the African coast. On the other hand, these mountains are scarcely noticeable as screens in the case of 5SW. Again, the short wave scores heavily in the matter of QRN.[1]

I made firm friends with the ship's operators, and was often in a position to listen to Rugby. On many occasions the atmospherics, particularly in the Indian Ocean and in the Bay of Bengal, were so pronounced as to make it impossible for me to read the Morse coming through. Admittedly, the ship's operators were far cleverer than I was at deciphering the messages, but the fact remains that atmospherics were often very pronounced on the 18,000-metre wave, when on 17, 23, and 45 metres they were negligible. Occasionally, of course, one had bad luck, and found that working on 45 metres was almost impossible owing to QRN, but bad days and nights were the exception.

[1] Absence of atmospheric interference.

7000 Miles with the Short Wave II.—

Turning now to my log, which, I confess, is rather scrappy, I find that, though I searched for it from the start at Birkenhead on December 23rd, I first picked up 5SW when the *City of Poona* was about 1,200 miles from London, between Cape St. Vincent and Gibraltar. Its signals were then very faint and unsteady, the strength being approximately R3, with fading to R1.

Twenty Feet of Aerial Wire.

Here, perhaps, I ought to say that on the outward journey my aerial arrangements were distinctly primitive. I had a deck cabin, and, with a somewhat complicated lead-in, ran an insulated wire up about 20ft. to the end of a derrick. My earth was sometimes of the counterpoise variety, and sometimes a diminutive sausage aerial with the far end wrapped round the waste pipe from the wash-basin in my cabin. On the way home I had a very much better arrangement, my aerial being well stretched and running some 40ft. or 50ft. up towards the foremast, with a short lead-in so steadied that it came precisely through the centre of an open port-hole facing forward on to the well deck. It was, indeed, about as good as it could have been, but the earth system was as primitive as before.

Short-wave broadcasting as a means of providing home programmes for listeners in remote parts of the Empire has brought about a need for exact information as to the range of the world's short-wave stations. The performance of a short-wave receiver is definitely indicated by the results obtained during a voyage to Colombo described in this article, the route being bordered by those countries where, owing to the absence of broadcasting stations, much interest is being shown in the building of short-wave sets.

To get back to my log. In the Mediterranean, about 250 miles east of Gibraltar, 5SW had improved to a strength of R2-5, but the fading was still bad. On that day I recorded that the American station 2XAD had faded very much in comparison with my reception of it in the Bay of Biscay As we journeyed east in the Mediterranean 5SW improved until we were about level with Malta, but from that point to Port Said it became fainter and fainter until at Port Said it was inaudible.

On January 1st, when we were about 500 miles west of Port Said, 2NM, of Caterham, came in exceedingly well with his experimental world broadcast, the strength being R3-6, with excellent speech and music. After we had passed Suez going south my results were at times disappointing, for the reason, as I discovered at the beginning of the homeward journey, that one earpiece of the phones I was using had developed a fault that deadened reception without actually killing it. Had I spotted the trouble at once my record for the run south would have been far more valuable than it is. Of this part of the voyage I will only say that 2XAD came in a good R4 350 miles south of Suez, and at this point 5SW also came in again well, sometimes R5, but with fading to R2. Some 600 miles down the Red Sea I first picked up the Dutch station in Java, working on, I believe, 17 metres, but, while he was my constant companion for weeks, I was never able to catch his call sign. Music from this station was invariably excellent, but the speech was woolly.

About half-way down the Red Sea I heard FO A4E[1] calling on CW from South Africa, his strength being R3-4, and quality good. At the southern end of the Red Sea, near the Straits of Bab-el-Mandeb, reception was very poor, hardly any short-wave stations being audible, but I am inclined to think that this was due to atmospheric conditions more than to screening. All the way through the Indian Ocean the Java station was good and strong, but 5SW was poor, and so were the American stations 2XAD and 2XAF.

I dismantled my set at Colombo, and only erected it again when we were on the homeward run some 450 miles north-west of Ceylon. With improved aerial conditions and a pair of telephones in good working order my homeward journey was very much more satisfactory. At the point mentioned the Dutch station in Java came in excellently R5, some part-singing being particularly well received. One hundred and fifty miles further north-west 5SW was heard well, the distance from London being, I suppose, approximately 4,700 miles. A talk on architecture was quite readable, and I listened with pleasure to the singing of madrigals.

As the voyage continued through the Indian Ocean 5SW came in satisfactorily, but there was a good deal of fading, sometimes from R6 to as low as R2. At this period of the voyage I had a lot of trouble with interference from the electric fans, which seemed to be doing a little transmitting on their own account on the 45-metre band. However, it was a question of being "QRNed" or grilled, and I preferred the former!

The Java station on 17 metres was received particularly well 1,150 miles from Colombo, it being quite possible even without full reaction to hear the music at comfortable strength. On the day in question I first heard, at 19.00 G.M.T., the Rugby experimental station GBS calling "Test and QRK[2]?" in connection with the transatlantic telephony on, so far as I could gauge, about 25 metres. The CW was received at R3-4, but the speech was not so good, many of the words being lost through fading.

Many Stations Heard.

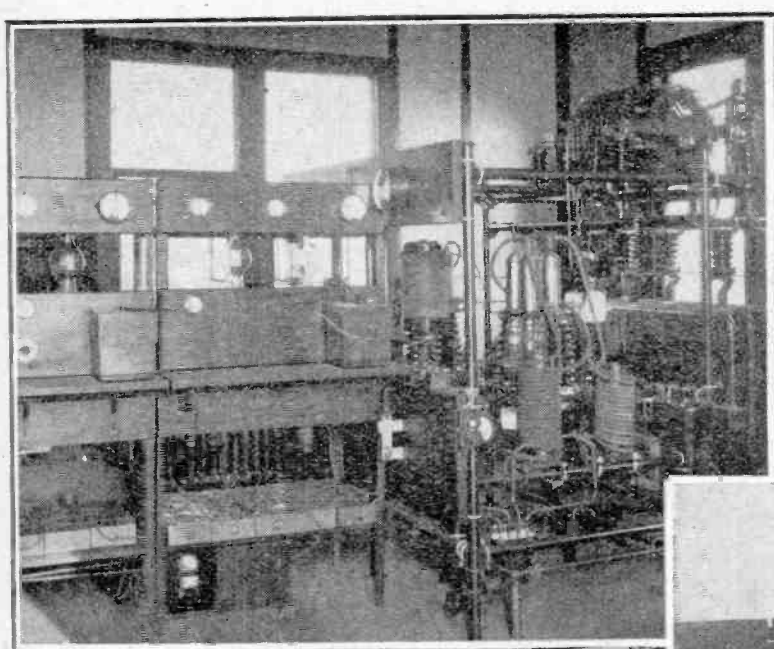
In the neighbourhood of Socrota, just south of the Red Sea, the Java station was still very strong, and at 10 p.m. ship's time I picked up OA 3ZA from Australia, calling "C.Q." on, roughly, 21 metres. His signal strength was R3-4. In the same neighbourhood 2XAF was audible, but difficult to read owing to fading. In the same locality 5SW came in very well.

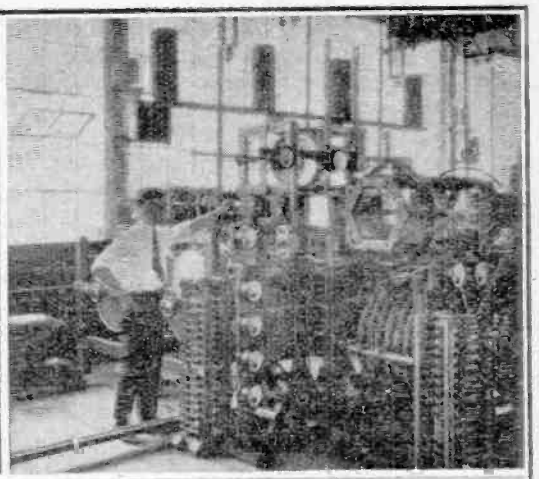
We reached the Straits of Bab-el-Mandeb at 6 a.m. ship's time, or 3 o'clock G.M.T., the only station then audible being KDKA, which was very poor. That evening, between 19.00 and 21.00 G.M.T., reception of 5SW, though good, was somewhat marred by fading. The New York CW station WIK was coming in excellently R5-7.

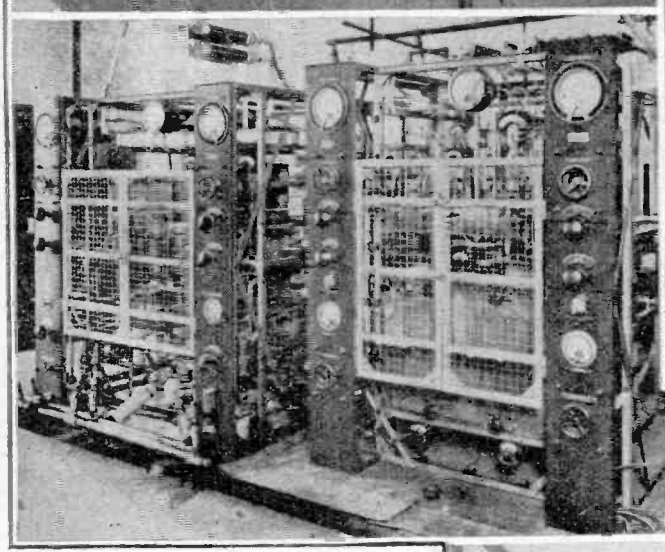
For the next few days in the Red Sea 5SW was satisfactory, but GBS became very poor. At the top of the

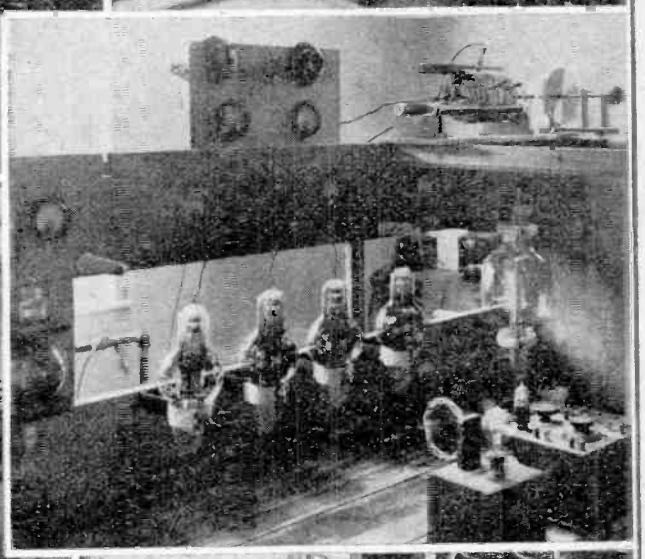
[1] Johannesburg, South Africa.

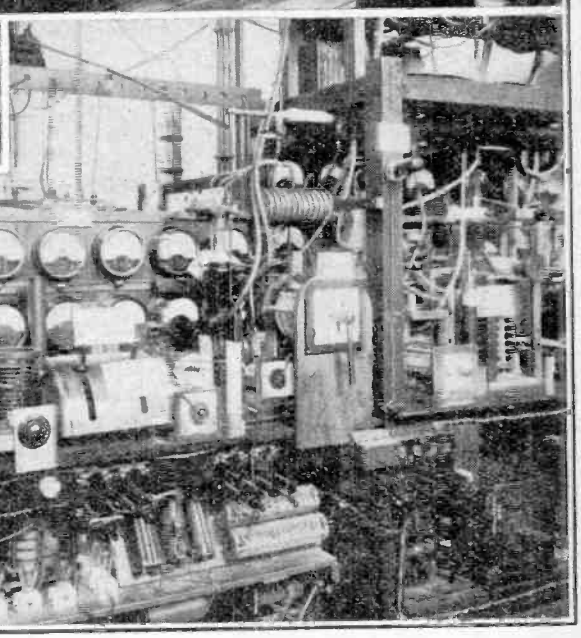
[2] "How are you receiving me?"











THE WORLD'S SHORT-WAVE BROADCASTING STATIONS.

KDKA	Pittsburg, Pa.	62.5 23.8 and 21.3 metres (*top left*).
5SW	B.B.C. Experimental Station, Chelmsford	24 metres (*centre left*).
2XAF	Schenectady	32.79 metres (*top right*).
2NM	Experimental Station of Mr Marconi at Caterham	32.5 metres (*centre right*).
PCJJ	Hilversum	30.2 metres (*bottom right*).
2XAO	Schenectacy	21.96 metres.
6XAH	San Francisco	33 metres.
ANH	Van Doeng, Java	17 metres.

7000 Miles with the Short Wave II.—

Red Sea I was much hampered by a very strong head wind and aerial swing, which made low-wave reception conditions peculiarly infuriating. Amateurs on the 45-metre band began to make themselves clearly heard as we entered the Gulf of Suez, but here again aerial swing hampered me a good deal. We lay for a few hours at Ismailia, midway in the Suez Canal, and, it being Sunday, I concentrated on the amateurs on 45 metres. Several French and Spanish stations were clearly heard, their strength being R3-5.

For the first two days out of Port Said, in the Mediterranean, the sea was too rough to enable me to open my porthole, but as we neared Malta conditions became excellent, 5SW coming in very well indeed, and various French amateurs being clearly heard. Particularly good was G 6VW. On the following day 5SW was again excellent, reception being often as good as R8, with speech modulation practically perfect Off Cape Bon, at about 15.00 G.M T., and on approximately 19 metres, I picked up some astonishingly good music and speech from a station that I failed to identify. The language was unfamiliar, but sounded more like Dutch than anything else. The same evening 5SW was very good, but the "mush" from French phone stations on 42-46 metres made it practically impossible to read British amateurs working on CW On the following day, some 500 miles east of Gibraltar at 16 00 G.M.T, I heard G 2BM calling "Test" to U.S.A. on 23 metres, his quality being good and strength R5-6. That evening many British amateurs were audible on CW.

Nearing Gibraltar I had a good bag, the largest fish being caught at 20 00 G.M.T., when I landed 3LO of Melbourne, Australia, on 32 metres. Speech was quite readable and music excellent. His strength was about R3, with slight fading probably due to a fairly heavy roll. Atmospherics, while non-existent on the 23-metre band, were very bad that evening on 45 metres. At 23.00 G.M.T 2XAD came in splendidly, being at least R8 at maximum strength.

Skip Distance of 5SW.

When we passed through the Straits out into the Atlantic I began to watch for the limit of 5SW's "skip" distance, which I expected to find somewhere south of Cape St Vincent. Fifty miles north-west of Gibraltar this station was received admirably, and at 19.00 G.M.T., when we were just south-west of St. Vincent, the British station was up to R8, while 2XAF at 23.00 G.M.T. came in perfectly at R5-7.

Next day we were 150 miles north of Cape St. Vincent, and 5SW s mid-day transmission, which I picked up at 13.15 G M.T., was down to R4-6, while at 19.00 G M.T., when our position was about 220 miles north of Cape St. Vincent, 5SW had become a trifle woolly, with fading to R3 from about R5. We were here badly screened by Cape Finisterre, which is notorious for the obstruction it seems to present to wireless waves of all lengths.

At 19.50 G M T. I picked up for the first time my own station G6ZA, and was informed that the operator had been away from home and unable to work before this day. By 24.23 G.M.T 5SW had faded to R1-3, while 2XAF was coming in splendidly. Next day, at 13 00 G.M.T., we were clear of Finisterre, out in the Bay of Biscay, and to my surprise 5SW was back again to R5-8 very clear and strong. Throughout the afternoon the 19-metre unidentified phone station was fairly roaring in with music of excellent quality. At 18.45 6ZA was again received, and, curiously enough, an hour later 5SW had faded right away to R3, and was very woolly. At 21.15 G 2HD came in with a very pure, steady DC note R5-6, and G 6SV was also clearly heard R4-5. At 23.00 G.M.T., despite heavy rain and saturated insulation, 2XAD was heard splendidly R5-9, but 5SW by this time had faded out practically to inaudibility.

In the mouth of the Channel 6ZA was again picked up with a strength of R8, but badly interfered with by two French CW stations. 5SW's carrier wave was very faintly heard at this point.

My final log entry relates to reception in the Thames as we were nearing Tilbury. 5SW had again sprung to very active life, and was received R9—presumably this was his ground wave—but was somewhat marred by a very loud dynamo hum. 6ZA was strong and clearly read at R7-8.

In Conclusion.

I think that a word of congratulation should be offered to the makers of the small two-volt Exide non-spillable accumulator upon which I relied implicitly. With two light chargings, which were kindly undertaken for me by the *City of Poona's* wireless operators, it carried me through with never a falter, and proved itself to be really non-spillable, a quality that it had every chance of demonstrating, owing to the cavalier manner in which it was treated.

I took with me an Ever-Ready 108-volt H.T. battery, and on my return, after it had been in fairly steady use for three months, it still showed rather over 100 volts, a performance of which its sponsors can properly be proud.

Of the Short Wave II receiver I can only say that it would be difficult to design a more perfect and more compact little outfit. Its performance, often in most adverse conditions, was everything that could be desired, despite the fact that I was using two-volt valves, whereas the set was designed for a six-volt current. The only criticism I had to make was that on certain wavelengths oscillation commenced with a slight low-frequency howl, but, since my return, this has been absolutely eliminated by the substitution of B4 valves, which seem ideal for use with this set.

In conclusion, a ship is exceptionally bad as a receiving ground. The masses of metal in the immediate neighbourhood of the receiver and the stray currents floating about from all the electrical apparatus connected with the vessel militate against really first-class results, and make for a noisy background for CW work just when one longs for dead silence against which to read faint incoming signals.

Bearing these considerations in mind, I think that, if I had as good results as I certainly did achieve on ship board, any wireless enthusiast with "*The Wireless World* Short Wave II" installed ashore, with a good aerial and earth system, should have the short-wave world regularly at his call.

CURRENT TOPICS

HIND

Events of the Week

THEY'VE SAID IT.

Polite society in certain parts of America is discarding the term "loud-speaker." The correct word is "enunciator."

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P.O. MEN AS WIRELESS EXPERTS.

Two defaulters under the Wireless Act who were recently fined at Staple Hill, near Bristol, stated that their sets had never given such good results as they did at the hands of the Post Office inspectors.

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DON'T SWEAR.

"If your set does not function well . . . do not worry. There is a reason which you can best discover by keeping calm and trying to locate the offending section of the receiver by freeing one part after another of suspicion. Keep yourself in a cheerful frame of mind, and be determined to master the problem that presents itself."—*Irish Weekly Times.*

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NATIONAL RADIO EXHIBITION.

Last year not a few visitors were attracted to the National Radio Exhibition at Olympia by the presentation of gifts to those who passed through the turnstiles at certain times during the day. The Exhibition Management announce that at this year's Show there will be further inducements of a more striking character.

As last year, the organisers are the Radio Manufacturers' Association. The Exhibition will be held in the New Hall, Olympia, from September 22nd to 29th inclusive.

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AN OPTIMISTIC BROADCASTER.

"We are on the eve of great things in the radio world, and South Africa will be surprised during the next month or so when we announce our plans for the future."

This exciting announcement was made recently by Mr. Eugene van Wyk, who has just taken up an important managerial position with the African Broadcasting Company. Mr. van Wyk said that the company's schemes were for the good of the Union. Everything was to be done to connect up all the most isolated parts of the country and bring them into direct touch with the outside world.

Optimism of this kind has been rather rare in South African broadcasting circles. It remains to be seen whether Mr. van Wyk has placed his finger upon some new elixir of radio life.

THE AMERICAN "OLYMPIA."

The Radio World's Fair, which is now an annual event in America, is to be held at Madison Square Garden, New York, in September.

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MARCONI WORKS EXTENSION.

We understand that plans are nearing completion for a big extension of the Marconi works at Chelmsford to cope with increasing output. It is probable that, in addition to building enlargements, the staff will be augmented.

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EUROPE TALKS TO CANADA.

As a result of recent extensions in the telephone service to Canada, it is now possible to speak from this country to towns in the Provinces of Ontario, Quebec, New Brunswick, Nova Scotia, Manitoba, Alberta, Saskatchewan and British Columbia. The minimum charges for 3 minutes' conversation range from £9 for Ontario and Quebec to £11 8s. for British Columbia.

The service to Canada is also available to subscribers in Belgium, France, Germany, Holland and Sweden, connection to the Continent being made by "through" telephone cable circuits from the London Trunk Exchange.

in Brief Review.

SWISS WIRELESS.

A big display of wireless apparatus is a feature of the twelfth Swiss Industries Fair now being held at Basle. The closing date is April 24th.

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BEAM *V.* CABLE.

Beam wireless dealt with 49 per cent. of the telegraph traffic between Australia and the United Kingdom from April, 1927, to January, 1928, according to the Sydney correspondent of *The Daily Telegraph.* The bulk of the messages were, however, of the deferred, Press and letter class, the cables retaining the greater proportion of the more profitable commercial traffic.

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"WIRED WIRELESS" IN CANADA.

The simultaneous transmission of 84 telephone messages on the same system will be possible with the new carrier current service, which is shortly to be established between Vancouver and Montreal by the Canadian National Railways Telegraph Department at a cost of about £500,000. According to Mr. R. W. Ball, General Manager of the Western Region, the installation of the Montreal and Winnipeg system has already been completed.

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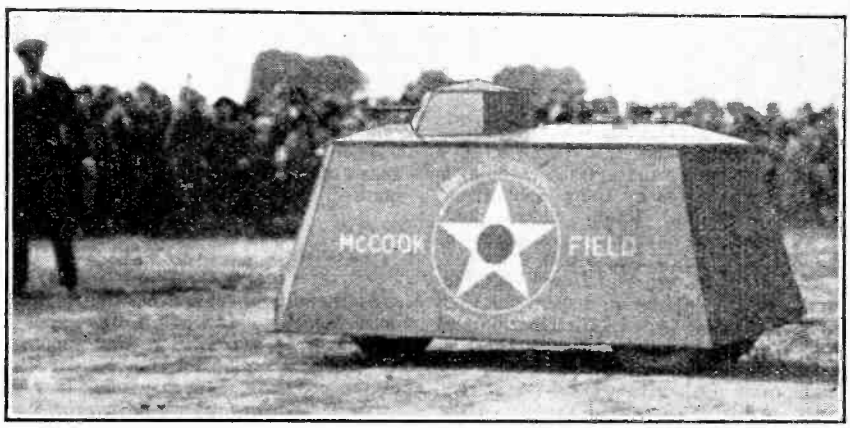
"STAND AND DELIVER"—BY WIRELESS.

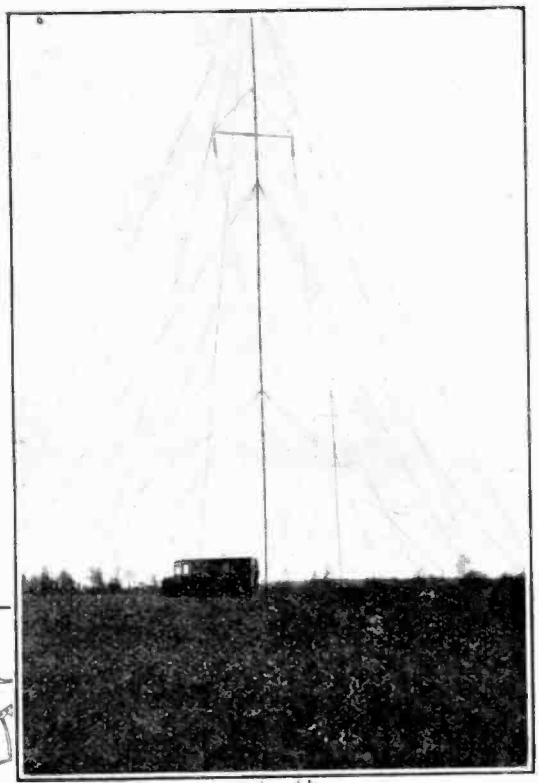
The Soviet Government, according to Press reports, is employing the broadcast system for a refined type of black-

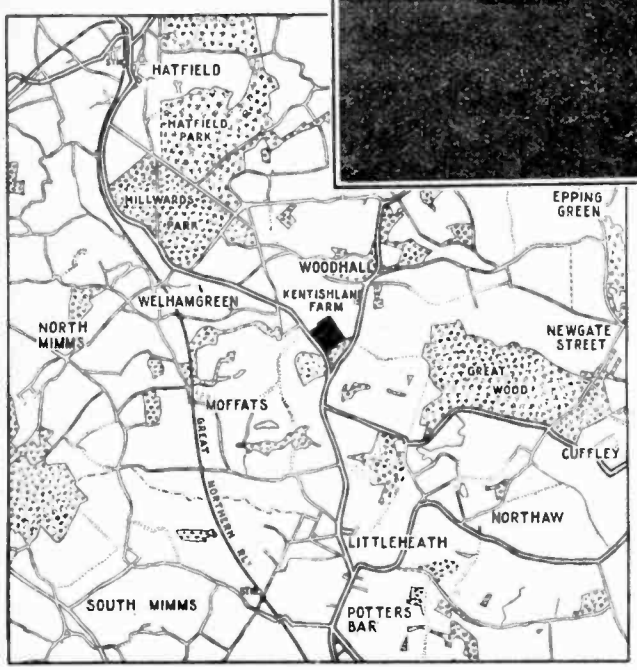


WIRELESS WAR OF THE FUTURE. A wireless-controlled tank photographed under test at Dayton, Ohio. This unusual form of weapon is being developed by the U.S. Army Air Service.

mail, in which the peasant listener is gently but firmly requested to deliver his grain to the Government buyer at the nearest collecting centre. Any peasant whose stock has come under the eye of a Soviet intelligence officer is liable to the doubtful distinction of having his name called in this manner during the evening news bulletin. When such a summons comes the boldest peasant knows that "the game is up."

One might imagine that such a risk would lend an unpleasant flavour to the pastime of listening; but apparently this is not the case. The fascination of wireless overrules other considerations, and the Russian peasant remains glued to his receiver, waiting in morbid uncertainty for his "birthday greeting."





TOO NEAR TO LONDON! It is learned that tests are being conducted on a site on high ground midway between Potters Bar and Hatfield as a preliminary to the building of the first station of the regional scheme. North London listeners are already alarmed as to the possible effect on long distance reception of planting a high power "Daventry Junior" in their midst.

THE U.S. MELTING POT.

American broadcasting is still in an unsettled state, and the prospect of a speedy solution of the present troubles is not brought nearer by the announcement that the Federal Radio Commission's latest plans will involve "a shake-up of the entire nation's licences."

According to reports from Washington, the new legislation passed by Congress provides equal distribution of licences, powers, frequencies and times of operation. Experts working with the Commission declare that there are 555,000 watts available for simultaneous radio transmission, and that these must be divided equally among five zones. Such a change makes revision of the existing situation inevitable.

It is predicted that the new wavelength allocations on which the Commission is now working will alter the face of American broadcasting to a marked degree.

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BURNDEPT RECONSTRUCTION SCHEME.

At the annual general meeting of Burndept Wireless, Ltd., last December, a committee of shareholders was appointed to formulate a plan for the reconstruction of the company, and they have now put forward a scheme, approved by the directors of the company and by the receiver and manager, which has met with the unanimous support of the creditors.

At a recent meeting of the latter, Mr. Chas. W. Rooke, the receiver and manager for the debenture holders, mentioned that in the six months preceding his appointment a trading loss of £30,000 had been incurred by the company. He had been carrying on the business for nine months, and was able to report a net profit of just under £2,500 for the first six months of the receivership to December 31st last.

The scheme of reconstruction under consideration provides for the raising of £90,000 in new money. The company would have a working capital of £70,000, including stocks, work in progress, book debts, and cash in hand. A committee of creditors has been appointed to work out the necessary details, and, subject to the necessary formal procedure, the reorganisation will be carried out as expeditiously as possible.

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RADIO MYSTERIES DEFY POLICE.

There is a pathetic note in the announcement that one hundred and ten radio sets bought for the New York police at a cost of about £3,000 are to be sold by auction. The explanation of such a sale is not that the Force has adopted more up-to-date instruments, but simply that the mysteries of directional wireless are too much for the men, whose abilities are more suited to the mysteries of crime.

Much comment was aroused when the sets were first purchased, but it is doubtful whether the criminal community lost much sleep o' nights pondering over the possibilities of a frame aerial in the hands of a typical "cop." Even in skilled hands the D.F. portable set can hardly be described at the present time as an instrument of precision, and it is just possible that the New York criminal welcomed it as an ally in putting his pursuers off the scent long enough to permit of escape.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 18th.

Tottenham Wireless Society.—At 8 p.m. At the Institute, 10, Bruce Grove. Demonstration of American apparatus by Mr. L. C. Ford, of Messrs. The Rothermel Radio Corporation.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Ordinary meeting.

Golders Green and Hendon Radio Society.—At 8.15 p.m. At the Club House, Willifield Way. Lecture and Demonstration: "The Hot Wire Microphone," by Mr. G. G. Blake, M.I.E.E., F.Inst.P.

THURSDAY, APRIL 19th.

Kensington Radio Society. Lecture: "Pick-ups," by Mr. S. Matthews, of the Cambridge Instrument Co., Ltd.

FRIDAY, APRIL 20th.

Wigan and District Technical College Radio Society. Lecture: "Radio Valves and Distortionless Amplification," by Mr. J. Ree, of Messrs. Mullard Radio Service Co.

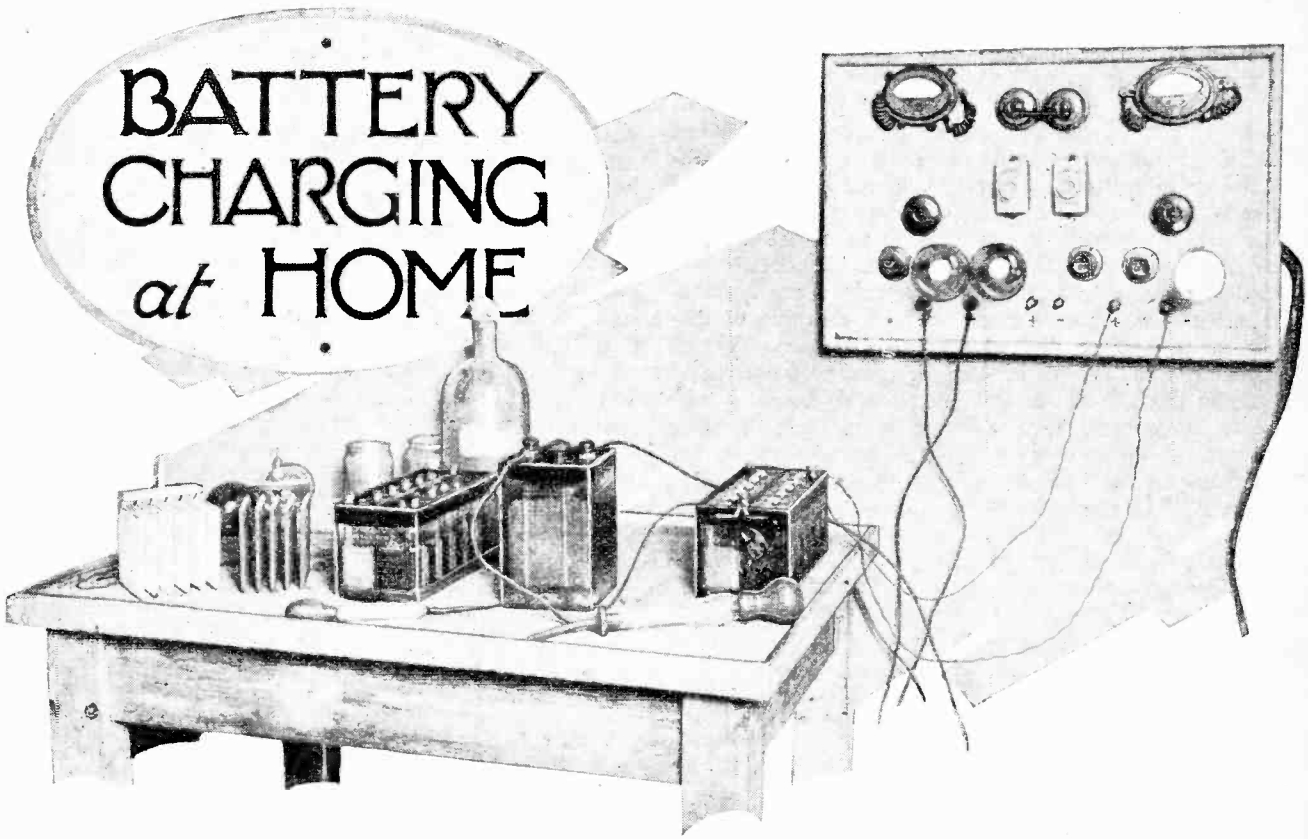
MONDAY, APRIL 23rd.

Holloway Literary Institute Wireless Society. At 7.30. At Holloway School, Hilldrop Road, Camden Road, N.7. Lecture by representative of the Marconiphone Company.

TUESDAY, APRIL 24th.

Hounslow and District Wireless Society. At 8 p.m. At Trinity Hall, Bulstrode Road. Lecture by a representative of Messrs. The Hart Accumulator Co.

BATTERY CHARGING at HOME



Hints on the Charging of H.T. and L.T. Batteries from House Supply Mains.

THE total filament power consumption of the average three- or four-valve broadcast receiver with a super power valve in the last stage is about 3 watts, the H.T. power consumption being about the same value. Since a 60-watt lamp, which takes twenty times the power demanded by either the L.T. or H.T. circuits of an average receiver, is in use in the average household for at least as long as the wireless set during the greater part of the year, it follows that, by charging his L.T. and H.T. accumulators at home, the ordinary wireless user should be able to supply his receiver with battery power for a very small sum.

In the case of D.C. it will be found that actually L.F. accumulators can be charged at no expenditure of money whatever, and in the case of H.T. the expenditure will be no greater than that of lighting the average room. This does not mean that no power at all is required for charging L.T. accumulators from D.C. mains, for obviously this would be absurd; it means that no extra expenditure will be entailed other than that which is required to light the room. In the case of H.T. accumulators, it may seem strange that we have to use (when dealing with 240-volt mains) a power of 60 watts when the battery only requires about 3 watts to charge it. The reason for these apparent anomalies will now be considered.

In order to charge an accumulator, it is necessary to pass a current through it in the reverse direction to that in which the current flows when it is lighting the filaments of our valves. The filament current consumption of the average home broadcast receiver is about $\frac{1}{2}$ ampere, and, assuming that we use a six-volt accumulator, we shall thus have a voltage of six driving a $\frac{1}{2}$-ampere filament current through the filaments. Now, the measurement of power in watts is obtained by multiplying the voltage by the current, the formula for power being $W = I \times E$, where W is the power measured in watts, I the current measured in amperes, and E the voltage. It is obvious from this simple equation that if we know the value of any two of the quantities expressed it is easy to find the value of the missing one. Therefore, it is equally true to say that $I = \frac{W}{E}$ and $E = \frac{W}{I}$.

Maximum Charge and Discharge Rates.

If our receiver requires a current of $\frac{1}{2}$-ampere, we must choose an accumulator whose normal discharge rate as specified by the maker is not less than this value. For safety we shall probably choose an accumulator which can be discharged at a considerably greater rate without suffering injury; in this manner we shall also gain the advantage of being able to add an extra valve or two to our set without the necessity of purchasing a new accumulator.

Now, the normal discharge rate of any accumulator depends on its ampere-hour capacity, which itself depends

Battery Charging at Home.—

upon certain physical characteristics of the accumulator which are fixed by its makers. In general, the greater the ampere-hour capacity of an accumulator the greater its bulk and weight. The normal discharge rate, which is also the normal charging rate, is the maximum safe rate at which the accumulator can be *charged or discharged* without risk of injury to it; this rate is normally one-tenth of the actual ampere-hour capacity of the accumulator. Thus if we have an accumulator possessing an actual ampere-hour capacity (hereinafter referred to as the A.H.C.) of ten, the rate of discharge must never exceed one ampere.

There is nothing to prevent us from charging or discharging at a lower rate than the normal one. Therefore, we can charge, for instance, by passing a current of 1 ampere through the accumulator for 10 hours, $\frac{1}{2}$ ampere for 20 hours, $\frac{1}{4}$ ampere for 40 hours, etc.; the same rule holds good when discharging. Thus it follows that if we know the total filament current taken by our receiver and the A.H.C. of the accumulator, we can predict with certainty the length of time during which our accumulator will operate our receiver before it requires recharging. The formula for this is $T = \frac{A.H.C.}{I}$ where T equals the time expressed in hours, I the current in amperes, and A.H.C. the actual ampere-hour capacity of the accumulator. By using the same formula we shall know exactly how long our accumulator will take to charge if we connect it in series with any apparatus through which a current of given value is flowing. It will be again obvious that if we know any two quantities in the above equation we can find the third, and that $I = \frac{A.H.C.}{T}$ and $A.H.C. = I \times T$.

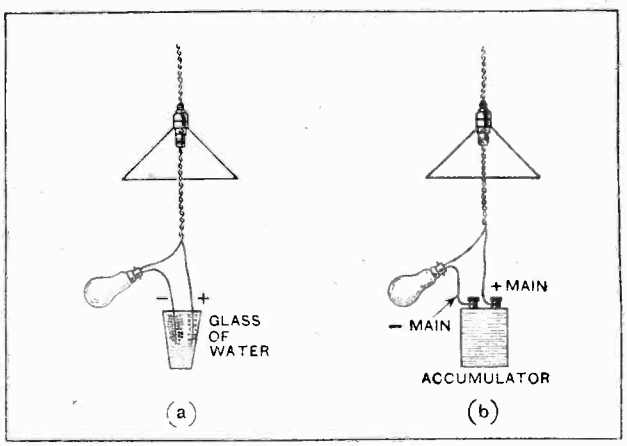


Fig. 1.—(a) First find the polarity by means of a glass of water, (b) then replace the glass of water by the accumulator to be charged.

Now let us see how we can charge our battery for nothing. It is quite simply done. Suppose we are on 240-volt D.C. mains, and that we normally use a 60-watt lamp in that room, it will be found by applying the formulæ already given that a current of about $\frac{1}{4}$-ampere will be flowing. If, therefore, we put our accumulator in series with this lamp as in Fig. 1(b), all the current passing through the lamp will pass through the accumulator and charge it without any cost whatever, because in any case we should be using the lamp to light the room. It is not suggested, of course, that charging be carried on during the daytime, nor is it suggested that the untidy arrangement shown be used, but that a special adaptor be purchased which will put the accumulator in series with the lamp, the former maintaining its normal position, and a length of "flex" going to the accumulator which may be put anywhere in the room that is convenient. Before connecting up as shown in Fig. 1(b), it will be necessary to find the polarity of the mains. The method of doing this is clearly shown in Fig. 1(a). The only extra accessory required is a glass of water. It will be found that the lamp will then burn dimly, and bubbles will arise from each wire in the glass, but twice as many bubbles will appear at one wire as at the other. The wire with the most bubbles is the negative main, and when charging this must be connected to the negative terminal of the accumulator.

Testing for A.C. or D.C.

There is no risk of blowing fuses when carrying out this experiment, as even if the wires in the glass touch each other accidentally, all that will happen is that the lamp will light up at normal brilliancy. An ordinary glass of water will do, and the addition of a teaspoonful of salt in the water which is sometimes recommended is quite unnecessary, and will only cause a disagreeable odour. *En passant*, it may be mentioned that this method is useful for determining whether mains are A.C. or D.C. If they are A.C. the number of bubbles appearing at each wire will be the same. Naturally, the switch controlling the particular lamp socket used will be in the off position when arranging the apparatus for the test in order to avoid risk of an electric shock, to which some people object.

It is obvious that charging our accumulator will cost us nothing, but whence is the power derived? It is simply derived by the fact that instead of the voltage drop across the lamp being 240, it will be 238 in the case of a two-volt accumulator, since two volts will be dropped across the accumulator. With a six-volt accumulator, six volts will be lost to the lamp. Therefore, the lamp will burn with less brilliancy than usual, but this loss is so slight that it is not perceptible although it is actually there.

We have, therefore, a $\frac{1}{4}$-ampere charging rate, and although this is low, we shall get the accumulator fully charged eventually if it is left in circuit for a sufficient number of evenings. The bigger the ampere-hour capacity of the accumulator, the longer will it take to charge. In the case of a battery of 10 ampere-hour capacity, it is obvious that it would take forty hours to charge it under these conditions. In the winter, therefore, when the light is normally on for six hours or so, it would take $5\frac{1}{2}$ evenings; in summer very considerably longer. Now assuming we have a spare accumulator of similar A.H.C. delivering half an ampere to our set, it will probably happen that it is discharged before the one on charge is ready for duty. Therefore, we want a bigger charging current. This can be obtained by putting in a 100-watt lamp instead of a 60-watt lamp, but this would be foolish, as it costs more to run a 100-watt lamp than to run a 60-watt one, and if we use an unnecessarily

Battery Charging at Home.—

bright light in the room just for the sake of battery charging, are we getting our charging done for nothing? No! But the solution is given in Fig. 2.

If we examine our main switchboard we shall find in addition to the main switch there are two porcelain fuse-boxes. We must first remove the cover from one of these boxes (it does not in the least matter which), and we shall see two terminals joined by a piece of fuse wire. We must remove this fuse wire, and connect up a glass of water as shown in Fig. 2(a) to find polarity, and having done this connect up our accumulator as shown in Fig. 2(b). In this manner *all* the current passing through the mains to one or more lamps in the house will pass through the accumulator. In most households there is generally more than one lamp alight in the house during part of the evening at any rate, and while these two or more lamps are alight, the total current drawn from the mains will be correspondingly greater, and so the value of current passing through the accumulator will be greater, and therefore it will be charged in less time. It is advised that an extra porcelain fuse-box be purchased at a cost of a few pence, and inserted in the position marked "fuse." This still gives us "free" battery charging at the price of an imperceptible diminution in the brilliancy of the lights in the house. Needless to say, in this operation also the stage should be set with the main switch in the off position in order to avoid irritating shocks if live wires are accidentally touched.

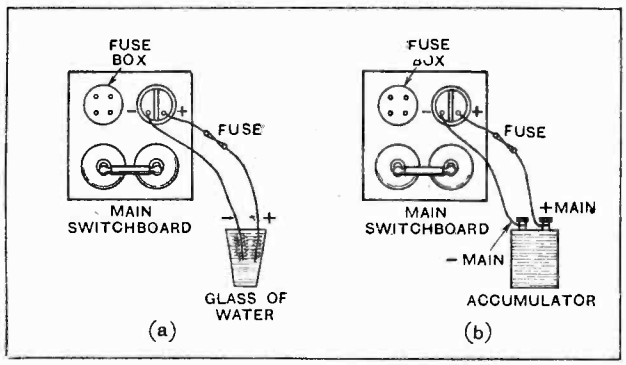


Fig. 2.—(a) The polarity of the two fuse box terminals is first found, (b) and then the accumulator connected up through a fuse.

Charging H.T. Accumulators.

Now with regard to H.T. accumulators which have an average A.H.C. of $2\frac{1}{2}$ ampere-hours, and therefore a maximum charging rate of $\frac{1}{4}$ ampere, we cannot adopt this method because although the automatic subtraction of six volts from the mains voltage in the case of charging an L.T. accumulator will give no perceptible diminution in light, it is obvious that the subtraction of 120 volts, if we assume our H.T. battery to have this voltage, *will* cause the lights to burn dimly. To charge H.T. batteries it is necessary to part with money, but the bill will not necessarily be large. The method of charging is to adopt the scheme shown in Fig. 1(b), but since the lamp will only be burning dimly we must use a separate lamp socket from which light is not required, and be content to regard the lamp as merely a resistance limiting the charging current to the value specified by the makers of the H.T. accumulator. Now our H.T. accumulator will, if it is of the type we have already mentioned, require that a current of $\frac{1}{4}$ ampere be passed through it for ten hours in order to charge it. We must not forget that the actual voltage pushing the current through the accumulator is the actual mains voltage. The power taken from the mains, therefore, is $240 \times \frac{1}{4} = 60$ watts. But the voltage drop across the accumulator will only be slightly above 120. The power used for charging the accumulator will, therefore, be $120 \times \frac{1}{4} = 30$ watts. What becomes of the other 30 watts? It is a sad thing to relate, but we merely have to waste it in heating up the lamp. Therefore, when charging an H.T. battery it will cost us as much as burning a 60 watt lamp for ten hours, but still, once charged, it will operate the average home receiver for from two to three months using the receiver three or four hours daily.

The Case of A.C. Mains.

With regard to the value of the current limiting resistance, we can easily calculate this by Ohm's law with which the writer has already dealt at some length in the pages of this journal.[1] There will obviously be a voltage drop of 120 across the H.T. accumulator, and since the mains voltage is 240, we must arrange to drop the extra 120 volts across the resistance. The value of the resistance can be found by using Ohm's formula of $R = \frac{E}{I}$, where R is the resistance required, E the voltage to be dropped, and I the current to be passed. Having this information in our possession it is only necessary to refer to the tables issued by the various wire manufacturers to know how much resistance wire of a given gauge we need. A lamp may be used as a resistance, of course, and it is only necessary to use a lamp, the resistance of whose filament is equal to the required value which we have just elucidated. In finding the resistance of the filaments of these lamps the writer hopes to have more to say at some future date, as there is a "snag" in that the resistance of their filaments is not constant, but varies with the temperature, or in other words, with the brilliancy of the lamp. Ohm's law can only be *directly* applied when the lamp is burning at normal brilliancy. At other times it is necessary either to use meters or to consult graphs prepared in the laboratory.

In the matter of A.C. mains, the procedure for charging an L.T. accumulator is exactly the same as for charging an H.T. accumulator, and a similar remark applies to the cost. We are compelled to invest in a piece of apparatus consisting of a transformer, and a rectifier, the cost being between two or three pounds. We cannot resort to any "free" charging subterfuges as in the case of "L.T. accumulators," and D.C. mains. The efficiency of our transformer and rectifying apparatus will not be greater than 25 per cent., and therefore if we want to apply three watts of power to the accumulator during the charging operations, we must take 12 watts from the mains to do it. The cost of charging an L.T. or H.T. accumulator, therefore, will be low, the power

[1] *The Wireless World*, March 28th, page 398.

Battery Charging at Home.—

used when charging being less than a quarter of that used to light an ordinary room, for, as we have already mentioned, a 60 watt lamp is customarily employed.

Therefore, we may definitely say that if we have D.C. mains the monetary cost of supplying power via accumulators to the L.T. part of the set will be nil, whilst the cost of running the H.T. part will (if we use H.T. accumulators) be roughly equal to the cost of lighting one room with a 60 watt lamp for the same period as we use a wireless set. With dry H.T. batteries of any type it will be much greater. In the case of A.C. mains, the cost of operating a receiver from the L.T. point of view will be only about a quarter of that for lighting the average room for a similar period, and the same remarks apply in the case of H.T. To these costs must be added that of acid or distilled water at intervals, but such costs are relatively very small indeed.

G 2NM Heard Clearly in India.

Mr. Gerald Marcuse informs us that the Post Office authorities have extended his licence for experimental broadcast transmissions until June 1st, so that the well-known short-wave programmes from G 2NM will continue for a time.

Mr. Marcuse has received many reports from India, where his transmissions are greatly appreciated. One from Peshawar, dated March 12th, states that at 19.15 G.M.T. on March 11th the reception was excellent and at R7 strength, and that, in addition to band items and gramophone records, he heard 2NM communicating with Bangkok, Siam, and a relay of the bells of St Martin's-in-the-Fields. The receiver used was an 0-v-1.

Another, writing from Cossipore, reports excellent reception at about the same time on an 0-v-2 set, and similar good reports were also received from Allahabad and Colaka, Bombay, the church bells being especially appreciated.

A further report from the operator of s.s. "Maid of Syria," when stationed at Matsuma Bay, Naxos, in the Grecian Archipelago, is of interest, as the spot is badly screened by an island rising to 4,000 feet in height, and is, therefore, a very poor place for reception. The writer states that both 5GB and 5XX are inaudible, yet he received 2NM at comfortable loud-speaker strength on an 0-v-2 set between 10.45 and midnight G.M.T. on March 16th.

Mr. Marcuse finds that there is still a considerable amount of interesting uncertainty in short-wave transmissions as regards seasonal skip effects. On March 18th his transmissions were abnormally clear and powerful over the whole of the British Isles, though probably at the time of writing he had not been able to collect sufficient reports from distant lands to ascertain whether this exceptional reception was widely distributed or confined to comparatively short distances.

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General Notes.

Mr. J. A. Cuthbertson, of Radcliffe, Northumberland, asks us to state that he is leaving for Cape Town very shortly and hopes to have his transmitter working there in due course, when he expects to keep up regular communication with British amateurs.

Mr. E. P. Allen (G 6LN), "Meadowcroft," Radcliffe-on-Trent, Notts, is conducting a series of nightfall fading tests in conjunction with Mr. J. Speakman, 33, Walton Road, Stockton Heath, Warrington. The tests will be as follows: Transmissions from 6LN every Thursday evening from half an hour before to half an hour after sunset. The call will be "Test skip de G 6LN pse. QSL." Reports giving strength of signals, time, extent of fading or variation in strength will be welcomed.

Mr. H. F. B. Sharp (GC 2SR), Hill of Tarvit, Cupar, Fife, is testing on Tuesdays, Wednesdays and Thursdays at 07.40 to 08.00 G.M.T. on 23 metres, telephony, and will welcome reports.

TRANSMITTERS' NOTES.

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Argentine Amateurs.

Supplementing lists published September 28th and December 28th, 1927.

AZ2	F. Delrio, Jnr., Gorriti 3757, Buenos Aires, Fed. Cap.
EB4	C. L. Pella, Caseros 166, Lincoln, Prov. of Buenos Aires.
EC3	A. C. Ramirez, Carmen de Arco, Prov. of Buenos Aires.
HH1	P. E. Vanzina, 9 de Julio 406, Cordoba.
HH2	J. E. Roman, Ituzaingo, 606, Cordoba.
HH3	J. E. O. Baidegts, Colon 230, Cordoba.
HH4	T. Nannini, Alicia, Prov. of Cordoba.
HH5	F. Bruno, 27 de Abril 692, Cordoba.
QA3	R. B. Avila, Balcaree y San Louis, Mercedes, Prov. of San Louis.
I1	R. J. A. Suarez, Buenos Aires 1184, Villa Maria, Prov. of Cordoba.
U8	"La Voz de San Justo," Colon 1040, San Francisco, Prov. of Cordoba.

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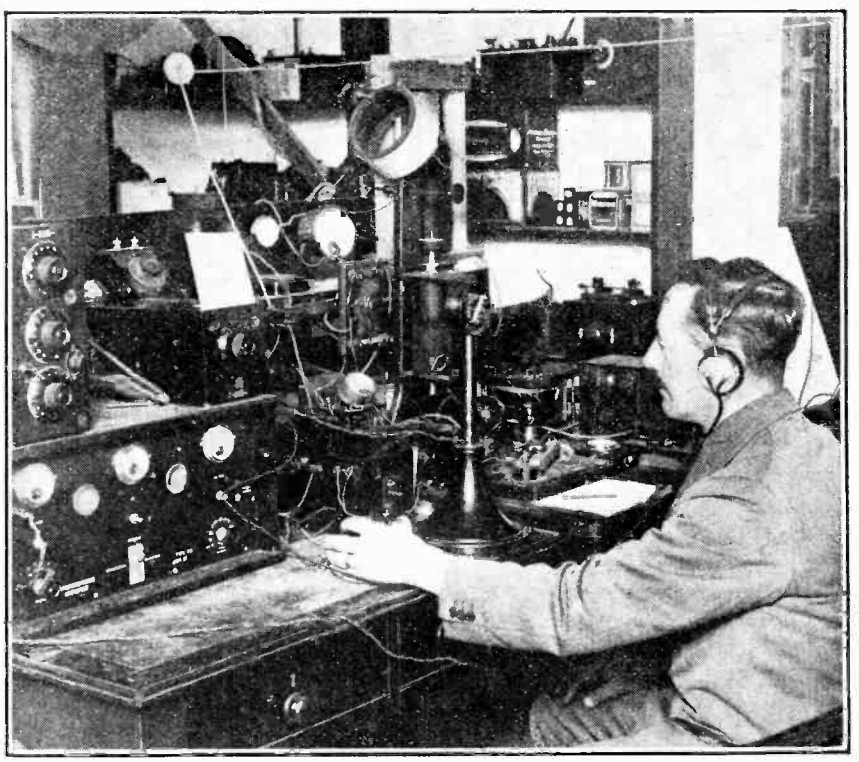
New Call-signs and Stations Identified.

5ES	C. S. Bradley, 10 Montenotte Rd., N.8. Portable set. (This call-sign was previously given in error as 5PS).
2AAK	M. Nicholson, Travers House, 114, Thorpe Rd., Norwich.
2ABK	R. C. Horsnell, 2, The Broadway, Wickford, Essex. (Change of address).
2AMN	E. T. James, Pitwood Yard House, Abercanaid, Merthyr Tydfil, Glam.
2BCF	L. Lade, Frimley Lodge, Frimley Green, Surrey. (Operated by H. A. Lade).
2BGS	E. J. Laker, 4, Alford Rd., Cranleigh, Surrey.
EATH	Radio Laboratory, The University, Vienna, transmits on 37 metres, generally from 23.00 G.M.T. onwards, and will welcome reports.
EK 4UJ	Karl Rittman, Munich.



2ZG, owned and operated by Mr. W. J. Badman at 12, Southside, Weston-super-Mare, who is here seen at work on the 200 and 400 metre telephony transmitter, A Meissner circuit is employed; the output from the "Round" microphone is passed through the amplifier on the left to a choke modulator.

VALVES WE HAVE TESTED

The New Ediswan PV2 with Coated Filament.

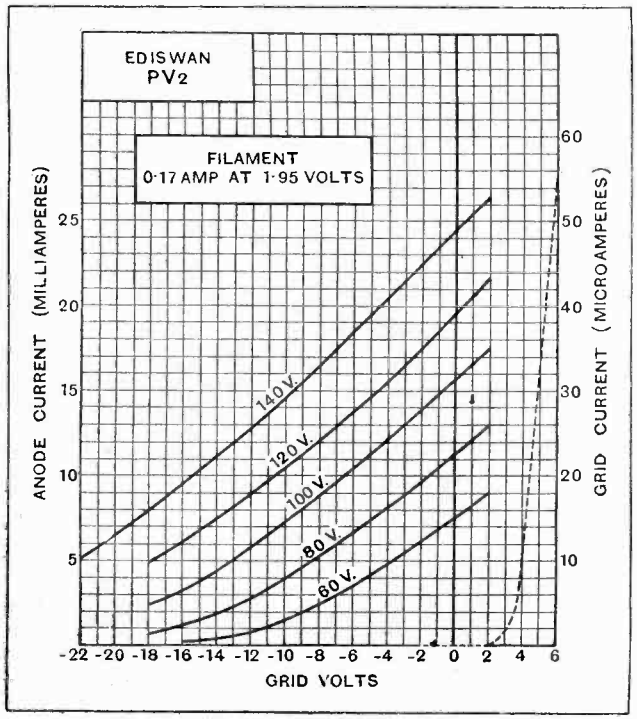
IN its new and improved form the PV2 is a useful addition to the range of two-volt power valves now available for loud-speaker work. The introduction of a low-temperature coated filament of increased length is the reason for the general improvement in the characteristics which compare very favourably with any other power valves in the 2-volt class. The filament is of the "V" type, and is suspended inside a grid and plate of conventional "flattened" form. Each valve is sealed before leaving the works by a glass sleeve over one of the valve legs; the valve cannot be put into use without first cutting the sealed string which holds this sleeve in position. Before inserting the valve in a holder it is advisable to open with a penknife the valve pins which are of the simple split type.

The Filament Current.

The characteristics of the sample valve submitted are reproduced in the accompanying curves. The filament current without any resistance in circuit other than that of the filament leads is 0.17, which is slightly more than the makers' rating. With low values of H.T., however, it is not necessary to run the filament at the maximum voltage specified, and a variable resistance up to 10 ohms may be used to reduce the filament current to the most economical working value.

Best results compatible with length of life will be obtained with about 120 volts on the plate and a negative grid bias of 10½ volts. Under these conditions with an A.C. resistance of 5,250 ohms and an amplification factor of 4.2 good loud-speaker results are assured, and the valve should find immediate use in the output stages of portable receivers in which a 2-volt L.T. circuit is practically compulsory. Suitable grid bias values for other H.T. voltages are shown in the table.

H.T.	Grid Bias.	Anode Current (mA).
60	−6	3.5
80	−7.5	5.5
100	−9	8.0
120	−10.5	10.0
140	−12.0	13.0



(Average values.)
A.C. resistance = 5,950 ohms.
Amplification factor = 4.2.
Mutual conductance = 0.71 mA/volt.

Grid Current.

A reverse grid current test showed the vacuum to be hard, an essential condition for a power valve. Incidentally, positive grid current did not start in the valve under test until the grid was made 2 volts positive. This adds another two volts to the available straight portion of the characteristic and, strictly speaking, the grid bias should be reduced a volt below the figures quoted in the table in order to bring the operating point to the correct position; but this would involve an increase of the mean anode current drawn from the H.T. battery, so that it is perhaps wisest to adhere to the grid bias value indicated in the table. In any case it is better to err on the negative side when fixing the grid bias to avoid all possibility of grid current.

BROADCAST BREVITIES

By Our Special Correspondent.

Campaign Against Soot.—Spring-cleaning at Savoy Hill.—The Nonsense of "Uncle Mac."—Copyright Problems.—B.B.C. Education Schemes.

The Great Spring Clean.

One by one the twenty-one transmitting aerials of the B.B.C. are now undergoing the half-yearly cleansing process. Most of the aerials are in the centre of towns, and the accumulation of soot alone entails a dirty job for the cleaning staff. Some aerials, by the way, are beyond the scaling powers of the B.B.C. staff, so steeplejacks are employed.

The Daventry aerials are fitted with ladders, and are inspected regularly once a fortnight. One of the most difficult aerials to take down and replace is the 2LO aerial in Oxford Street.

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Up With the Lark.

To avoid interruption to the programmes each aerial has to be cleaned as quickly as possible during "off" periods. Sunday morning is generally chosen for the job.

The work is begun at 5 o'clock a.m., when the great public mind has temporarily forgotten that there is such a thing as broadcasting; and if all goes well, the aerial is back in position at 2 o'clock in the afternoon and is ready for testing prior to the opening of the programmes at 3.30.

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Taking No Risks.

The slightest sign of wear in any of the wires is remedied at the outset, the B.B.C. believing that it is better to discard partially worn material than to run the risk of a stoppage. The result of this policy is a fairly high maintenance expenditure, but most listeners will agree that this is a case of money well spent.

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Whitewashing in Silence.

Meanwhile spring-cleaning is also in progress at Savoy Hill, where the air resounds to the "plop plop" of the whitewash brush on the stairs, strangely mingled with the "yap yap" of the artist in the studio. But the whitewashers are not at ease; "silence" notices glare at them on all sides and they are not allowed to whistle.

A May Day Event.

May Day will be marked in the 2LO and 5XX programme by a broadcast of Dr Arne's comic opera, "May Day." The "book" of the opera was the work of David Garrick.

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Lambing Season at Daventry.

Heroic scenes were witnessed at Daventry last week when a lamb, only a few hours old, fell into the cooling pond. In attempting a rescue its mother fell in, too, and a mutton tragedy was only averted by the timely arrival of the station staff.

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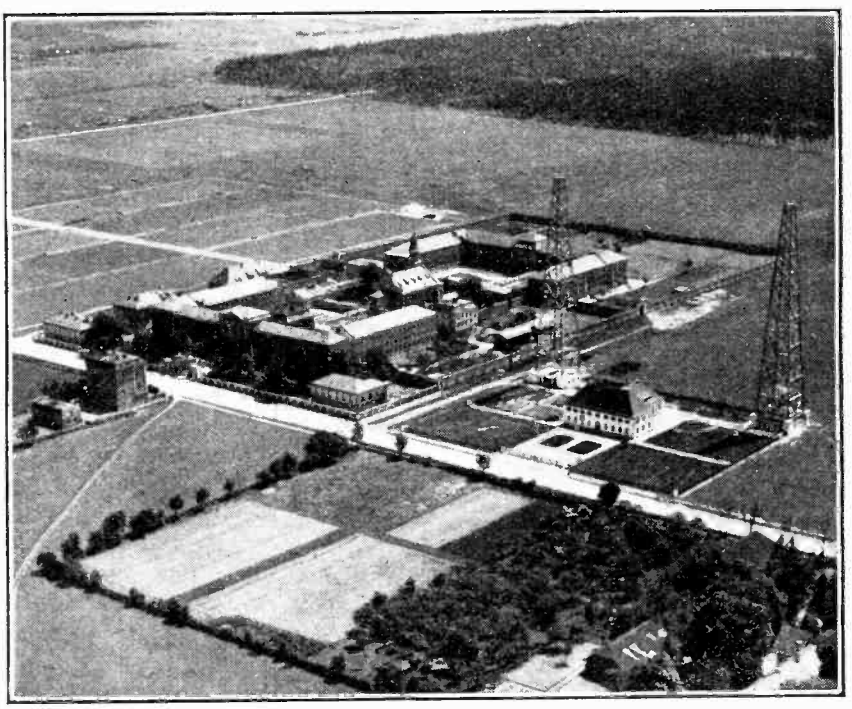
When He Was Very Young.

A. J. Alan, who is giving a "repeat" of his "B.B.I." story on April 25th, was recently asked for a portrait for publication in connection with his broadcasting turns. He offered a picture of himself as a baby, which, he said, was the only one that had been taken. Incidentally his more intimate friends remember that he was not "A. J. Alan" then.



MUNICH STATION FROM THE AIR. This popular German station recently scrapped its steel masts, replacing them with the wooden masts, 190 feet high, seen in the photograph. The steel masts were found to absorb a considerable percentage of energy. Munich can be heard nightly on a wavelength of 535·7 metres.

"Nonsericks."

I get few opportunities to listen to "Uncle Mac" (Derek McCulloch) during the Children's Hour, but if he is half as funny then as he is in "Nonsericks" (Methuen and Co., Ltd., 3s. 6d. net), the little ones must run a grave risk of splitting their sides or succumbing to lockjaw.

After being left for dead on the battlefield, Uncle Mac has come back to civilisation as a living testimony to the truth that dangers and difficulties are powerless to destroy an innate sense of humour. He has a limerick about his own tribe:—

"Those wonderful wireless announcers
Have gained 'double blues' as pronouncers;
Take such words as ídyll,
Or Cholmondeley or Fídyll,
They never trip over these nouns, sirs."

The author is splendidly supported by his artist, Ernest Noble, and I wish space permitted a reproduction of the picture which accompanies this limerick:—

"There was an old man from the Cape,
Whose trousers were made out of crape.
When people said 'Oh!
Supposing they go!'
He said, 'No! 'cos there's lashings of tape!'"

A foreword to "Nonsericks" has been written by A. P. Herbert, of *Punch* fame.

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Another Weatherly Programme.

On May 4th Mr. Fred E. Weatherly, K.C., will give one of his attractive programmes, entitled "When I Was a Child," from Cardiff station. Helen Alston, who is well known to listeners, will sing "I'm in love with Mary," "Belinda and the Bishop," and "Noah." When she formerly broadcast "Noah," a listener who seemed not to care for the sentiment of the song sent her an admonitory note, saying: "It would do you good to read your Bible, young woman."

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Not a Simple Matter.

In a letter published in last week's *Wireless World* Mr. G. Herbert Thring, of the Incorporated Society of Authors, Playwrights and Composers, suggests that it will not be necessary to form a corps of sleuths with portable sets to track the broadcasting of copyright items—an idea propounded in these columns on March 21st. I notice, however, that Mr. Thring supports his contention by referring to the fair manner in which the B.B.C. deals with all questions of copyright. But the virtue of the B.B.C. in this respect was never in dispute, and in my recent paragraph reference was made to the excellent copyright department at Savoy Hill.

It is the broadcasting of copyright items by foreign stations which presents the problem, and many people are wondering how the Rome conference will sort out the tangle.

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A Humorous Pair.

John Henry and Stainless Stephen are to broadcast from 2LO on April 25. In the same programme is an amusing sketch by Gordon Lowe, entitled "Bath Salts."

Adult Education by Broadcasting.

The outcome of the deliberations of Sir Henry Hadow's Committee of Inquiry into the subject of educational broadcasting is the issue of a 115-page report published by the B.B.C. (price 1s., post free 1s. 3d.). The Report is written with an eye on that great mass of hardworking people who "feel disinclined in the evenings to do more than go home, smoke a pipe, read the paper, or play a quiet game." The question approached is: Can broadcasting transform education so as to make it profitable and pleasurable to such as these? The signatories to the Report—they include many educational authorities—believe that it can.

The main proposal in the Report is that the B.B.C. shall associate itself with the work of a National Council for Broadcast Education, a body which would superintend the planning of an educational programme and the organisation of group listening. The issue of a new weekly educational journal is also foreshadowed.

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Leslie Henson to Direct Variety.

An all-star variety show, directed by Leslie Henson, is to be broadcast from 2LO on April 28. It will include Cicely Courtneidge, Mimi Crawford, George Carney and the De Groot Trio.

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Cinema Music in Edinburgh.

Edinburgh listeners are to hear regular relays from several new outside broadcast points in the city during the summer. One of these is the "New" Picture House, from which recitals on the giant Wurlitzer organ will be relayed regularly three times a week in the 6 to 6.30 period, starting on April 30th. The organist who manipulates this monster instrument, Mr. Stanley Peters, like so many other cinema musicians, was originally organist in a London church.

Two years ago he was organist at the famous New Gallery Cinema, London, where he was succeeded by Reginald Foort.

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Wiltshiremen's Dinner.

Lord Lansdowne's speech at the annual dinner and reunion of Wiltshiremen in London will be relayed from the Connaught Rooms to Bournemouth station on April 21.

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Welsh Orchestra Begins Season.

The first six weeks' season of the newly formed National Orchestra of Wales opened on Thursday last, April 12th. Weekly throughout the season there will be two mid-day concerts and two afternoon concerts in the National Museum, Cardiff, to which the public will be admitted free, and two evening concerts in the City Hall, Cardiff, on Thursdays and Saturdays, at popular prices. All mid-day and afternoon concerts will be broadcast from Cardiff station, and the majority of the evening concerts, or parts of them, will also be broadcast from Cardiff and Swansea stations, with occasional relays to 5GB.

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Versatility.

An astonishingly cosmopolitan repertoire is a feature of the programme of those Armenian artistes, the Meduria Sisters, who will broadcast from 2LO and 5XX on Monday next, April 23rd. They are giving old English songs, negro spirituals, Swiss and Mexican folk songs, and old London street cries. They sing in English as well as in foreign tongues.

In the same programme Vivien Lambelet will be heard in an international group of songs—Greek, Italian, French, and English.

FUTURE FEATURES.

London and Daventry.

APRIL 22ND.—Military Band Concert.
APRIL 23RD.—"King Henry V," by William Shakespeare.
APRIL 24TH.—A Musical Comedy Programme.
APRIL 25TH.—Vaudeville Programme.
APRIL 26TH.—Charlot's Hour.
APRIL 27TH.—"Cosi Fan Tutte" (The School for Lovers), an opera in two acts by Mozart.
APRIL 28TH.—A Military Band Concert.

Daventry Exp. (5GB).

APRIL 22ND.—Some Popular Classics.
APRIL 23RD.—"The Banner of St. George," a ballad for soprano solo, chorus and orchestra, by Sir Edward Elgar, from Birmingham.
APRIL 24TH.—A Military Band Programme.
APRIL 25TH.—"Cosi Fan Tutte" (The School for Lovers), an opera in two acts, by Mozart.
APRIL 26TH.—A Symphony Concert.
APRIL 27TH.—Folkestone Municipal Orchestra.
APRIL 28TH.—A Symphony Concert in memory of Debussy.

Cardiff.

APRIL 23RD.—An English revel, including comedy at Elizabeth's Court.

Manchester.

APRIL 22ND.—Schubert, a Programme of Chamber Music and Songs.
APRIL 26TH.—"An Extraordinary Drama," in two developments, by an unorthodox author.

Newcastle.

APRIL 28TH.—"Here and There," a radio revue devised and arranged for broadcast by Donald Gilbert.

Glasgow.

APRIL 28TH.—"The Fantasticks" (Act I.), a romantic comedy by Edmond Rostand.

Aberdeen.

APRIL 28TH.—Songs and Stories of the Gael.

Belfast.

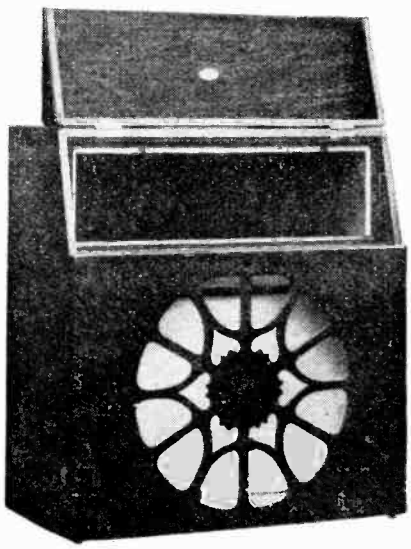
APRIL 23RD.—"Robin Hood," a comic opera in two acts.

A Review of the Latest Products of the Manufacturers.

"CAMCO" PORTABLE CABINET.

The overall dimensions of this case are 18in. × 17in. × 8½in., so that the finished receiver would fall into the so-called "transportable" category. In other words, it is ideal for those who wish to build a high quality frame aerial receiver for use either in the home during the winter or on motoring or river expeditions in the summer.

The cabinet itself is light in weight and is fitted with a spring-tensioned flush-type carrying handle. The back lifts out, giving easy access to the interior and is supplied with a lock and key. On the front is a hinged flap covering an opening 15½in. × 4⅜in. for the tuning controls; space is allowed for a $\frac{3}{16}$in. panel, which may be extended to a depth of 7in. if desired. The ornamental fret for the loud-speaker is exceptionally strong and the movement may be mounted on the centre if desired.



"Camco" portable set cabinet.

Each cabinet is supplied with a removable inner frame. This is constructed of strong light wood and is comb-jointed at the corners. A ply-wood baseboard for mounting components and a "sound board" as an alternative mounting for the loud-speaker unit are also included. The price of the complete outfit with oak cabinet is 52s 6d. or 58s. in mahogany, and the maker's address is the Carrington Manufacturing Co., Ltd., Camco Works, Sandersteąd Road, South Croydon.

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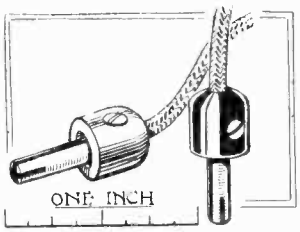
WANDER PLUGS FOR PORTABLES.

The Eelex "Midget" wander plug has been produced by Messrs. J. J. Eastick & Sons, 118, Bunhill Row, London, E.C.1, specially for use in portable receivers where economy of space is of the utmost importance. The ordinary wander plug projects, on an average, $\frac{3}{4}$in. above the level of the H.T. battery, and the depth of the battery compartment must be increased by this amount. With the



Eelex "Midget" wander plugs for use in portable receivers.

"Midget" wander plug this waste space can be reduced to $\frac{3}{8}$in., allowing for the flex connection, since the insulated top projects only $\frac{5}{16}$in. The pin is slotted in two directions at right angles, and a good contact is therefore assured.

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ANELOY VALVES.

In the report on these valves on page 317 of March 21st issue it is regretted that the A.C. resistance of the A.P.412 L.F. was given as 20,500 ohms, whereas the figure should have been 8,250 ohms. This high figure has been subsequently traced to an error in the connections of one of the measuring instruments, which had the effect of raising the curves above the zero line thus showing several milliamps of uncontrolled grid current. The characteristics of the particular valve in question should therefore be revised as follows:—

A.C. resistance = 8,250 ohms.
Amplification factor = 7.3.
Mutual conductance = 0.88 mA./volt.

These figures indicate that the valve is very considerably better than the figures given in our report would imply. The amplification factor is slightly lower than the average (8.0) given in the maker's catalogue, but the A.C. resistance more than compensates for this and brings the mutual conductance, by which the "goodness" of the valve may be judged, up to 0.88, which is more than 30 per cent. better than the maker's figures.

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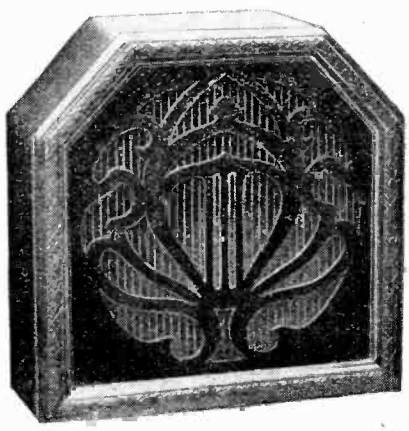
CELESTION MODEL C.12.

There are certain products in every industry upon the merits of which it is a waste of time to dilate. Their names are household words and have passed into the language as synonyms of excellence.

Whether the Celestion loud-speaker was designed in accordance with theoretical principles or whether it just happened is immaterial; we gratefully accept it as the embodiment of all that is best in cone loud-speaker reproduction. We have recently tested a Model C.12 in mahogany



The Celestion Model C.12 cone loud-speaker in mahogany cabinet.

which sells at £7 10s., and note with satisfaction that the high standard which the makers have set for themselves in the past is being maintained.

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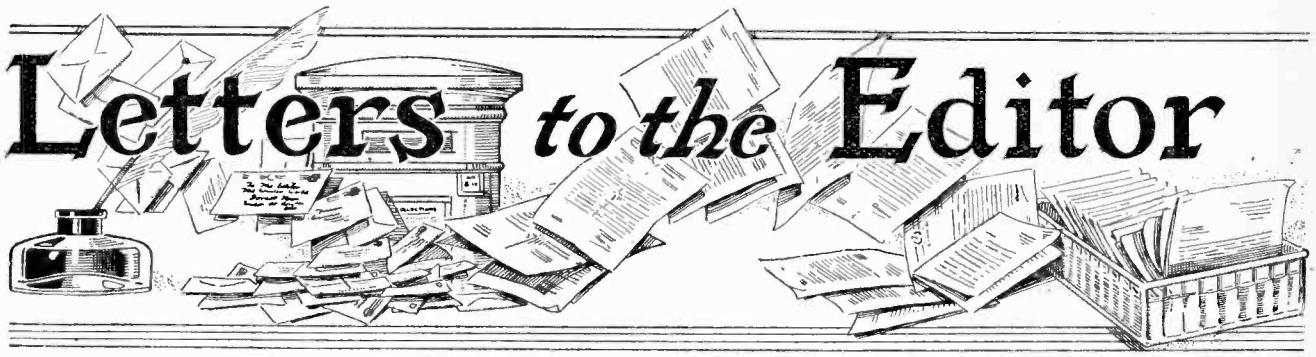
Trade Notes.

New Exide H.T. Battery.

The type WH high-tension battery hitherto made in 24-volt units is now available in a 10-volt size of improved design. The capacity is 5,000 mA. hours, and the initial cost works out at 9d. per volt.



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.

GRAMOPHONE REPRODUCTION.

Sir,—Being greatly interested in the electrical reproduction of gramophone records, I much appreciated the special gramophone issue of *The Wireless World*. In particular I was attracted by the article on pick-ups and their effects on records, as I have been troubled on this point for some time past in connection with both pick-ups and soundboxes.

I have found that one source of "chattering" and damage to records is due to the fact that the soundbox describes an arc over the surface of the disc. For ideal results the needle must be free to vibrate in one plane only, and should only be called upon so to do. The plane is at right angles to the diaphragm of the soundbox, and consequently at a tangent to the arc at the needle's point. At the same time the direction of the vibration should be at right angles to the tangent of the groove on the record, at the point on which the needle is pressing. When the soundbox describes an arc these two demands are not satisfied, except at two points.

With my own machine the fault is most marked, as at the commencement of a 12in. record the needle is in its correct position and results are excellent. Towards the end of the record the soundbox has swung round, and pressure is applied to the needle at an angle with its direction of vibration. Chattering then occurs, and the record soon shows signs of damage.

I do not see how this could be remedied with an ordinary soundbox, but matters might possibly be improved by using a larger tone arm, thus flattening the arc.

When using a pick-up, however, I do not see why it is necessary to retain the pivoted tone arm, and it is quite an easy matter to contrive a carriage (somewhat on the lines of a typewriter carriage), which could travel freely from side to side, and be arranged to lift up when required. With such an arrangement the needle point could be made to travel along a straight line, which would be a radius of the record, and so would be called upon to vibrate in one plane only.

I have not yet completed the model I am building, but, as I think the idea may be of interest to others, I submit it to you to pass on should you think fit. H. R. WEBB.

MORSE INTERFERENCE.

Sir,—I have read with great interest the articles and correspondence on morse interference which have appeared at various times in your valuable paper. Just recently the interference on short waves has been intolerable, and to those of us in the Colonies who rely on short waves for the reception of news or concerts from the Old Country, or from the powerful American stations, it seems that drastic action should be taken to abate this nuisance.

Last night I attempted to listen to KDKA, and tuned in this station with enormous volume, easily sufficient to operate a loud-speaker, but reception of the religious service from this station was completely spoiled by GLQ, which I understand is Ongar beam station.

KDKA was transmitting on 26 metres. Ongar is supposed to have a wavelength of 24.5 metres, but on this occasion was right on top of the American station and was audible on five or six metres on either side. Ongar's power seemed to be tremendous, and for nearly two hours he sent out GLQ GLQ GLQ de LPZ LPZ LPZ, only varied by successions of dots or dashes or the eternal VIC VIC VIC VICs.

GLQ quite often wanders into the sacred territory of 5SW and also spoils this programme; but there are other stations which I have not yet identified which are the greatest offenders on or about the wavelength of 5SW. On several evenings I have had to give up in disgust, although I had tuned in the Empire station and was really enjoying excellent programmes, because of the frightful and apparently unnecessary din which various stations were causing on this wavelength. Is it really necessary for morse stations to indulge in their nightly orgies, giving first-class imitations of an overworked woodpecker or a navvy manipulating a pneumatic drill? If so, why cannot they satisfy their lust on their own wavelengths?

I suggest that many of the operators should pay more attention to the quality of their morse transmissions, instead of striving for excessive speeds, which only results in their being tangled up. How often can the "wash-out" signal be heard during an evening? During most messages to which I listen, I am afraid.

If the Government can do little to cope with the morse interference nuisance, is it not possible for the B.B.C. to organise a constant watch on their wavelengths and to black-list all stations who err in this manner? We have policemen on our streets to keep vehicles from straying off the road on to the footpath. Cannot we patrol the ether in some way?

Might I take this opportunity of expressing the appreciation and thanks of many of us in West Africa for the very excellent efforts which 5SW, the Chelmsford short wave station, is making towards providing Empire broadcasting?

Here in Northern Nigeria reception of this station is often almost perfect and quite worthy of a regular Empire broadcast service, and I would like to add voice to the many thousand of appeals that must be made daily, that such a service is speedily organised.

The experimental short-wave station at Rugby also comes in with great volume. KDKA, 2XAF, 2XG, and other American broadcasting stations I can hear most nights, or rather mornings. Java, and also two German stations, can frequently be heard. But what we folks in the colonies want is an evening programme from London, 2LO itself if possible. That would mean more to us than receiving American or other foreign stations by the gross. W. MUIR.

Kano, Northern Nigeria, West Africa.
February 27th, 1928.

CHEAPER VALVES?

Sir,—With reference to your editorial of January 18th and Dr. Finch's remarks thereon, while wishing to detract in no way from the value of Dr. Finch's application of the use of

sodium potassium alloys for the absorption of mercury vapour and the careful work he appears to have carried out on the subject, I should like to point out that liquid alloys of sodium and potassium have been commonly used for removing traces of gases other than the "inactive" ones for at least twenty years. I myself introduced small quantities of such an alloy into two of the first commercial type neon tubes which I made in the Cavendish laboratory in 1911, and did not regard the procedure as anything unusual. It was not, of course, possible at that time to make accurate measurements of the residual vacuum.

The work of Hughes and Poindexter is undoubtedly of fundamental importance, as they have applied modern methods of high vacuum technique in a quantitative manner, and the extremely low vapour pressure of mercury in contact with sodium or potassium could not have been anticipated. A glance at Landolt's tables suggests that the reason for this is the low vapour pressure of the compounds of sodium and potassium with several molecules of mercury, and, if so, it would be highly probable that mixtures of the two metals would exhibit similar properties.

Given (*a*) the known (qualitative) properties of sodium potassium alloys as general absorbents, (*b*) Hughes' and Poindexter's results for sodium and potassium, and (*c*) the known superiority of liquids over solids as absorbents, it is difficult to see how the results obtained with sodium potassium alloy are "quite and fundamentally distinct from Hughes' and Poindexter's discovery." The actual amount of mercury that can be usefully absorbed may have somewhat exceeded expectations, but I consider that the discovery that these alloys did not absorb mercury would have been of a much more fundamental character than the converse. (Prof.) H. E. WATSON.

Indian Institute of Science, Bangalore, India.

EMPIRE BROADCASTING.

Sir,—On reading the reports of "Short-wave Reception" from your various readers, I feel I should like to contribute some notes, which may prove to be of some value to those interested.

For the last two years the Central Provinces of India have, in my opinion, been a good "zone of reception," and, in consequence, it has not been difficult, in spite of occasional adverse conditions, to tune in 5SW, PCJJ, 2XAD, 3LO, 2FC, ANH, ANE, and several others at varying strengths—certainly well worth listening to.

The Eindhoven station, PCJJ, held the supremacy of the ether, both for well-selected programmes and constant strength, until the B.B.C. inaugurated the Chelmsford station, 5SW, which at first penetrated the Central Provinces wonderfully well, but began to fall off in strength during December, strength again increasing at the end of January until the present date.

One evening during early November I was swinging the dials rather viciously, in consequence of never being able to receive "Bandoeng" clearly, when suddenly I passed a very penetrating carrier (greatly amplified by my three super power valves, transformer-coupled L.F. amplifier), followed by the "Ethovox" and "Etho-cone" loud-speakers. On tuning out the carrier, and standing well away from the "threshold," the first and most wonderful voice came through announcing: "Chelmsford station, 5SW, testing. We are using some old records. Stand by, please."

I might mention here that, if new records had been used, it would have been exceedingly hard to differentiate between the old and the new, as the reception was exceptionally clear and of good loud-speaker strength. Only occasionally was high-speed fading noticeable.

The Armistice transmission came through very well, but at Christmas the tuning was rather difficult to maintain at audible strength. At present the reception of the second transmission from 18.30 hrs. G.M.T. onwards is very nearly perfect, high-speed fading seldom falling to zero. So now with expectant eagerness we await the sequence of the programmes.

I must say that when one can repose comfortably in the drawing-room, which has two loud-speakers installed, and listen to very interesting and amusing conversations between the B.B.C. and 2XAD, which of late have preceded the second transmissions, it is evident that the vagaries of the short waves are not so serious and mysterious as one is led to believe, and I consider it only fair to say that during the exalted fame of PCJJ the B.B.C. engineers were certainly not idle.

It is good to hear the B.B.C. say that "The sun has only just receded beyond the horizon; it has been fine for a week;" "*rather*"; and then a good hearty laugh at the expense of 2XAD, enquiring of him whether the American or the English accent affected articulation, etc.

The conversation of the B.B.C. with 2XAD on Tuesday evening, February 28th, was received as if a megaphone was being used in the room. Commonplace conversation was carried on at first, dealing with weather and times for future transmissions. Afterwards the Postmaster of Washington was introduced, who said: "This time next year I shall also be able to see you as well as speak to you." The finish was occupied by the two stations exchanging their reports on previous transmissions.

The programme from 5SW for the evening in question came through remarkably well, it being chiefly from provincial stations, such as Daventry and Liverpool. It was first announced that 5GB would for the remainder of the evening transmit on half power. The talk on the organisation of the St. John's Ambulance Association was splendid, and not a word was missed.

So, in consequence of such reception, it is obvious that whilst repeated appeals were being published in the various wireless periodicals, asking for a British Empire broadcasting station, and whilst adverse criticism was continually being hurled at the heads of Capt. Eckersley and his subordinates, based upon the success of PCJJ, the B.B.C. were perfecting their short-wave plans behind a cloak of silence, and for their success I wish to tender them my heartiest congratulations.

(Receiver, modified Reinartz, 0-v-1. 3-valve amplifier.)

R. N. FOX.

Jubbulpore, C.P., India,
February 6th, 1928.

SHORT-WAVE RECEPTION.

Sir,—Having built the "Empire Short Wave" set, as described in your issue of *The Wireless World*, June 29th, 1927, I have always been able to receive 2XAF, 2XAD, KDKA, and several other short-wave stations. On three occasions I have received 2ME Sydney and 3LO Melbourne, all with an aerial under the roof.

I feel that I must congratulate you on the wonderful set; a set with which one can listen to all parts of the world—supper time side of midnight—is surely a treasure of the wireless den.

Croydon. REGINALD T. HOLLANDS.

ELECTRIC SUPPLY SYSTEMS.

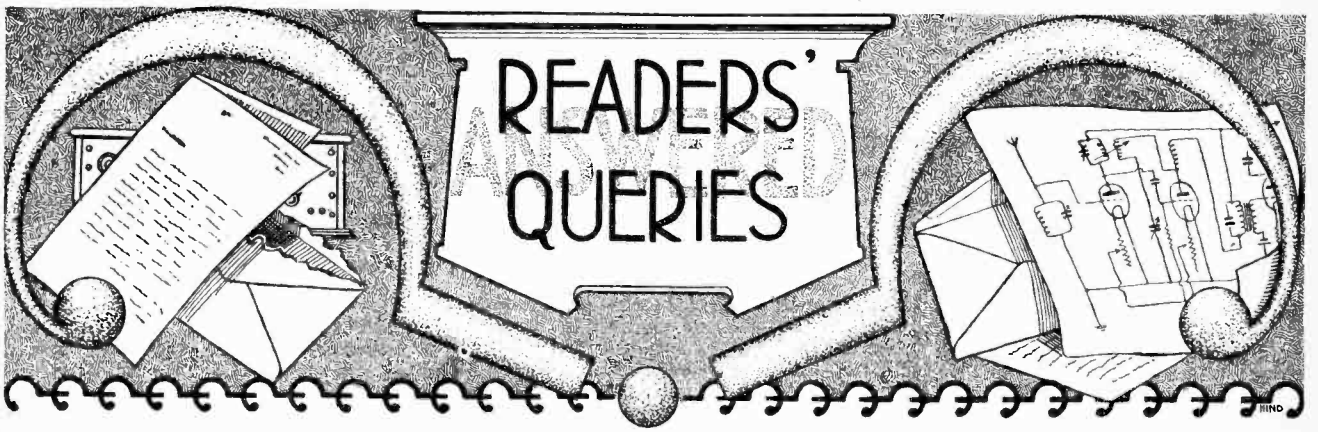
Sir,—I have observed in your correspondence columns a certain amount of discussion regarding the supply companies and their treatment of listeners, so perhaps the following extract from the *Daily Mail* of April 10th may be of interest to you:—

"The electrical engineer for Bangor (North Wales), in a report to the local council, states that he finds that several electrical consumers are using 'H.T. eliminators' in connection with their wireless receivers by connecting them to their electrical supply installations and to the corporation electrical supply.

"The council have decided not to approve of the connection of these eliminators to electricity consumers' installations unless they conform to the electrical engineer's requirements in certain technical matters, *and unless the consumers give written undertakings that the corporation will not be called upon to change direct current types for alternating current types when the system is changed over.*"

It doesn't affect me personally; I don't live in Bangor, and here in Newcastle, in my district at any rate, the supply is already A.C.; but it seems to me that if the "Bangor" principle were generally adopted listeners in "D.C." areas must deny themselves the immediate benefit of H.T. from the mains, and wait patiently for a change-over to A.C., which, in some cases, may not occur for years! K. O.

Newcastle.
April 11th, 1928.



"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.

An "Everyman Four" Modification.

Is there any objection to my using a 5 : 1 L.F. transformer in the "Everyman Four" in place of the ratio specified? M. T. T.

Provided the transformer is of good design, there is no real reason why it should not be used, but it will almost certainly be necessary to use a low-impedance power valve as V_3 (the first stage L.F. amplifier). Moreover, it is probable that overall amplification will be less than that obtainable with the specified valve-transformer combination.

○○○○

A "Standard Five."

Would it be possible to replace the L.F. amplifier of the "Standard Four" by the resistance-coupled arrangement shown in Fig. 10, page 287, of "The Wireless World" for March 14th, in the article "High-note Loss in Resistance Amplifiers"? I take it that the valve V_1 in this diagram would take the place of the detector in the original set. E. M. C.

Yes, the detector-amplifier in question would be quite suitable for use after the H.F. portion of the "Standard Four," but it would be as well to retain the grid damping resistance R_6, which restricts the development of H.F. potentials across the input of the L.F. side. As you say, V_1 will act as the detector, and you must make suitable arrangements for applying a negative bias to its grid.

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"Motor-boating" and a Remedy.

The L.F. transformers in my 0-v-2 receiver have been replaced by a new component of well-known make, and I am now troubled by "motor-boating." This difficulty was not present with the old pattern components, and I should be obliged if you can assist me to overcome this. The H.T. supply is taken from a D.C. battery eliminator. F. A.

By substituting good L.F. transformers for those used previously, the efficiency of the L.F. amplifier has been improved, and the receiver is now passing on a bigger percentage of the low frequencies; some of these are being fed back to the detector stage, and result in the amplifier oscillating at a low audio frequency. The back coupling is produced by a resistance in the H.T. supply, which is common to all valves, and in similar cases encountered this has been overcome by fitting a choke-capacity output circuit of the type in which one side of the loud-speaker is connected to L.T. minus. If this does not lead to a complete cure, you should try adding anode feed resistances as described in "The Gramophone Amplifier" in March 14th issue.

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.

Where the Voltmeter is Misleading.

I have just completed the "Universal" H.T. battery eliminator and am working on 220-volt D.C. mains. Can you explain why I am only getting at my highest tapping a voltage of under 100? W. J. M.

You do not describe your method of measuring the voltage output of your eliminator but we cannot help thinking that you are in error in supposing that the voltage is not greater than 100. We expect that you have taken a reading with a comparatively low-resistance voltmeter, and that the voltage dropped across the smoothing chokes, etc., is comparable to that dropped across the voltmeter itself. The result is that you are getting a totally misleading idea of the actual voltage existing under working conditions.

A voltmeter must be used with considerable care and some thought if one is to obtain a reasonably accurate knowledge of the working output of any eliminator.

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A Recommended Refinement.

Is it permissible to connect a potentiometer in the manner shown in the attached diagram? This is an addition to the original design, but the set certainly seems to work very well with it, and reaction control is improved. E. C. T.

The circuit is that of a simple directly-coupled grid rectifying valve with reaction and a two-stage L.F. amplifier. The potentiometer winding is connected between L.T.+ and L.T.− and the low-potential end of the grid leak is joined to its slider. This arrangement is most certainly permissible in any circuit of this type, and, indeed, it is a refinement that can be recommended, as by a suitable adjustment of the potentiometer it is possible to adjust the detector grid voltage to a value giving good detection, and at the same time smooth control of regeneration. No harm can result from this addition.

Trouble from L.F. Oscillation.

My receiver, 0-v-2 with resistance-capacity L.F. coupling units, functions satisfactorily when H.T. batteries are used, but the results are disappointing if these are replaced by a D.C. battery eliminator. On changing over to the eliminator, a regular "popping" is heard in the loud-speaker, which completely spoils reception. Can you advise me what to do to cure this, please? R. K. D.

This effect is not uncommon when battery substitutes are employed, and is traceable to low frequency oscillation in the L.F. amplifier, brought about by a resistance common to all valves. In the majority of cases this can be cured by fitting a choke-capacity output circuit arranged so that one side of the loud-speaker is joined to L.T. minus. If you are not conversant with the circuit, we suggest you refer to page 182 in our issue of February 15th last, where we published the theoretical diagram of an output circuit of this type. Reference should also be made to page 17 of the January 4th issue.

°°°°

Too Much Inductance.

I have recently constructed a simple and straightforward two-valve set (detector and L.F.), but have as yet been unable to get satisfactory results, although Daventry 5GB is received quite well when the earth connection is removed. Can you suggest what is wrong? C. K. S.

The fact that you can hear Daventry quite well at your very considerable distance from that station would indicate that there is no serious fault in your set. We are fairly confident that the trouble is due to the use of an unsuitable aerial tuning inductance. This, we feel sure, has an excessively high inductance, with the result that even when the tuning condenser is set at zero you cannot tune to any stations on the boadcasting band. Removal of the earth connection will have the effect, practically speaking, of entirely neutralising the aerial capacity, and thus the natural wavelength of your circuit is, of course, reduced. We think that the substitution of a smaller coil will certainly overcome the difficulty.

°°°°

Tracing Distortion.

The quality of reproduction given by my receiver, a 1-v-2, is poor, the high notes being accompanied by a "rattle." This has been noticed only since installing a moving coil loud-speaker, and I should be obliged for any suggestion you can make which will enable me to trace this trouble to its source. C. T. E.

Perhaps this is the most difficult of all wireless troubles to trace to its source, as there are two main unknown factors to consider, namely, the set and the loud-speaker. The only method possible to those not equipped with accurate measuring instruments is to adopt a policy of elimination. By the use of telephones it is possible to obtain a fair idea of the performance of the receiver, as for all practical purposes, and with a moderate input the reproduction can be considered reasonably faithful over the audio band of frequencies. These should be connected to the output terminals of the set, but for the purpose of limiting the input to the telephones it will be necessary to include a resistance in the circuit. The arrangement is shown diagrammatically in Fig. 1, where for the present purposes a transformer output circuit is adopted; however, the same procedure will hold good in the case of a choke-capacity output circuit. The value of the resistance R must be adjusted to give comfortable telephone strength, and to achieve this a resistance of a megohm or more may be required; however, its value can be found only by trial.

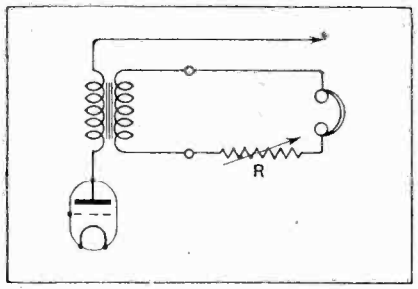

Fig. 1. — Method of limiting input to phones when testing for distortion.

If it is found that under these conditions the quality is above reproach, then this should leave no doubt in your mind as to the source of the distortion, and the loud-speaker should be examined carefully for possible faults in its construction, special attention being paid to the joint between the cone and the moving coil. Any looseness here will lead to distortion, and the same remarks can be said to apply to all mechanical parts.

°°°°

H.F. or L.F.?

I wish to construct a small self-contained two-valve portable receiver for telephone reception of London and Daventry (5GB) in London. Would it be best to adopt a detector-L.F. or an H.F.-detector circuit? A. N. B.

We would hesitate to state definitely that a detector-L.F. receiver with a very small frame would be capable of receiving 5GB in London, although such a result is frequently obtained. For your purpose, however, there can be no doubt that, provided it has sufficient sensitivity under working conditions, such a set is much simpler to construct and operate than the alternative arrangement, and we strongly recommend you to make it up in temporary form and to decide for yourself whether the sensitivity is sufficient for the conditions under which the set is to be used. Without personal knowledge of these conditions, it is difficult for us to offer a definite opinion.

Insulating Condenser Spindles.

I am about to construct a receiver including an H.F. stage and anode bend detector. The panel will be of metal, in metallic connection with L.T. negative and earth. I understand that it is necessary to insulate the condenser spindle from this panel, and should be glad to know if this is correct. If so, can you tell me where suitable bushes may be obtained, or say if the necessity for insulation can be avoided in a simple manner? R. T. S.

Practically speaking, it is essential that the condenser spindles should be insulated from the panel, otherwise a short circuit of the grid bias battery will be introduced. This could be avoided by inserting the bias battery in the tuned circuit instead of in the grid return lead, but this, of course, is not altogether satisfactory.

We do not know of any insulating bushes which are commercially obtainable and which are suitable for all condensers, but we suggest that you can overcome the difficulty by using components in which the frame is insulated from the plates; Burndept and Pye condensers are constructed in this manner.

°°°°

Efficiency before Compactness.

With reference to a recent article which appeared in "The Wireless World" on coil design, using formers of varying diameter, it appears to me that an economy in space would accrue by using coil formers of about 5in. diameter, and mounting the condensers inside. I should be pleased to hear your opinions on this, as I fail to see why this method is not adopted in "Wireless World" receivers. E. K. G.

It is not in keeping with the best wireless practice to insert a mass of metal in the intense field of an oscillatory circuit, as this will result in a considerable increase in the H.F. resistance of the coil, and its efficiency will be seriously impaired.

For this reason variable condensers are not mounted in the manner suggested in your query.

°°°°

When Push-Pull Amplification is Justified.

I have a three-valve receiver (1-v-1), but find that the volume is insufficient for my requirements. I have tried paralleling another output valve, but this does not give any apparent increase. Would you advise me to connect the two output valves in push-pull, please? H. S.

The push-pull arrangement of output valves will lead to an increase in volume only when one output valve of similar type can be overloaded, and unless this condition exists there will be no gain in resorting to this arrangement. Your best course would be to add an extra stage of L.F. amplification, making two in all, when push-pull could be used advantageously in the last stage.

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CONTENTS OF THIS ISSUE.

IS THE REGIONAL SCHEME DEAD?

IN view of the publicity which has been given to the regional scheme since the idea was first conceived and the importance which attaches to the fulfilment of the promises of alternative programmes, it may seem somewhat out of place to ask the question, "Is the regional scheme dead?" There is, however, some foundation for uneasiness and a feeling of uncertainty as to whether the scheme as originally proposed will ever reach fruition. The reticence which has been shown by the B.B.C.—and, incidentally, the Post Office—for a considerable time past in making any reference to the progress of development of the scheme, is sufficient to justify us in believing that some hitch of considerable magnitude has occurred.

The B.B.C. officials seek to put the blame for delay on the Post Office, and have implied that they are awaiting Post Office sanction for the scheme, but at the same time listeners are themselves aware that 5GB, although a valuable addition to our broadcasting service, has not quite come up to the expectations of the engineers of the B.B.C., and the suspicion has quite naturally been aroused that the B.B.C. themselves are not over anxious that the Post Office should publicly sanction the scheme, and would welcome any delay which would enable them to look round for some more satisfactory alternative. If there is no truth in these rumours we hope the B.B.C. will take steps to kill them in the most effective manner possible, which would be to give the public an adequate explanation of the reasons for delay.

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"MOTOR-BOATING."

NEW developments in the design of wireless receivers and component apparatus which tend to increase efficiency frequently bring with them corresponding troubles which require to be tackled in order that full advantage may be taken of such improvements. In the early days of the valve, when it was a comparatively inefficient piece of apparatus, a very great advance in the sensitivity and selectivity of receivers was achieved when the principle of reaction was discovered, enabling energy from the plate circuit to be passed back to the grid circuit to augment the strength of signals applied to the grid. When, however, H.F. amplification began to be used and the efficiency of valves as magnifiers was enhanced, the problem of instability of the receiver became a serious one, and inventive talents were applied, this time in the direction of devising means to prevent any tendency to pass back energy from the plate circuit to the grid circuit of the valves in the H.F. amplifier. The result, as is well-known, was the development of the Neutrodyne circuit, and, more recently, the production of the screened grid valve. With successive improvements in the efficiency of low-frequency amplification, the same troubles of instability which formerly were not experienced, or, perhaps, were not actually observed (because we were then not so critical of quality in reproduction) became serious, and with many types of receiver the phenomenon which has come to be known as "motor-boating" made its appearance. Many attempts have been made to cure this and allied troubles, but hitherto with only partial success.

An article in this issue deals with this problem in a comprehensive manner, and shows, we believe for the first time, what are the causes contributing to this instability, particularly in the case of battery-fed receivers where any resistance in the battery constitutes a common coupling between the valve stages of the receiver. The knowledge that the causes have now been located and that definite remedies can be applied will, we feel sure, be of very great interest to our readers.

The Wireless World SELECTIVITY UNIT

A Loose-coupler which can also be Used as a Wave-trap.

By A. L. M. SOWERBY, M.Sc.

THE opening of the alternative programme service transmitted by 5GB on the broadcast waveband has rendered practically obsolete many receivers which were primarily designed to receive the local station only, for their users naturally wish to avail themselves of the new source of entertainment. For those living in the country no great difficulties arise, even with a simple set, for 5GB has sufficient power to enable its reception to be carried out with ease over a wide area. Those, however, who live in or near towns in which one of the older stations is situated frequently cannot hear 5GB, not because their receivers cannot pick up its transmission at good strength, but because the local station, at close range, is heard at the same time. In such a case there is no particular point in increasing the sensitivity of the receiver, because it is already adequate in this respect for the work it is expected to do; what is really needed is an increase in selectivity, so that the local station may be cut out when desired and the receiver given an opportunity to show its ability to receive the alternative programme.

For the many listeners experiencing interference from a local station precluding long distance reception, this easily constructed unit has been designed. It is applicable for use with many types of receiving sets either as a separate loose-coupler or a wave-trap.

The steady increase in the power employed by foreign stations, too, is making it possible to receive real entertainment from abroad, and foreign listening can no longer be looked upon solely as an exhibition of the sensitivity of the receiver. Such transmitters as Langenberg can now be depended upon with fair certainty, in many parts of the country, for a programme of music with only a quite unobtrusive background of "mush" and noise. It may fairly be said that the days are over when the listener was content to wait until the local station had closed down before he searched the ether for Continental and the more distant British stations; he requires now to receive at least the more powerful of these, as sources of alternative entertainment, while his local station is still busily transmitting.

There must be in use many thousands of receivers which employ a circuit of the o-v-1 or o-v-2 type. Such receivers, used with a full-size outdoor aerial, are capable of receiving, on telephones or loud-speaker, every station of importance in Europe, though the quality of reproduction, owing to the need for using excessive reaction, is seldom good on any but the nearest stations. Nevertheless, their simplicity and cheapness have given them a tremendous vogue.

But—and it is a very big "but"—the sensitivity of such a receiver is of no value whatever to its owner if he should happen to live at no great distance from his nearest station, for that station will be heard "all over the dial," so that reception of all other stations is rendered entirely impossible.

The same difficulties are found also in the case of many receivers in which a stage of high-frequency amplification, and therefore an extra tuned circuit, is incorporated, but, as might be expected, a receiver of this type may be used much closer to the local station

"The Wireless World" Selectivity Unit.—

than the simple detector before the lack of selectivity is such that only the local station can be heard. Even with the aid of the extra tuned circuit, however, transmitters on wavelengths closely adjacent to that of the local station can only be received if the latter is more than a dozen miles or so away.

At still closer ranges even more ambitious receivers, with a greater number of tuned circuits, suffer from the same disabilities, for as the local station is approached more closely the difficulty of tuning it out in favour of other stations increases very rapidly. Probably, it would hardly be too much to say that there must be in use very few receivers indeed whose owners have not felt, at one time or another, the wish to hear some programme that is being transmitted on a wavelength just close enough to that of the local station to render reception impossible.

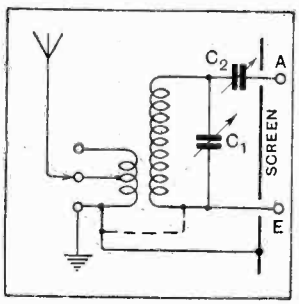


Fig. 1.—Circuit diagram of the loose-coupler unit. C_2 is the variable capacity coupling.

Whether the receiver has one tuned circuit or three, whether the local station is one mile away or twenty, the addition of an extra tuned circuit will always confer an acceptable increase of selectivity. Added to a receiver that is already capable of bringing in a score or more of stations, it may increase by a dozen or so the number of those available when required; connected to a simple set it may do no more than add 5GB to the repertory, but only those living in the country, far from any transmitter, will find that the extra tuned circuit gives no return in results for the extra trouble in tuning that it entails.

There are three ways of adding a tuned circuit to a receiver, and the best of the three involves rebuilding the set entirely, and incorporating the extra tuned circuit as an integral part of the design of the receiver. This, however, entails a considerable amount of labour, and, since the opportunity will probably be taken to make a number of incidental improvements at the same time, it is likely to entail a good deal of expense as well as work.

There remain two possibilities: one the addition of a wave-trap, and the other the addition of a loose-coupled aerial circuit, either of which can conveniently be applied to a complete receiver without necessitating any alteration to the latter. Of the two, the writer is a staunch upholder of the loose-coupler, for his own experience has brought him to the conclusion that the wave-trap makes tuning unnecessarily difficult, especially where reaction is used into the aerial circuit. The effect of the wave-trap upon tuning is large simply because, for efficient elimination of the local station, it is necessary to have the trap-circuit coupled quite closely to the aerial circuit of the receiver, with the result that it becomes very difficult to arrange for complete independence between the two tuned circuits. Figures showing the manner in which one type of trap affects tuning, in a case where the aerial circuit and the wave-trap were designed for one another, have been published in the pages of this journal.[1]

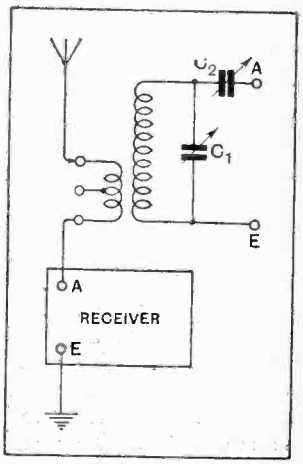
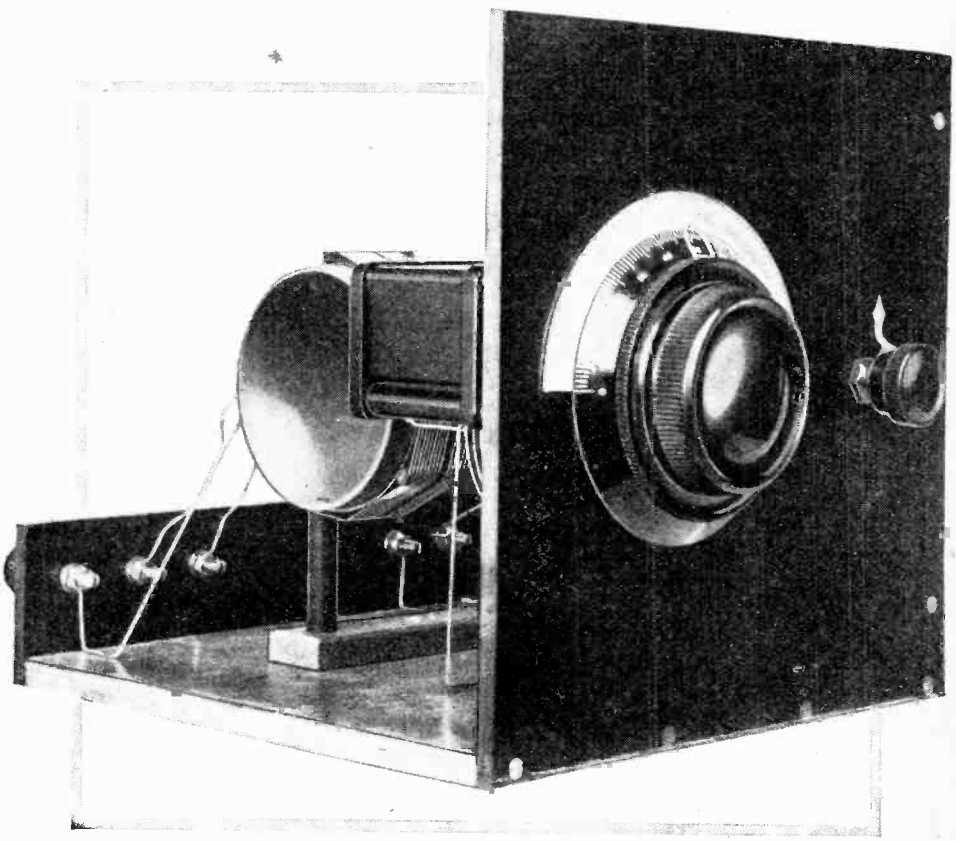


Fig. 2.—The Selectivity unit used as a wave-trap.

[1] *The Wireless World*, Jan. 19th, 1927; p. 63.



General view of the unit showing the two controls.

"The Wireless World" Selectivity Unit.—

Since a loose-coupled circuit depends for its efficiency entirely upon the lightness of its coupling to the tuned circuit that succeeds it, it is not difficult to understand that it is easier in this case to make the tuning of the two circuits, aerial and secondary, quite independent of one another. The addition of a loose-coupler need, therefore, entail no extra difficulty in tuning other than is implied by the presence of the extra tuning dial.

It has already been indicated that it is not proposed to deal here with the incorporation of a loose-coupler into a receiver, but to consider its addition, in the form of a small unit, to a receiver that is already built. This being the case, the conventional type of loose-coupler, in which the aerial and secondary circuits are magnetically coupled, is hardly suitable, for each different receiver would require a unit specially designed so that the necessary coupling might be obtained between the coil in the unit and the first coil of the receiver. Additional difficulty, with the modern solenoid coil, would arise owing to the fact that the extent of the coupling should preferably be variable.

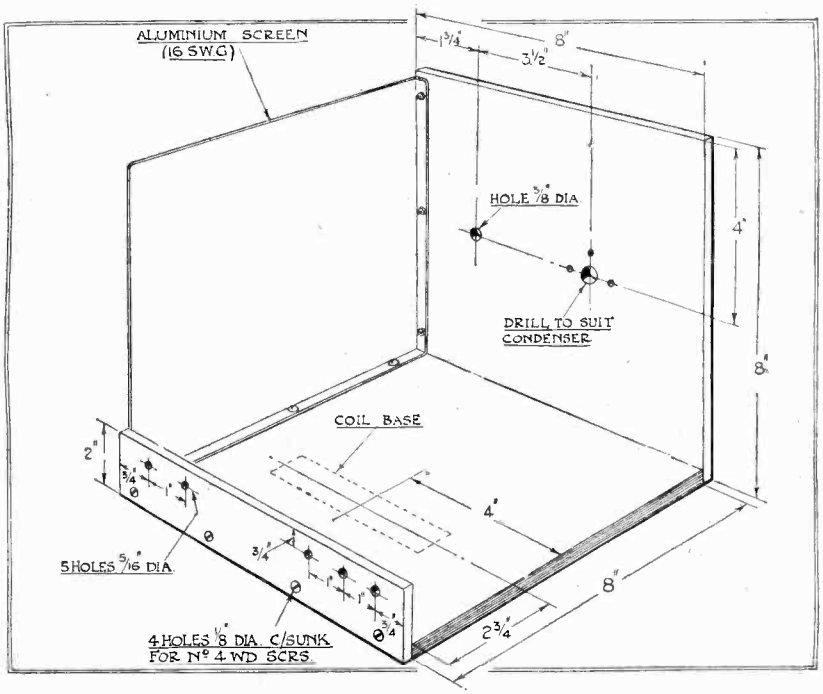


Fig. 3.—Dimensional data for panel, baseboard, and terminal strip.

In the unit illustrated here, and of which the circuit diagram is given, this difficulty is surmounted by employing a variable capacity coupling in place of magnetic coupling, using for the purpose one of the small air-dielectric variable condensers now available. In order to ensure that the accidental magnetic coupling between the coil in the unit and that in the receiver shall be small in comparison with the deliberate capacity coupling through this condenser, there is a screen on the right of the unit which is earth connected. This screen, although in a few cases it may hardly be necessary, has the advantage that it enables the unit to be attached to any receiver without taking into consideration the position of the coils within it. Provided that two simple conditions are complied with, there is therefore no need to make any alteration whatever to the receiver itself.

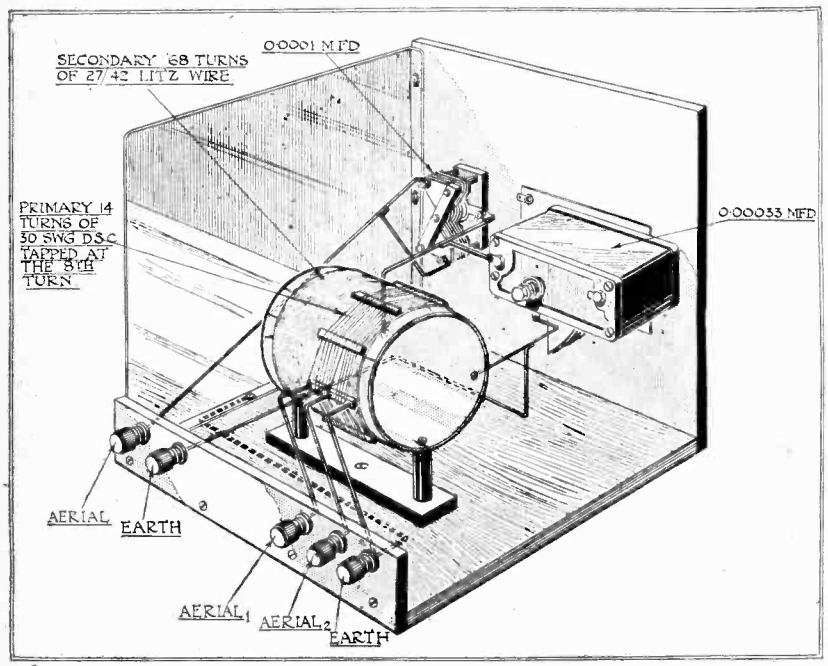


Fig. 4.—General layout of the components. The wiring can easily be traced.

With the Unstable Set.

It is necessary, however, for the prospective user of a loose-coupler of this or any other type, to assure himself that the receiver is stable with the aerial removed. Many of the earlier receivers employing a stage of high-frequency amplification relied entirely upon the aerial load for stabilisation; it is therefore not possible to add any form of loose-coupler to these receivers without drastic internal alteration. If it is desired to add to the selectivity of a receiver of this kind, the unit should be employed in its alternative capacity of a wave-trap.

Secondly, it is essential that the receiver should be capable of covering the wavelength range required without the aid of the aerial capacity; if it cannot do so, the present aerial coil should be replaced by one of higher inductance. If examination of the receiver shows that these two conditions can be complied with, the construction of the unit may be

"The Wireless World" Selectivity Unit.—

LIST OF PARTS.

20 yards Litz wire, 27/12 (P. Ormiston & Sons).
1 Paxolin tube, 3in. × 3½in. (Micanite and Insulators Co., Ltd.).
1 variable condenser, 0.0005 mfd. log scale (Burndept).
1 slow-motion dial, Ethovernier (Burndept).
1 midget condenser No. R/149 (Ormond).
5 ebonite shrouded terminals (Belling Lee).
Aluminium screen, 8½in. × 8in. 16 S.W.G.
Ebonite panel, 8in. × 8in. × ¼in.
Baseboard, 8in. × 8in. × ⅜in.
Terminal strip, 8in. × 2in. × ¼in.

Approximate cost of parts, 44/-.

embarked upon with full confidence in the final result, while if only the second condition can be fulfilled the unit will still be useful in its secondary *rôle* of wave-trap.

Since the acquisition of greater selectivity will be the motive prompting the building of the unit, some pains have been taken in order to make the gain in this direction as high as possible. The coil used is wound of Litzendraht to ensure a low resistance; it is a standard aerial-grid transformer of "Everyman Four" pattern. The aerial is coupled to it by a small primary, wound over the main coil, for there is no sense in choosing a coil of low resistance and then throwing the whole aerial load upon it by attaching the aerial directly to its upper end. The arrangement shown, therefore, is practically a loose-coupler within a loose-coupler, so that the extra selectivity it confers is quite considerable. The use of the over-wound primary does not involve a loss in signal strength, on account of the low resistance of the main coil; on the contrary, signals with any normal aerial are louder than would be the case if the aerial were to be connected directly to the upper end of the tuned coil.

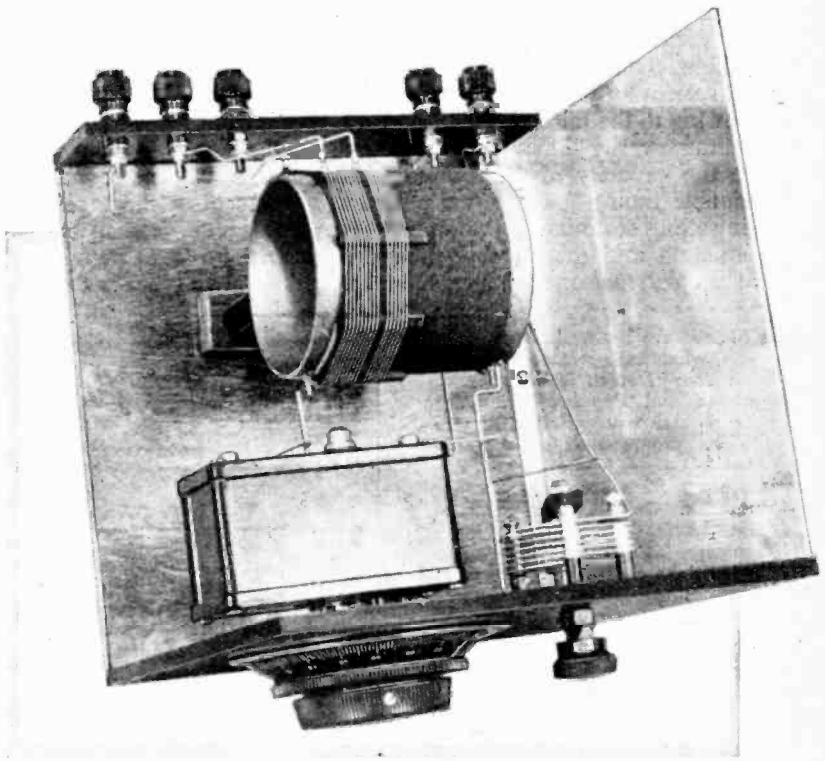
It will be observed that two aerial terminals are provided: that next to the earth terminal will be suitable for large aerials, or where the highest selectivity is required, while for general reception on a smaller aerial the remaining terminal, connected to the upper end of the primary, and producing a tighter coupling, will usually prove more suitable.

In the photographs and wiring diagram there is shown no connection between the low-potential end of the tuned circuit and the earth terminal. This connection, shown dotted in the circuit diagrams, may be added or not according to circumstances, bearing in mind that if it be omitted the receiver will not be earthed. If the high-tension supply is derived from the mains, especially if these are of the direct current variety, this will probably be an advantage rather than otherwise.

The coupling condenser is variable, though it is not suggested that alterations in its capacity should be made as part of the routine of tuning. Rather is it intended that a setting should be found that suits the aerial, the receiver that follows the unit, and the precise degree of selectivity required. The setting, once found, may be left more or less permanently untouched, though it may occasionally be useful to reduce the coupling to very small dimensions in receiving a station exceptionally close in wavelength to the local station.

Operating Hints.

The connection of the unit to the receiver is very simple. Aerial and earth are removed from the receiver, and connected to the appropriate terminals of the unit, while the two output terminals of the unit are connected across to the aerial and earth terminals of the receiver. If the latter has several alternative terminals, corresponding to various internal arrangements, the unit should be tried on each in turn, though if the difference between the aerial terminals consists only of the presence or absence of a fixed condenser in series with the aerial, no appreciable difference will be found between them. Although the unit shows up to the greatest advantage when the receiver has an aerial circuit similar to that in the unit itself—that is, of very low resistance—no great attention need be paid to the mode of aerial coupling employed, for this will be designed to suit the coils in the receiver, and will, therefore, also be found satisfactory when the unit is in use.



Plan view of the Selectivity unit.

Reference has already been made to the necessity for finding a suitable value for the coupling condenser,

"The Wireless World" Selectivity Unit.—

which may then be left untouched for long periods. To find the best setting for any individual case, the writer would recommend the following procedure: First set the coupling condenser to its maximum value, and then tune in a station at some distance, taking some care to adjust the tuning so as to give maximum strength, and using no more reaction than is strictly necessary. 5GB, if it be more than a hundred miles or so from the receiving station, is suggested; alternatively, the loudest Continental station may be selected.

Now study the behaviour of the tuning controls. Turn the tuning condenser in the unit slowly in one direction until the signals have been reduced to about one-half of their original strength. Then turn the first tuning condenser in the receiver (*i.e.*, the one controlling the circuit coupled to the unit) very slowly in the other direction; if this results in any increase in signal strength the coupling between unit and set is too close. The increase in signal strength will then be due to the fact that the two circuits are closely enough coupled for it to be possible, over a small range at least, to tune the first coil with the second condenser, and *vice versa*. Under these conditions the two circuits are virtually one, and selectivity will be poorer than it need be, while tuning, owing to the interdependence of the two circuits, will be unnecessarily difficult. It is necessary, then, to decrease the capacity of the coupling condenser until this "double tuning" effect *just* ceases to be perceptible; the setting so found is that which gives maximum signal strength and ease of tuning, and should, therefore, be adopted as standard for general reception. The coupling may be loosened beyond this point on occasion, if a greater measure of selectivity is required, by reducing the capacity of the coupling condenser still further, but the standard setting should be returned to as soon as circumstances permit, and the tuning dials should be calibrated for this setting.

So far, the unit has been considered almost entirely as a loose-coupler, owing no doubt to the writer's prejudice in favour of this arrangement. As already mentioned, it can also be used as a wave-trap, for which purpose the circuit shown in Fig. 2 is suggested. Here the over-wound primary of the unit is connected between the aerial and the receiver, the earth terminal of the unit being connected to the aerial terminal of the receiver, while the aerial is connected to one or other of the aerial terminals on the unit. It will then be found that when the circuit in the unit is tuned to the wavelength of the local station, the latter's signals will be "trapped out."

In using the unit in this way it will probably be found best to detune the receiver from the local station until signals become fairly faint, using telephones rather than a loud-speaker for the purpose, and then to tune the trap circuit very carefully. A point will be found where the local station is reduced to complete silence, but, owing to the low resistance of the circuit, this setting is so sharply defined as to be easily passed over. It must be found very accurately. If this point is sought when the receiver itself is tuned to the local station, interaction between the two circuits is liable to be sufficient to permit the unwanted signals to return as soon as the set is tuned to a different wavelength.

TRANSMITTERS' NOTES AND QUERIES.

Danish Short-wave Transmissions.

The experimental station ED 7RL, owned by our Danish contemporaries, *Radiolytteren* and *Populær Radio*, continues its regular transmissions on 42.12 metres. The programme for this week will be:—

APRIL 26TH AND 27TH.

Calibration ...	2400-2405 G.M.T.
Morse course	2405-2450
Telephony ...	2450-0200

Reports will be cordially welcomed and should be addressed to *Radiolytteren*, Raadhusplads 55, Copenhagen V.

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Low-power Communication with the Antipodes.

Mr. G. A. Jeapes, whose station, G 2XV, at 117, Victoria Road, Cambridge, is well known to amateur transmitters, has been in two-way communication, on 32.5 metres, with OA 7CW, Mr. C. Walch, Bellerive, Tasmania. Mr. Jeapes was using an Osram L.S.5D valve in a tuned-grid tuned-plate transmitter with an aerial only 35ft. in length and 32ft. from the ground, the input to the valve being 10.8 watts. C.W. communication was established for nearly an hour.

We understand that 2XV has also been in communication with over eighty amateur stations in America on a wavelength of 23 metres.

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Messrs. D. M. and D. F. O'Dwyer (GW 18B), 9, Upper Leeson Street, Dublin, have been in two-way communication with OZ 3AU, Mr. O. Hills, 97, White Street, Rangiora, Canterbury, New Zealand, when messages were exchanged on Sunday, April 8th, for twenty minutes on the 23-metre wavelength. The following day GW 18B was also in communication for half an hour with OZ 3AJ, Mr. R. G. Blake, whose station is in the same district.

Messrs. J. B. and R. D. Scott (GW 17C), 9, Upper Garville Avenue, Rathgar, Dublin, were also successful in exchanging messages on April 12th with Mr. R. W. Mintrom (OZ 3AW). Bartra Street, Woolston, Christchurch, N.Z., the wavelength used being 23 metres.

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General Note.

Mr. G. H. Houghton (5YZ), 110, Heathwood Gardens, Charlton, S.E.7, has been active on the 23-metre waveband; he is generally transmitting between 2200 and 2300 G.M.T., and will welcome reports.

South African Transmitters.

We give below a list of QRA's, which supplement those previously published by us and those in the R.S.G.B. Annual:—

A 4Y	H. Garland, P.O. Box 1607, Capetown.
A 5P	F. A. Ellor, P.O. Premier Mine.
A 9T	J. A. Black, 27, Clee Rd., Observatory, Cape Province.
A 9U	G. A. Brickhill, 43, Gillespie St., Durban.
A 9V	Col. N. Harrison, 127, Exploration Bldgs., Johannesburg.
A 9W	M. C. van Schoor, 18, Hangar St., Bloemfontein.
A 9X	W. Hilarius, Box 4559, Johannesburg.
A 9Y	A. F. Hayes, 20, Percy St., Yeoville, Johannesburg.
A 9Z	R. S. Perry, 720, Musgrave Rd., Durban.

Rhodesia.

SR A3W	C. A. Rieder, Bulawayo.
3 SRB	G. G. Livesey, "Killarney," Lalapaanzi, Southern Rhodesia.
4 SRB	T. Greaves, Box 646, Salisbury.
5 SRB	H. R. Warren, Box 715, Bulawayo.
ROLA	R. A. Logan, Box 335, Bulawayo.

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Japanese and Chinese Broadcasting Stations.

We are indebted to a correspondent in Japan for the following list of broadcasting stations in his country and in China:—

JAPAN.		
JOAK	375 metres	1.5 kW.
JOBK	385 ,,	,,
JOCK	360 ,,	,,
JODK	345 ,,	1 kW.
JOAK	395 ,,	500 watts.
CHINA.		
COPK	330 ,,	50 ,,
COTN	480 ,,	500 ,,
COK	335 ,,	2 kW.
COHB	445 ,,	1 kW.
KRC	345 ,,	
NKS	315 ,,	
GEC	300 ,,	50 watts.

BATTERY RESISTANCE and DISTORTION

The Causes and Prevention of Actual and Incipient L.F. Oscillation.

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

SUCH meticulous care has been exercised in the last two or three years in so designing high-frequency amplifiers to prevent even the minutest amount of energy from being fed back from the output to the input of a valve, that it would seem strange that to-day we evolve receivers destined to give perfect quality, but in which the *low-frequency impulses may be allowed to develop quite large voltages across a resistance that is common to all the valves in the set.* That the subject of energy feed-back in low-frequency amplifiers has not received a great deal of attention until lately is probably due to its concomitant effect being evident as a form of distortion difficult to locate rather than as an actual audible howl. As such small imperfections in design in a high-frequency amplifier give rise to audible interruptions which quite spoil a programme their elimination was perforce required before any important advance could be made in broadcast receivers.

Modern Loud-speakers Require Better Amplifiers.

Loud-speakers are developing apace in the direction of a more even response to the full range of frequencies transmitted, and their sensitivity is such that the accentuation of any frequency produced by L.F. back-coupling is more apparent than hitherto. It would seem purposeless to design an amplifier in which costly coupling components are obtained to ensure a straight line response characteristic from, say, 30 to 10,000 cycles and then to feed it from a common H.T. battery with the result (especially in a number of popular types of receiver) that at, perhaps, 200 cycles the amplification is no less than 5 times that at 2,000 cycles and upwards. There must be thousands of sets in use to-day which are on the very threshold of L.F. oscillation and in which the reproduction is "woolly" and the tone deep and muffled—due to the resistance of the common H.T. battery, and especially does this condition exist in those popular sets, wherein a leaky-grid detector is followed by resistance and then transformer coupling.

There is indeed ample evidence that in any set, whatever be the form of L.F. coupling employed, the effect of the impedance of a common anode supply is to mutilate the frequency characteristic to some extent. A profound modification of the overall amplification as a whole may arise, differing from that which would be predicted by taking the theoretical product of each separate stage. Readers are referred to a highly important article on this subject which has appeared in a recent issue of this journal.[1]

The Cause of L.F. Oscillation.

It is the purpose of the present article to describe a few qualitative experiments in L.F. oscillation with typical sets and to give a further description of the anode-feed resistance scheme which has been developed by Mr. A. Hall, of Messrs. Ferranti's research laboratories to combat the ill-effects of feed-back, and to which reference has already been made in two articles.[2] If the fluctuating currents in the anode circuit of the last or last but one valve of a set be passed through a resistance fluctuating potentials will be set up across that resistance, and the greater the resistance the greater the potentials. It has been pointed out in the article describing the "Gramophone Amplifier" that a new large-size dry-cell H.T. of 160 volts may have an internal resistance of some 25 ohms when new and may still have a working voltage when the internal

How can I cure "motor-boating" is a baffling query that has presented itself at some time or other to almost every wireless set user and has invariably proved insoluble. During the past few months the problem has been methodically pursued and its properties and causes carefully analysed. So important are the conclusions arrived at in this article and here clearly set out for the first time that it is safe to predict that the set modifications suggested will become standard practice in receiver design when good quality of reproduction is the aim, for it must not be overlooked that incipient L.F. oscillation with its quality destroying properties precedes actual "motor-boating."

[1] "Back Coupling in L.F. Amplifiers," by M. G. Scroggie. *The Wireless World*, December 14th, 1927.

[2] "L.F. Oscillation," January 4th, 1928, and "The Gramophone Amplifier," March 14th, 1928.

Battery Resistance and Distortion.—

resistance has risen to 550 ohms or more; H.T. accumulators of the same maximum voltage when partly discharged, together with leads and inter-battery connectors, may have a resistance of the order of 70 ohms, while a battery eliminator may offer an impedance of many hundreds of ohms to the frequency at which the amplifier is trying to oscillate. The question of calculating the impedance of an eliminator from the point of view of examining the chance of its causing L.F. oscillation is a difficult one, for the chokes and condensers may form a low-frequency resonant circuit and the network offers a different impedance to each frequency, whereas the internal resistance of a battery is practically independent of frequency.

It is proposed to deal with battery-fed receivers since the vast majority of listeners are probably employing these, and since they are more susceptible to providing data which can be relied upon for repetition. To return to our discussion on the formation of fluctuating potentials across a resistance, it will now be clear that the H.T. battery (whether new or old) will provide the resistance, and since the plates of the valves in a receiver are generally fed from a common battery, the speech frequencies will be impressed upon the output circuits of every valve.

As to whether the grids (or input circuits) of the valves will receive these parasitic oscillations depends upon whether the intervalve couplings are designed to pass L.F. impulses. It is quite obvious that a low-frequency amplifier is built to pass low-frequency impulses, with the result that the grid of each L.F. valve will receive any unwanted oscillations that have been passed to the preceding plate, whereas the detector grid will only receive such oscillations if the preceding plate (H.F.) is coupled direct to it by a grid condenser, but will not be affected if a high-frequency transformer with a very small capacity between primary and secondary be used. Couplings capable of passing these unwanted L.F. impulses will hereafter be known as " danger " couplings in this article.

The last valve of a set naturally creates the largest current fluctuations in its plate circuit; if, therefore, we can divert these from the H.T. battery so that sympathetic potentials are not built up across the resistance of that battery, we shall have gone a long way towards preventing back-coupling. It will be seen later, however, that such filtering of the speech potentials in the last valve alone is not a panacea for L.F. oscillation troubles; it is necessary for complete immunity that the speech potentials in the plate circuit of *every* valve (except the H.F. valve in certain cases) be diverted from the H.T. battery.

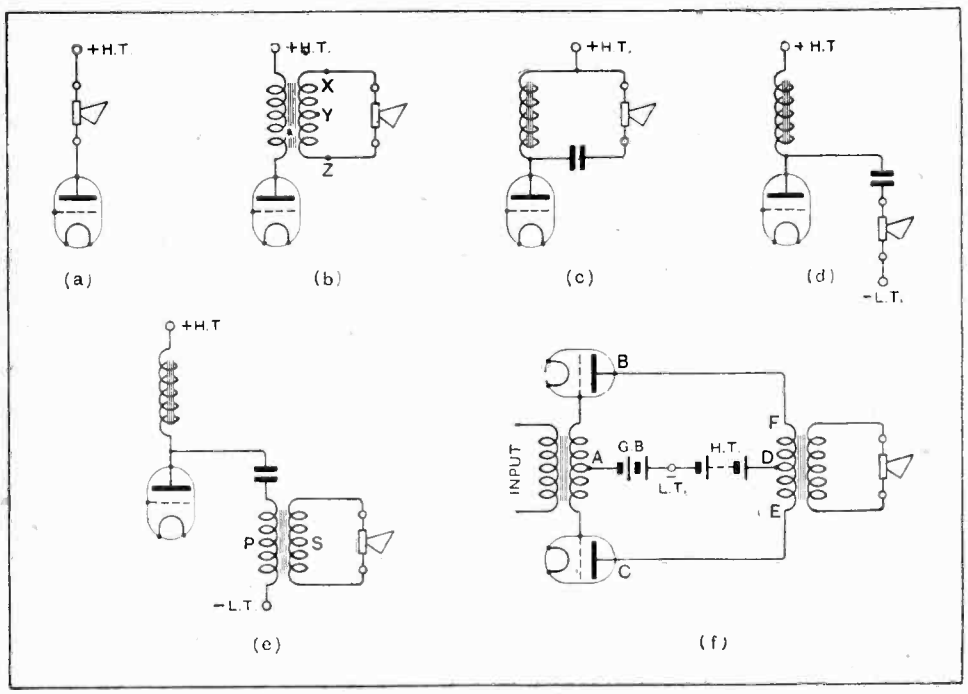

Fig. 1.—Six methods of coupling the last valve to the loud-speaker. The first three do not tend to arrest L.F. oscillation. In the last three (d), (e), and (f) the speech frequencies from the last valve are prevented from passing through the H.T. battery, which militates against L.F. feed-back.

The Output Stage and L.F Oscillation.

The various methods of coupling the last valve to the loud-speaker are shown in Fig. 1. The direct method (a) obviously does not help to eliminate feed-back, neither does (b) the output transformer, for the speech impulses are still passed through the source of H.T. In (c) an out-of-date choke filter is shown in which one loud-speaker lead is returned to H.T. + ; here, again, no immunity from back-coupling is obtained. The choke-filter scheme shown in Fig. 1 (d) diverts the speech frequencies from the H.T. battery, and owing to its manifold advantages should be used in all receivers built to operate loud-speakers. The choke-filter-fed output transformer is shown in (e), and may be necessary where a low resistance moving-coil loud-speaker is employed. The push-pull arrangement is shown in (f), and provided AB equals AC and DF equals DE, we have a balanced bridge in which there is no difference of A.C. potential across AD—in other words, the speech potentials do not pass through the H.T. battery. Thus (a), (b), and (c) are of no help to us in stemming L.F. oscillation, while (d), (e), and (f) are of great assistance.

The anode feed scheme, which has been referred to a number of times lately in this journal, should be applied before all " danger " stages, but not to the plate of the last valve, and consists essentially of diverting the speech

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impulses by means of a resistance so that they pass through an alternative low resistance path to earth. Examining Fig. 3 and taking the plate circuit of the detector, R_2 (which can be about 20,000 ohms) diverts the L.F. impulses through the low resistance path C_3 to earth. It is important that the resistance of R_2 should always be high compared with that of C_3 for all frequencies concerned. It is also important that R_2 should be many times greater than the resistance of the source

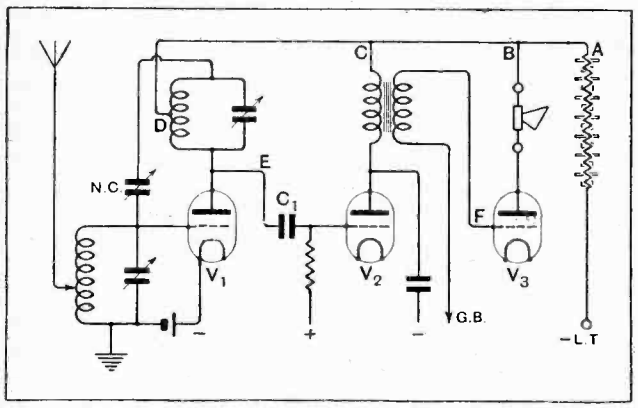

Fig. 2.—A neutralised tuned anode three-valve set in which it was found that the L.F. impulses built up across even a fairly new H.T. battery were fed to the grid of the detector valve along the path ABCDE, and caused violent howling. The H.T. battery is represented as an ordinary battery with a resistance across it.

of H.T. (this condition does not always obtain with eliminators). To work out the value required for an anode feed resistance, it is necessary to know the permissible drop in anode volts for the valve concerned and the anode current which would be taken by that valve at the slightly reduced voltage; the anode feed resistance is then given by dividing the voltage drop by the anode current in *amperes*. Let us suppose that in the circuit shown in Fig. 4 the total H.T. volts are 160, and it is found that the third valve will handle its likely maximum input with 110 volts H.T., and at that voltage takes 2 milliamperes, then R_5 should be $\frac{160-110}{0.002} =$ 25,000 ohms.

In view of the relationship which the anode feed resistances must bear with the resistance of other components to ensure that it shall properly separate wanted and unwanted impulses it is advisable that its value should not be lower than 20,000 ohms.

Some time ago the writer was asked to diagnose a fault in a home-constructed receiver, the circuit diagram of which is given in Fig. 2. It was the type of set built some two years ago before efficient H.F. transformers were well known, and in which a neutralised tuned anode circuit using plug-in coils gave a modicum of success on the 5XX wavelength. A dry-cell super H.T. battery had recently been purchased in which the rated voltage of 144 had dropped to 120 after an intermittent discharge at about 12 milliamperes. A few minutes after the set was switched on a continuous howl at about 200 cycles started which drowned all signals, and which was not affected by alteration of either tuning controls. The loud-speaker was moved to various distances from the set to see whether the trouble was acoustic reaction with the detector valve; this not being the case, it was decided that L.F. oscillation had started.

Various Remedies Tried.

The first remedy attempted was to shunt the H.T. battery with a 2 mfd. condenser, hoping that this would provide a low resistance path to earth. The oscillations, however, still persisted, and careful thought will show the reason why; a 2 mfd. condenser offers an impedance of about 400 ohms at 200 cycles, and since this is in parallel with a battery whose measured resistance was later found to be 70 ohms, the total effective resistance of the H.T. battery has thus only been reduced by about 10 ohms, which still provides sufficient common impedance to create serious back-coupling. Thus the shunting of the H.T. battery with reservoir condensers, of 2 or 4 mfd., is of little assistance in curing actual or incipient oscillation.

The next step was to reverse the secondary of the L.F. transformer; this stopped the oscillation, but it was noticed that the pitch of the music was higher and that the amplification was less. On artificially increasing the resistance of the H.T. battery to 600 ohms (a possible condition in which an H.T. battery might still give a working voltage) the signals became weaker and weaker until they practically ceased, and then "motor-boating" commenced. The reason for this is fairly clear, for when we reversed the transformer secondary

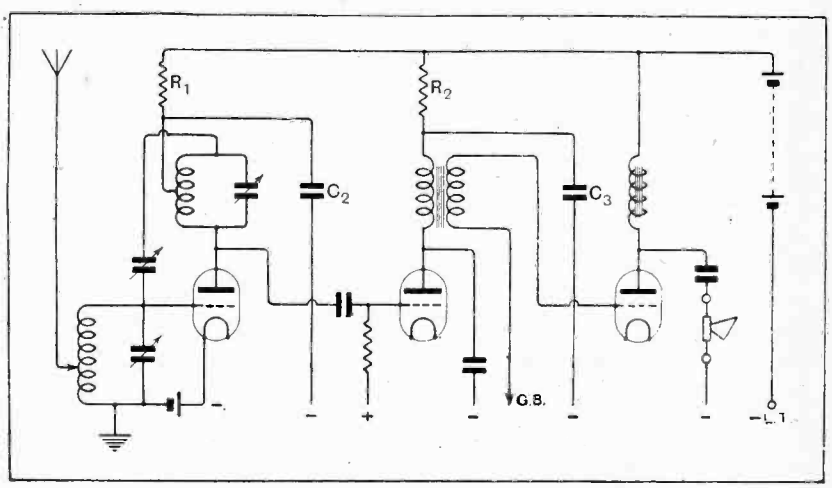

Fig. 3.—The same circuit as in Fig. 2, but with the addition of the anode feed scheme to two valves and choke-filter output to the last valve. This receiver was absolutely stable and gave excellent quality when the H.T. battery resistance was as high as 1,500 ohms.

the spurious oscillations and the normal signal oscillations were applied to the grid of the last valve out of phase with one another, akin to the effect of applying reverse reaction. The reversing of a winding of an L.F. transformer would therefore appear to be inadmissible, as this expedient is only resorted to when with

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the makers' normal connections oscillation trouble is experienced, proving the existence of battery resistance. A reversal of connections under these circumstances is to prevent an actual howl at low frequency, but to create distortion at a higher frequency and to reduce signal strength. The next experiment was to connect a choke-filter output wired as in Fig. 1 (d) (the intervalve transformer connections being returned to normal). Although the set ceased to howl, the addition of about 400 ohms between the H.T. + terminal of the set and the H.T. battery "motor-boating" accompanied by distortion took place. The anode feed scheme of introducing resistance was now applied to all valves but the last, and the output choke and condenser were still retained (see Fig. 3), with the result that the quality for this type of receiver was excellent, and *neither alteration in volume nor in the character of the signals could be detected when the battery resistance was increased to 1,500 ohms.* Surely no more convincing proof could be obtained of the effectiveness of the anode feed scheme for combating distortion and oscillation due to H.T. battery resistance. Further experiments were necessary to trace the path of the parasitic oscillations.

Feed-back to the Detector Grid.

A new H.T. accumulator of 120 volts was now used to feed the set in its original condition, and it was found again that when a resistance was added such that the total effective resistance of the battery was about 70 ohms oscillation started. It may well be asked why sets of this type produce any noise other than a howl when the H.T. battery is more than, say, six weeks old; the probability is that as the internal battery resistance slowly rises the H.T. volts drop, although the one is not a direct function of the other, for we can have two old 120-volt H.T. batteries each giving, say, 5 milliamperes at 100 volts, but the resistance of one battery may be twice that of the other. This drop in volts means that the amplification per stage is less and the chances of actual oscillation are less, but the set may well be on the verge of oscillation, a condition which produces "woolliness" in speech, indistinctness of consonants, and general muffling of the reproduction.

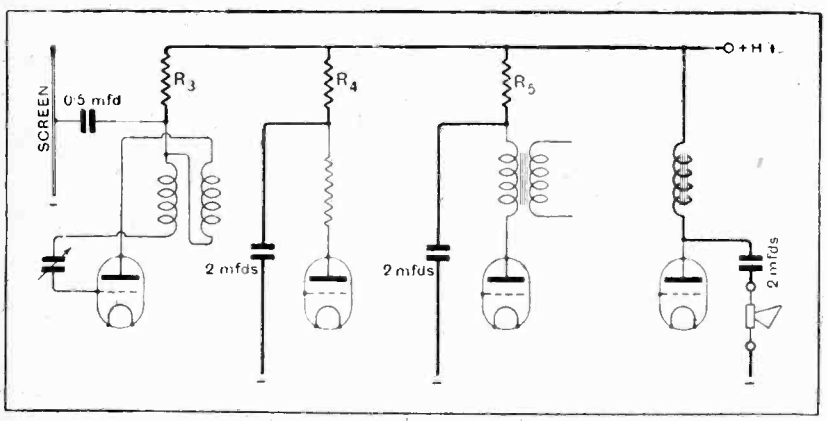

Fig. 4.—The anode feed scheme as applied to the plate circuits of the first three valves of a receiver of the "Everyman Four" type. Distortion due to incipient L.F. oscillation is prevented.

To find whether any appreciable back-coupling was taking place *via* the detector plate along the course ABCF (Fig. 2) a new and separate H.T. accumulator was connected at C to feed the detector valve only, the other two valves being fed from the old dry-cell H.T. The set oscillated with no less violence than when all three valves were fed from the one battery, thus disposing at once of the loose statement often made that "so long as a separate H.T. battery is used for the detector valve no ill effects from L.F. back-coupling need be feared." On feeding the H.F. valve from a separate H.T. battery oscillation ceased, from which must be inferred that practically all the L.F. potentials built up across the H.T. battery were finding their way to the detector grid by the path ABCDE and so through the L.F. amplifier.

Converting Existing Receivers.

Just to verify the theoretical consideration that an output transformer, by reason of the fact that it does not prevent the speech frequencies of the last valve from passing through the source of H.T., is no help to us, one of 1 : 1 ratio was connected between the output of the set (as originally wired and using the old battery) and the loud-speaker. The oscillations were, if anything, more violent (the D.C. resistance of the primary of an output transformer is generally less than that of an H.R. loud-speaker) and earthing any one of the points X, Y or Z, Fig. 1(b), made no difference. The choke-filter output scheme as shown in Fig. 1(c) also slightly increased oscillation.

Various other receivers were tested for oscillation by adding resistance to the H.T. battery, and it is worthy of note that those having an R.C.C. stage followed by transformer coupling seldom required an increment of over 150 ohms to cause actual oscillation, while incipient oscillation accompanied by characteristic distortion could be detected when the resistance was considerably below this figure. With amplifiers containing only R.C.C. stages a high resistance battery may cause a surging effect with the signals whereby a regular cyclic increase and decrease in volume takes place. Of the well-known *Wireless World* receivers, the "Everyman Four," the "All-Wave Four," and the "Standard Four" have two "danger" stages, and the anode feed scheme with choke filter output as applicable to them is shown in Fig. 4. Although R_3 is not necessary, since the coupling between the H.F. valve and the detector is not a "danger" stage, it may be thought advisable to apply rather less H.T. volts to the H.F. valve anode than to the last or power stage. Any reader who owns one of the above receivers and wishes to modify it to prevent incipient L.F. oscillation will already have three out of the four condensers necessary, and will need to obtain the three anode resistances and the output choke at a total expenditure for the conversion of a little over a sovereign.

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Value of Anode Feed Resistance.

Typical values for R_3, R_4 and R_5 for generally used valves will be found in another article headed "The Anode Feed Resistance Scheme" in this issue. The "Everyman Three" receiver, although containing a grid condenser, has no danger stage before the detector as an H.F. transformer is used; there is, therefore, one danger stage only—after the detector. The "Regional Receiver" (I.v.I.) having an H.F. transformer and a choke-filter output has no danger stages, and is a case where the anode feed scheme cannot be used to any advantage. Although the tuned anode method of coupling, being in effect a one to one transformer, has fallen into disuse lately, it may come into its own again with increasing use of the screened grid valve; the anode feed scheme applied to the H.F. valve will be necessary in this case.

Summary.

It will be as well to summarise the various experimental data obtained in connection with combating L.F. oscillation:—

(1) *H.T. batteries,* of accumulator or dry-cell type and whether new or old, all have appreciable resistance. Unless some precaution be taken to prevent feed-back, distortion, oscillation or periodic fading may take place if "danger" stages exist.

(2) *Choke-filter output* where one side of the loud-speaker is connected to earth (Fig. 1(d)) or choke-filter-fed transformer (Fig. 1(e)) should be used in every receiver designed to operate a loud-speaker. The chief advantages accruing are the prevention of feed-back from the *last* valve and the diverting of the steady D.C. current from the loud-speaker windings.

(3) *Anode-feed resistances* (in conjunction with condensers) for every valve but the last are essential if choke-filter output is not used and are an important addition if choke-filter output is used, as feed-back is possible from the penultimate valve.

(4) *Push-pull* output, provided the valve impedances and the transformer sections are matched, *i.e.*, provided the balance of the bridge is maintained, will prevent feed-back from the output valves, but here again anode feed resistances for the other valves are advisable.

(5) *Output transformers* by reason of the fact that they allow the speech currents to traverse the H.T. battery do *not* tend to prevent L.F. oscillation. However, in a set provided with this component sufficient immunity from the ill effects of battery resistance can probably be obtained by adding anode resistances to all valves but the last.

(6) *Choke-filter output* where one loud-speaker is taken to H.T. + (Fig. 1(c)) does not prevent feed-back from the last valve, and would appear to have no sphere of utility in any receiver.

(7) *Reversing the secondary of an intervalve transformer* gives a temporary cure of audible oscillation but generally mutilates the response curve at a higher frequency and considerably reduces overall amplification. The reversal of one winding of a transformer is rendered unnecessary if (2) and (3) above are adopted.

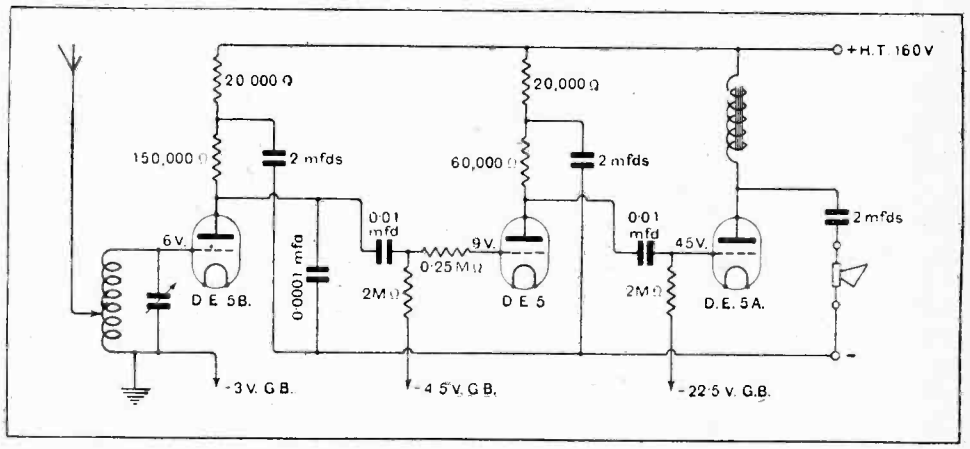

Fig. 5.—A "Quality" receiver for the local station. Numerical treatment of the signal imputs should prevent overloading. The grid swings are shown against the grid terminals of each valve. Care has been paid to retention of high and low notes and distortion due to back coupling is prevented.

(8) *Reservoir condensers* shunted across an H.T. battery give very little assistance in preventing feed-back, especially if the tendency to oscillate is at low frequency. They become superfluous if (2) and (3) above are incorporated in a set.

(9) *The useful life of an H.T. battery* is considerably increased by the use of anode feed resistances, and furthermore the battery is exhausted evenly since no tappings are required.

(10) *The tendency to L.F. oscillation* is greater the higher the H.T. voltage and the higher the amplification per stage. The introduction lately of more efficient L.F. intervalve coupling components has therefore led to the trouble becoming more evident. A set having L.F. resistance coupling followed by transformer coupling is very prone to L.F. oscillation, while a two-stage resistance amplifier, due to the low overall amplification, is less liable to cause trouble.

(11) *The value of the anode feed resistances* has already been worked out, but should the reader not have the necessary data available, it is usually safe to use 20,000 ohms as being the lowest resistance which is advisable from the point of view of preventing oscillation while the drop in H.T. volts is generally small with this value as the last valve is not involved.

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(12) *Separate H.T. battery for the detector valve,* often considered a sure cure for L.F. oscillation, is of no help where the plate circuit of the H.F. valve is passing on the unwanted energy (see Fig. 2).

It seems reasonable to suppose that where a common H.T. battery is used in a receiver containing "danger" couplings, that it is only a matter of time before the anode feed scheme (together with choke-filter output) will become standard practice. The cost of additional components when building a new set is small, and the extent to which an existing set has to be modified to conform to the scheme is trifling.

Receiver to Give Highest Quality.

Having described the methods to be employed in order to eliminate distortion due to the use of a common H.T. battery, it might not be out of place as a befitting conclusion to this article to give the design data for a receiver in which attention has been paid to those other factors which control the even amplification of the whole musical scale as transmitted. The circuit diagram of such a receiver is shown in Fig. 5. It will be seen at once that it follows closely the design of the gramophone amplifier lately described in this journal. Since atmospherics now have to be contended with, resulting possibly in the momentary flow of grid current in the last valve, the time constant of the condenser-leak combination has been made a little lower by employing 2 megohm instead of 3 megohm leaks. Attention has also been paid to the retention of high notes by avoiding the use of high anode resistances in conjunction with high impedance valves which give a high working capacity to the valve. The low notes are looked after by a correct ratio of the values of grid leak and coupling condenser. Overloading of the valves should not be allowed to take place if careful attention be paid to the permissible grid swings (and grid bias voltages) which have been included in Fig. 5 and marked close to their respective grid terminals.

The receiver having no stage of high frequency amplification is not intended for listening to distant stations, and as anode bend rectification is used it is important that a good aerial be employed so that the maximum grid swing of a 20 per cent. modulated carrier wave is of the order of 6 volts requiring about 3 volts negative grid bias. So that the high notes should not be cut off by side band cutting neither reaction nor critical tuning is employed.

What is the likely maximum grid swing that will have to be accommodated by the grid of the first L.F. valve, when an H.F. input as described is applied to the detector which is a DE5B with anode resistance and H.T. as shown in the diagram (Fig. 5)? An exact answer cannot be given, but by a careful examination of the curves given in the article entitled "Quality and the Anode Rectifier," by A. L. M. Sowerby, in the issue dated January 25th, 1928, a close approximation can be obtained. The actual figures given in the curves were for R.M.S. input volts and L.F. output peak volts, and by converting these to total grid swings for a 20 per cent. modulated carrier wave for a valve (DE5B) whose characteristics are between the S.P./55B and the PM5X a grid swing of about 9 is obtained for which a bias of about $4\frac{1}{2}$ volts is necessary.

Makers' Curves Wanted.

As every modern receiver built to give good quality with loud signals has incorporated in it an anode bend detector, it would be of great help if the makers of suitable valves for this purpose were to give us curves to show the relation between input and output volts for given conditions of modulation, anode resistance, H.T., etc., we should then be able to design our amplifiers scientifically and not rely on the principle of hit or miss. How often do we couple a $3\frac{1}{2}$: 1 transformer to the plate of a valve having an amplification factor of about 20 as a stage between a detector and an output valve, the latter being capable of handling not more than 45 volts grid swing. Working backwards it will be seen that if the detector output is much more than 0.6 volts swing, overloading will take place. Surely the output of the detector valve fed from a modern stage of H.F. is likely to give five or ten times this output unless great care be exercised with the volume control which must certainly be pre-detector.

If the numerical treatment of a set based on the calculation of the growth of the signal as it passes from valve to valve may serve to stem the present orgy of over-amplification, where the reproduction of music from the loud-speaker can only be a mere travesty of the original, then the reader may feel that the system is worthy of emulation at least in sets which are designed to give the highest quality from a nearby broadcasting station.

BOOKS RECEIVED.

Practical Television. By E. T. Larner, with a foreword by J. L. Baird. Pp. 175, with 97 illustrations and diagrams. Published by Ernest Benn, Ltd., London. Price 10s. 6d.

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Commercial Electrical Measuring Instruments for Direct and Alternating Current. Including moving-coil, hot-wire, electrostatic, and induction-type instruments, with a chapter on tachometers, thermo-electric pyrometers, etc. By R. M. Archer, B.Sc., A.R.C.Sc., M.I.E.E. Pp. 259, with 74 illustrations and diagrams. Published by Sir Isaac Pitman and Sons, Ltd., London. Price 10s. 6d. net.

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National Electrical Safety Code. 4th edition. Approved November, 1927, by the American Engineering Standards Committee, being the rules and recommendations for the installation and maintenance of overhead and underground electrical supply and communication lines, electric motors, furnaces, etc., transmitting and receiving aerials, earths, protective devices, etc. Pp. 525. Published by the Bureau of Standards, Washington, D.C. Price $1.

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Admiralty List of Wireless Signals, 1928. Corrected to December 31st, 1927, and including Details of Direction Finding, Fog Signals, Weather Bulletins, Storm and Navigational Warnings, Time Signal Stations, etc. Published by H.M. Stationery Office, and sold by J. D. Potter, 145, Minories, London, E.1. Price 6s. 6d. net.

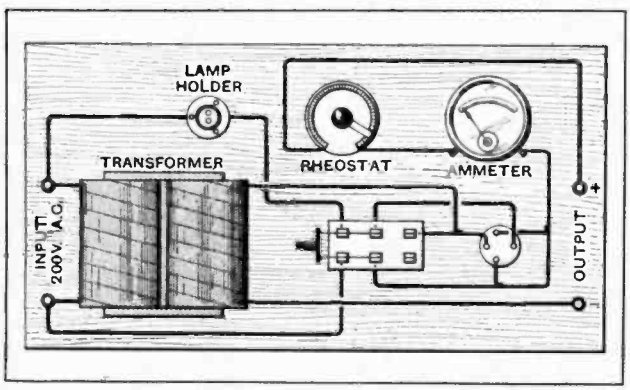
REJUVENATING RECTIFYING VALVES.

The Construction of a Unit for Battery Charging.

THE gas arc type of rectifying valve is very popular at the moment for accumulator charging, etc., and is a safe, clean, and moderately efficient method, which requires practically no attention. The commercial units contain a small transformer to supply the filament heating current for the valve and the charging current for the battery. A ballast resistance and valve socket mounted in a light metal case complete the outfit. On plugging the device into circuit the filament of the valve is raised to an orange-red heat, and an electric current is conducted *via* the gas to the anode. The approximate potential of the anode is 30 volts, obtained, of course, from the transformer. The battery to be charged is included in this circuit. The bombardment of the filament is sufficient to keep it hot—and the valve working, in consequence—even if the filament heating current is turned off or fouls for some reason.

Using the Filament Stubs.

After running a considerable number of hours the filament collapses and the valve is rendered useless unless certain alterations are made to the charger as a whole. As the valve has now become of the common but unpopular "four electrode" type, due to the disappearance of its filament, various liberties can be taken with its partly vacuous contents. To make the valve work again it is essential to get the gas inside to conduct so that a rectifying arc can be struck. Now the valve contains two flat anodes and two filament stubs (cathodes),

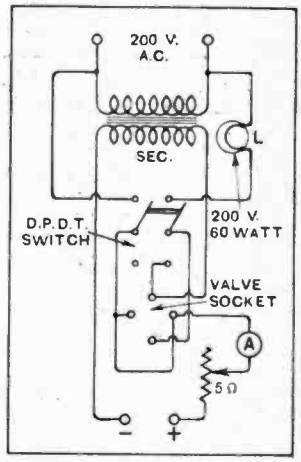


Plan diagram of the charging board.

so that if we put one pair in the charging circuit as before and use the other pair as starting electrodes the valves will again function. It is necessary to apply a moderately high potential to the starting electrodes in order to ionise the gas so that current will flow between the other two electrodes. Since the transformer primary is probably connected to 200 volts or so, use can be made of that pressure and a suitable current-limiting resistance included in the circuit. A metal filament lamp is quite satisfactory.

When the arc is struck the starting electrodes are disconnected from the 200-volt circuit, and by an extra contact on the switch they are paralleled with the running electrodes.

An experimental panel was made up as indicated in the photograph, three valve sockets wired up in parallel were used, as three valves, which were of the "four electrode" variety, were available. Since these had been purchased separately for use without the usual commercial outfit, it was necessary to make a transformer to supply the necessary potentials. This appears in the photograph, and is the result of an excess of enthusiasm one evening. The whole thing was dismantled and rewound to the required voltages in a very short time. The workmanship is not of the best, but the apparatus gives the required outputs, and is cool and silent in operation. The turns constant used is 10 turns per volt; the primary is wound with No. 28 D.C.C., and the 30-volt secondary with No. 18 D.C.C. There is in addition a 2-volt winding for use with bulbs possessing the filament intact. This is wound with No. 12 D.C.C., as the filament current on starting is in the neighbourhood of 5 amperes per valve. This winding is disconnected when valves having no filament are used.



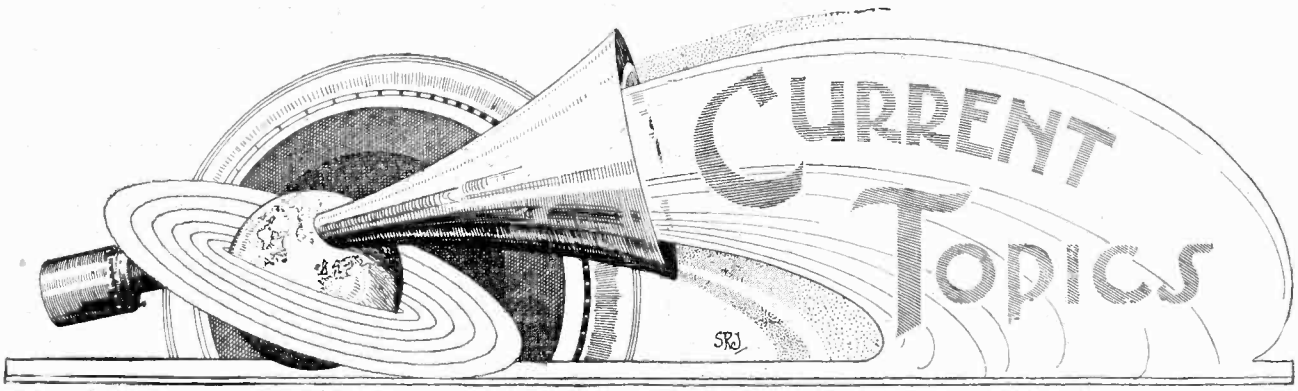
Circuit arrangement of the complete charger.

To charge an accumulator the operation is very simple. The transformer primary is plugged into the A.C. main, the + terminal of the battery is connected to the + terminal of the charging circuit, and the − terminal to the negative of the charger in the usual way. It is assumed that one or more valves are in position and that a suitable lamp is in the starting circuit. The starting switch should be in the midway position, that is, not in contact with any of the circuit.

To start the apparatus place the change-over switch in the 200-volt position. This causes the lamp to light and the valve to arc over. When the arc is going well, as indicated by the ammeter, the change-over switch should be placed into the other pair of contacts and left there. It is advisable not to have an earth connection on the battery and not to keep the switch in the starting position any longer than getting an arc justifies. A few seconds is really all that is necessary. The resistance in the charging circuit is used to regulate the current. A safe working density is 2 amperes per valve.

The equipment described has now done some forty or fifty charges and is entirely satisfactory, and would appear likely to remain so indefinitely.

E. M.



Events of the Week in Brief Review.

THOSE QSL CARDS.

"Now that conditions are generally favourable for picking up long-distance stations, there is a revival of coast-to-coast deception."—Sunday Paper.

There is many a true word spoken in error.

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SHORT-WAVE BROADCAST FROM AUSTRALIA.

A special licence has been granted to the Melbourne station (3LO) to conduct a world broadcast on May 6th on a wavelength of 32 metres. The programme will begin at 9.45 a.m., Melbourne times (5.30 p.m., G.M.T.), and will continue at intervals until 5.45 p.m.

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AMERICAN SETS IN JAPAN.

The swamping of Japan with American built wireless sets is foreshadowed by the news that Brunner, Mond and Co. (Japan), Ltd., shortly to be known as Imperial Chemical Industries (Japan), Ltd., has entered into an agreement with the Atwater Kent Manufacturing Co. to act as distributors of the wireless receivers made by the latter firm.

Of recent years popular interest in wireless has greatly increased among Japanese people, and there seems little doubt that the American sets will meet with a large sale.

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£50 FOR A WIRELESS POSTER.

In order to obtain a striking poster for the National Radio Exhibition, the Radio Manufacturers' Association have arranged an open competition for which six prizes will be awarded, as follows: 1st prize, £50; 2nd prize, £25; 3rd prize, £10; 4th, 5th, and 6th prizes, £5 each. The sketches (finished rough, in colour) must be double crown full size—30in. × 20in.—and the maximum number of colours permissible is nine. Designs, which must be applicable to radio, should incorporate the following wording:—

"The National Radio Exhibition, Olympia, September 22nd to 29th, 11 a.m. to 10 p.m. Admission 1s. 6d. daily. (Tuesday, September 25th, up to 5 p.m., 2s. 6d.) Dancing."

Sketches, bearing the entrant's name and address on the back, must be sent to the Secretary, The Radio Manufacturers' Association, Astor House, Aldwych, London, W.C.2, so as to reach him not later than May 31st next.

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RECEIVING LICENCE INCREASE.

At the end of March the total number of receiving licences issued in this country reached 2,470,696, in addition to 12,234 issued free to blind listeners. This marks an advance of 20,000 on the February figures.

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LOUD-SPEAKERS AT WEMBLEY.

Sixteen Marconi public address loud-speakers were installed at the Wembley Stadium for last Saturday's Cup Final. They were used for the Community singing concert before the game.

SCREENED-GRID VALVES.

"Screened-Grid Valves" is the topic chosen for discussion at the next meeting of the Wireless Section of the Institution of Electrical Engineers on May 2nd.

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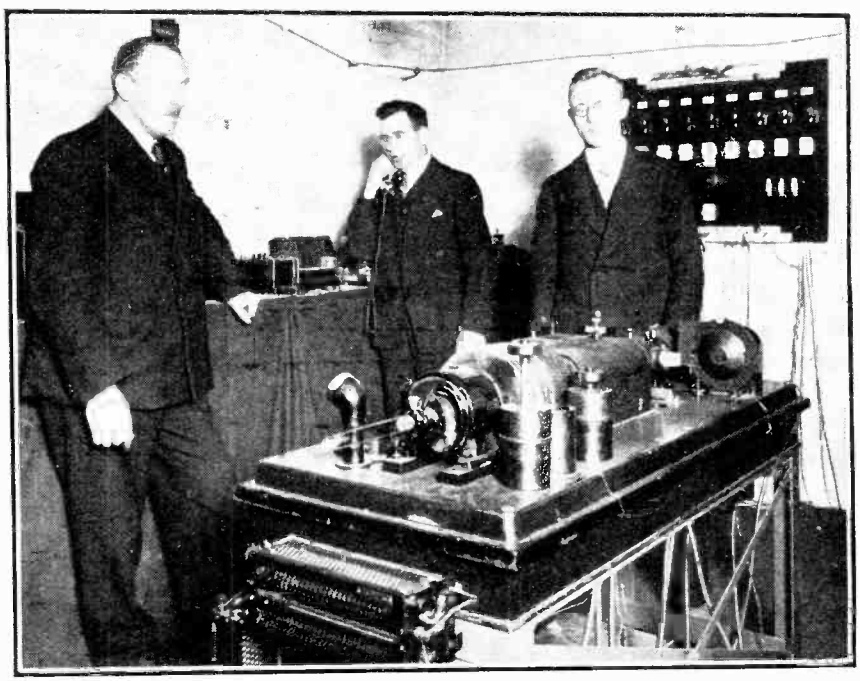
RECALLED BY WIRELESS.

An air liner bound for Paris last week was recalled to Croydon aerodrome by wireless telephone to pick up a belated passenger.

This incident, which is stated to be the first of its kind in British commercial aviation, opens up new possibilities in the service which wireless can render to mankind. It suggests that in the present restless age of hurry and scurry, the late-comer, in whatever walk (or run) of life he may find himself, is better cared for than his forefathers. Even in the most



TRANSMITTING NEWS PICTURES. Apparatus of the Siemens Karolus system which has just been installed in a London newspaper office.

leisurely period of the Victorian era, to lose a train was to lose it, and no amount of pious imprecation could bring it back.

If the Croydon case can be accepted as a precedent, we may soon enjoy the spectacle of the Scotch express backing irritably into King's Cross after being recalled by an S.O.S. at Potters Bar. This alone would justify the existence of the new regional station.

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RADIO CORPORATION OF PORTUGAL.

On April 13th a private company known as the Radio Corporation of Portugal was registered with a nominal capital of £100 in £1 shares, to acquire all or any of the interests in the undertaking and business known as the Companhia Portuguesa Radio Marconi and the properties and liabilities thereof. Registered office: 9, Essex Street, Strand, W.C.2.

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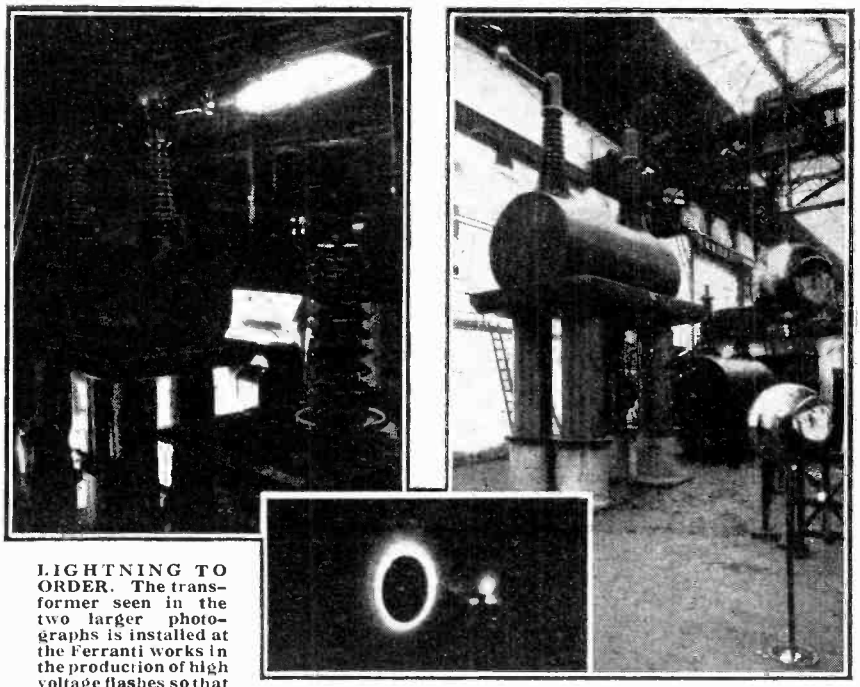
POWER TRANSMISSION BY WIRELESS.

In view of the reports from America regarding the development of valves for use on ultra-short wavelengths and the accompanying speculation on the possibility of employing wireless for the transmission of power, the General Electric Company, Ltd., have issued an interesting statement regarding experiments in the same direction now being made in this country.

For a long time tests have been carried out in the construction of valves handling enormous power; for instance, Osram valves capable of dealing with an input of 30 kW. are now in actual commercial use. The research laboratories responsible for the design of these valves are aiming at wavelengths far below those at present in commercial use with the possibility in mind of employing wireless for transmitting power. It must be appreciated, however, that the power necessary for signal work over the longest distance by modern methods of transmission is infinitesimal compared with that required for lighting and other industrial purposes.



LIGHTNING TO ORDER. The transformer seen in the two larger photographs is installed at the Ferranti works in the production of high voltage flashes so that wireless and other apparatus may be tested under thunderstorm conditions. The transformer raises the generated pressure to one million volts. Inset: the corona effect of the discharge.

RADIO BEACONS IN AMERICA.

The establishment of a chain of forty aircraft wireless beacons covering approximately 8,000 miles of civil airways is the project of the United States Department of Commerce.

The civil aviation plans also provide for a telephone service between airplanes.

NEWS FROM THE CLUBS.

A Good Record.

That no fewer than 47 meetings have been held during the past year was the encouraging report of the retiring hon. secretary at the annual general meeting of the North Middlesex Radio Society on March 28th. The year's programme included visits to 2LO, the National Physical Laboratory and the Science Museum, besides two field days and the usual fortnightly gatherings. The election of officers and Committee for the forthcoming year resulted as follows:—President, Mr. F. T. Chapple; hon. treasurer, Mr. H. A. Crowch; hon. secretary, Mr. E. H. Laister; installation officer, Mr W. Gartland; committee, Messrs. L. C. Holton, L. F. Summers, H. A. Green and R. Kirlew.

The meetings of the Society are held fortnightly in Shaftesbury Hall, adjoining Bowes Park Station, N., and visitors are always welcome. Hon. secretary, Mr. E. H. Laister, Endcliffe, Station Road, Winchmore Hill, N.21.

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200 per Cent. Membership Increase.

At the first annual general meeting of the Wigan and District Technical College Radio Society on April 4th the secretary's report disclosed an increase in membership from 41 on December 2nd, 1927, to 127 on April 3rd last—an increase of more than 200 per cent. in four months. Eight meetings were held during this time and the average attendance was 65. Outstanding lectures have been the Presidential Address by Mr. Harlow on Wave Transmission and Prof. Marchant's address on Beam Wireless. The treasurer's report showed a fair credit balance. With the revised subscription of rates of 5/- for full members and 2s. for junior members, the Committee faces the coming session with confidence. Mr. Harlow consented to be re-elected president for the second session. At the conclusion of the formal business the evening was given up to social activities. The Society has already been graced by a lady vice-president, and now a lady member has been enrolled. More ladies are expected to follow suit and will be very welcome.

Hon. secretary, Mr. M. M. Das, B.Sc., Library Street, Wigan.

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Southend Society's Annual Dinner.

The annual dinner of the Southend and District Radio Society, held recently at Garon's Restaurant, was the first occasion at which ladies have attended the function. A large gathering of members and friends attended the dinner, which was followed by a musical programme. While the guests assembled excellent musical selections were provided by a moving coil loud-speaker. The usual toasts were honoured, and a presentation was made to the popular chairman of the Society, Mr. H. H. Burrows.

Hon. secretary, Mr. F. J. Waller, Eastwood House, Rochford, Essex.

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Leyton Society's New Headquarters.

The Leyton and Leytonstone Radio Society held its first meeting at the new headquarters, Grove House, 452, High Road, Leyton, E.10, on April 5th. The meeting took the form of a "question night," members seeking advice on a wide range of topics, from crystals to selenium cells.

The Society has plenty of room in the new headquarters, and a cordial invitation is extended to all *Wireless World* readers in the district to attend the meetings.

Hon. secretary, Mr. E. Boatright, 265, Murchison Road, E.10.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 25th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Demonstration of the Igranic Neutro-Regenerative Short-Wave Receiver. (H.F. Amplification on 15 metres.)

North Middlesex Radio Society.—At 8 p.m. At Shaftesbury Hall, Bowes Park, N. Lecture: "Capacity Measurement with the Neon Tube," by Mr. R. Kirlew.

South Croydon and District Radio Society.—At 8 p.m. At the Surrey Drovers' Hotel. Lecture and Demonstration by the President, Mr. H. R. Rivers-Moore, B.Sc.

Tottenham Wireless Society.—At 8 p.m. At the Institute, 10, Bruce Grove. Demonstration of the Igranic gramophone pick-up and amplifier, by Mr. Curtis, of the Igranic Electric Co., Ltd.

THURSDAY, APRIL 26th.

Golders Green and Hendon Radio Society.—Fancy Dress Ball. At 8.15 p.m. At the Club Ball Room, Willifield Way.

Leyton and Leytonstone Radio Society.—At 8 p.m. At 452, High Road, E.10. "Elementary Electricity."

MONDAY, APRIL 30th.

Croydon Wireless and Physical Society.—At 8 p.m. At 5, Altyre Road, East Croydon. Lecture: "The Design and Construction of a Quality Wireless Receiver," by Mr. A. C. Dale.

Holloway Literary Institute Wireless Society.—At 7.30 p.m. At Holloway School, Hilldrop Road, Camden Road, N.7. Display of Members' Sets.

TUESDAY, MAY 1st.

Hounslow and District Wireless Society.—At 8 p.m. At Trinity Hall, Bulstrode Road. Demonstration of Celestion Loud-Speakers and Woodroffe Pick-up.

THE ANODE FEED RESISTANCE SCHEME.

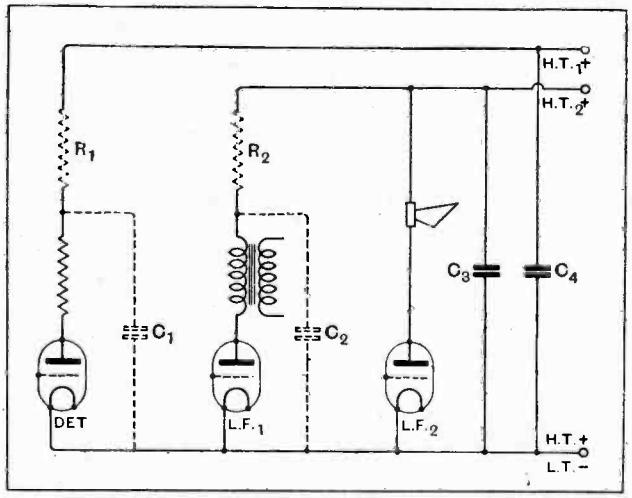
Applying it to Existing Sets.

By "RADIOPHARE."

SO serious is the effect of interstage L.F. coupling, due to battery and other incidental resistances common to the anode circuits of several valves, that, prior to the introduction of the anode feed resistance method discussed elsewhere in this issue, there was a distinct tendency on the part of some designers to obviate all possibility of such interaction by restricting the low-frequency amplifier to a single stage. Possibly it is cowardly to shelve the problem of designing a stable multivalve amplifier, but there can be little doubt that the "1-L.F." set, when submitted to the practical test of actual demonstration before those with ears keen to detect imperfections, gives a better performance than the *average* set with two L.F. valves. This applies to receivers with comparatively high-magnification stages, when used under conditions commonly prevailing, with an anode current source (battery or eliminator) having an appreciable internal resistance.

Now a given battery resistance may be insufficient to produce actual howling in a two- or three-stage amplifier, but still may cause very serious distortion, brought about by low-frequency reaction, although individual stages may be as near perfection as possible. It is certain that this reaction effect is responsible for a good deal of poor reproduction, and the insertion of series feed resistances—which are an almost certain preventative—in the anode circuits of detector and each L.F. valve (except the output) can be confidently recommended to those who have reason to be dissatisfied with the performance of their sets from the point of view of quality. Although the necessary additions are simple, it is considered that some detailed information regarding the method of procedure will be of interest to a number of readers.

The positions of the extra resistances, marked R_1 and R_2, in a typical det.-2 L.F. set are shown in the diagram. It will be seen that they are interposed between the low-potential end (that end which is *not* connected to plate) of whatever intervalve coupling component may be used and the high-tension battery connection. If this is borne in mind, no difficulty will be found in making the addition, even by those who are unaccustomed to following theoretical circuit diagrams. The first step is to remove from the coupling component the H.T. lead already mentioned, and then to replace it by a connection to one side of the feed resistance, the other side of which is joined to the original H.T. wire.



L.F. oscillation and some forms of distortion may be prevented by connecting resistances (R_1 and R_2) and extra by-pass condensers (C_1 and C_2) in the anode circuits. The additions are shown in dotted lines. C_3 and C_4 are the usual H.T. shunt condensers.

Nothing remains but to add the extra 2-mfd. by-pass condenser (shown at C_1 and C_2 in the diagram) which is required for each anode circuit; one side is joined to the low-potential end of the coupling component, and the other to a convenient point on the common L.T. negative lead. This procedure should be followed in the anode circuits of the detector, first stage amplifier (and second stage, if three L.F. valves are used), but the output valve connections need not be altered.

The value of the resistances is of some importance; generally speaking, it should be not less than 20,000 ohms if full benefit is to be obtained. This at once brings up the question of voltage drop, as the addition of the resistance will reduce the electrical pressure actually applied to the valve. It will be convenient to assume in the first place that we have surplus voltage at our disposal, as may well be the case when some 160 volts is applied to the last valve. If these conditions obtain, it is advisable to join together all the H.T. terminals of the set (except perhaps that supplying the H.F. valve) and to regard the feed resistances as voltage reducers. Their value may be calculated with sufficient accuracy with the help of information given in the makers' curves. Let us assume that it is desired to apply 120 volts to a D.E.5b., that the supply is 160 volts, and that the valve is biassed to $1\frac{1}{2}$ volts negative. Under these conditions, and with the required anode voltage, the curve shows that a current of about 1 milliampere will pass. The necessary resistance value (in ohms) will be obtained if we divide "volts to be dropped" (the difference between the supply and the desired voltage) by the current taken (in amps.). In the case under consideration, the "volts to be dropped" are $160-120=40$ volts, while the current is 0.001 amp.; thus we get $40\div0.001=40{,}000$ ohms. Accordingly, a resistance of this value will be required. In the above calculations other resistances in the circuit have been ignored. As far as transformer primaries and chokes are concerned, this is permissible, and with resistance coupling there is no real need to reduce voltage, so a 20,000-ohm resistor may be used.

Although at first sight the scheme under discussion may seem to be inapplicable when the customary 120 volts is used on all valves, this is not so in practice; it is very seldom that the drop in anode voltages resulting from the insertion of 20,000-ohm feed resistances will have any bad effects.

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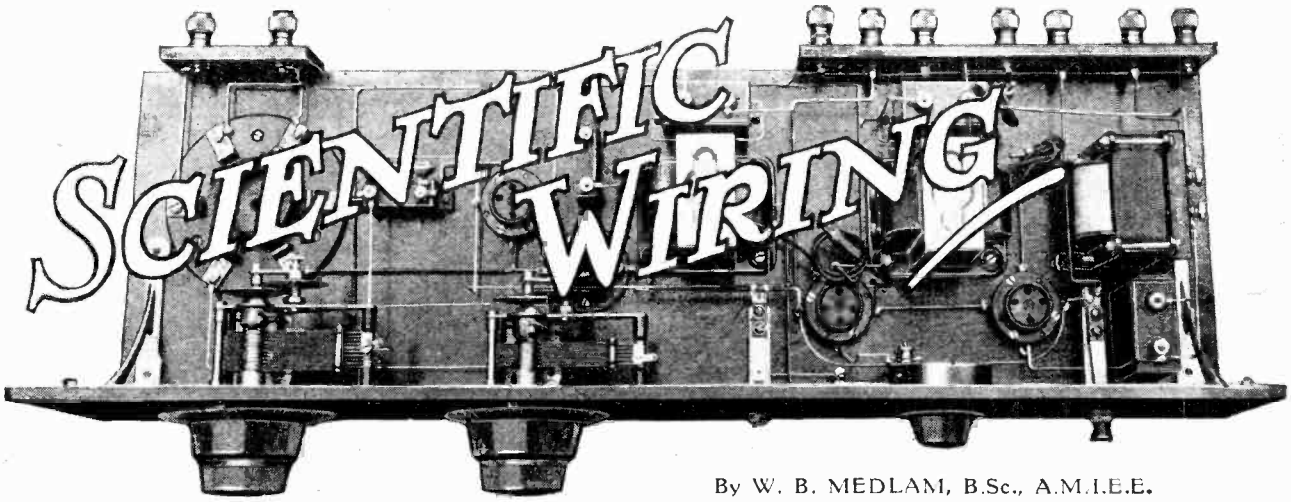


SCIENTIFIC WIRING

By W. B. MEDLAM, B.Sc., A.M.I.E.E.

Stray Coupling Caused by Wiring—A New Viewpoint.

The ground covered by this article is entirely new and marks progress. In it attention is drawn to stray couplings set up in receiver wiring and which are still present in spite of complete stage by stage screening. How soon will the suggestions made here bring about a new system of wiring?

THE wiring of receivers with several valves in cascade has lately been receiving more attention, and it is beginning to be generally realised that however well arranged the wiring may be, there always remains a certain degree of undesirable coupling between the various circuits. Even when seemingly adequate screening of the stages is provided these defects may not be sufficiently reduced when using screened grid valve circuits, or when a high degree of audiofrequency amplification is required for operation of a moving coil speaker.

It is the purpose of the present article to point out some of the fundamental defects of the standard method of wiring, and to suggest a modified system which will overcome them.

In Fig. 1 is shown a theoretical diagram of a four-valve set. Transformer coupling has been shown throughout, with single battery supply, in order to simplify the following analysis of the circuits. Altogether there are, in Fig. 1, eight distinct alternating current circuits, every one of which should be entirely separate, electrically, from all the others, in order to avoid the interaction of one stage with another. As a matter of fact, even with carefully arranged wiring to the various components there is resistance, capacity, and inductive coupling between each circuit and every other one in varying degree.

The resistance coupling will be considered first. In Fig. 1 the paths of the anode circuit currents A_1, A_2, A_3, and A_4, and of the grid circuit currents G_1, G_2, G_3, and G_4, of the four valves are shown by the arrow heads on the wiring. It will be seen that the common H.T., −L.T., and negative bias wires inside the receiver, and also the external battery leads, all form part of more than one circuit, and with heavy outputs their resistance may be sufficient to cause undesirable interaction, as has recently been pointed out in *The Wireless World*.[1]

For example, the section B C of the common −L.T. wire is actually part to all the eight A.C. (speech current carrying) circuits of the set. If the resistance of this wire approaches 1 ohm, due possibly to a defective connection to the −L.T. terminal, to the use of too fine a wire, or to connection of a common filament resistance in this lead, measurable reaction effects will probably develop. The use of entirely separate H.T. and bias supplies for the last valve, and complete screening of the stages will not remedy the trouble.

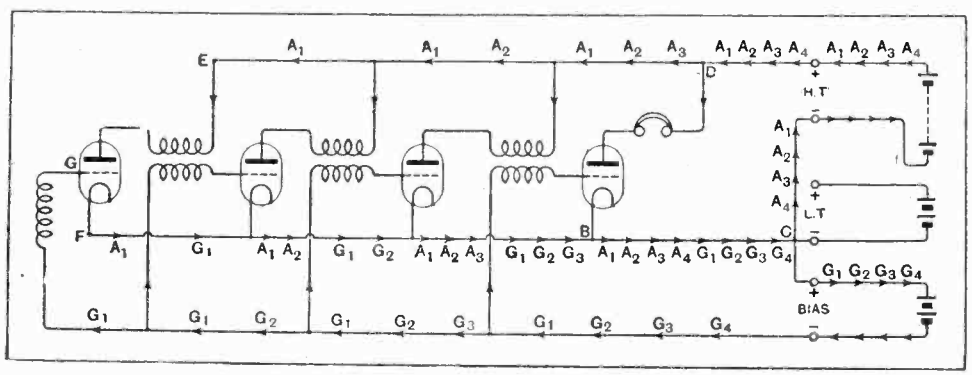


Fig. 1.—Common paths of current distribution in a four-valve receiver. The connecting lead between the points B and C carries the anode and grid circuit-speech currents of all four valves and its resistance gives rise to a coupling between the amplifying stages.

[1] "Battery Circuits in Multi-stage Amplifiers," A. L. M. Sowerby, Feb. 15th, 1928.

Scientific Wiring.—

Internal inductive couplings, due to the wiring itself, will now be traced. Referring again to Fig. 1, the anode circuit of the last valve comprises the inductive loop from the +H.T. terminal to D, anode, B, C, to −H.T. The anode circuit of, say, the first valve contains the inductive loop from the +H.T. terminal, along the common H.T. lead to E, anode, F, along the common −L.T. lead to C, −H.T. For clearness, these loops are shown diagrammatically in Fig 2, and denoted by L_4 and L_1 respectively. It will be seen that the loop L_4 is actually a part of the larger loop L_1, and flux in the former must necessarily link with the latter. It should be particularly noted that complete screening of the stages between D B and E F (Fig. 2) will not prevent this linkage of the two hoops, which is, indeed, inherent in the system of wiring by common connections. Although only two anode circuit loops are shown, there are similar inductive loops common to all the anode circuits, every circuit being linked permanently to every other one. In general these linkages will not be reduced to any appreciable extent by the use of separate H.T. supplies to all the valves. For instance, if the wire from E (Fig. 2) is taken back to a separate +H.T. terminal situated a little above the existing one, the two loops are still linked almost to the same extent.

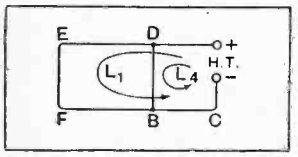


Fig. 2.—Undesirable inductive coupling may also arise. EF is the anode circuit of the first valve of Fig. 1, and DB that of the last valve. The loops L_1 and L_4 are formed and magnetic coupling takes place between the circuits which will not be prevented by stage screening.

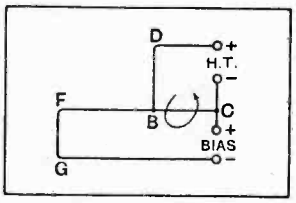


Fig. 3.—Inductive coupling between anode and grid circuits is brought about by virtue of the common negative L.T. lead BC.

It is evident that there are similar inductive loops common to all the grid circuits, and also linkages between each anode and every grid circuit. One example of the latter type of linkage may be noted. The anode loop of the last valve is from +H.T., D, anode, B, C, to −H.T. The grid loop of the first grid circuit is from the +bias terminal to C, B, F, G, to the −bias terminal. These two loops are inductively interconnected in virtue of the common −L.T. lead B C, whatever may be the distribution of the rest of the wiring, as may be more clearly seen from their diagrammatic representation in Fig. 3. The section B C of the common −L.T. bus bar links the last anode circuit with all the grid circuits; and, in a similar way, other sections of this common lead give further linkages between the other anode circuits and the grid circuits.

It is curious that the lead one would least suspect, namely, the common −L.T. bus bar, is or may be the cause of a complicated series of resistance and inductive couplings between everything and everything else. This same wire leads also to considerable capacity coupling between the anode and grid wiring of the valves. This point is more conveniently dealt with later.

Although only the defects of the common L.T. leads have been dealt with at length, other couplings, both resistance and inductive, due to other common leads, may be noted on careful inspection of Fig. 1.

De-coupling Wiring System.

The couplings between circuits due to the wiring may be entirely eliminated by adopting the system shown in Fig. 4. The new method is shown applied to the same receiver as in Fig. 1 above for comparison purposes. It will be seen that each circuit is wired wholly independently of all other circuits, so that no wire, at any point, carries more than the one current belonging to its own circuit. Thus it is evident that no resistance coupling can occur whatever resistances may be included anywhere in the wiring (up to the point of connection to the common batteries).

Inductive couplings are eliminated by running the go and return leads of each circuit very close together throughout their length, and ensuring that the go and return currents are exactly equal. One convenient method, suitable for all the wiring, other than the wires direct to the anodes and grids, is to use twin flex, the circuits being run independently right through to the terminals of the batteries. To facilitate connection to the batteries the common ends, in this case four at each point, may be secured to a spade terminal for insertion under the corresponding battery terminal. If the circuits are slightly spaced, say, 1in. apart, there will be practically no inductive couplings when using twin flex. The reason for this is that the current circulates in opposite directions round the tiny adjacent

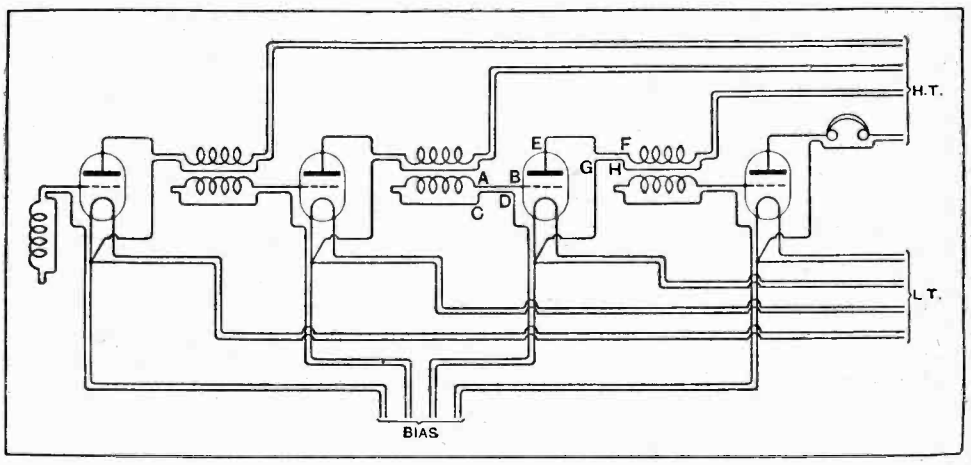


Fig. 4.—Circuit of the receiver shown in Fig. 1, with modified wiring to eliminate stray couplings. Each valve circuit is wired wholly independently.

Scientific Wiring.—

loops in the flex, as shown in Fig. 5; thus the external field due to one loop is cancelled by the oppositely directed field, due to the adjacent loops at all points a short distance away from the wires.

An ideal form of wiring would consist of flexible, or bendable, concentric conductors, as shown in section in Fig. 6, the outer cylindrical conductor being connected in every case to its proper negative filament terminal of the valve holder. The capacity between these go and return wires is not at all harmful, however great it may be.

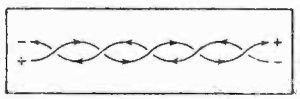


Fig. 5.—Twin flex when used for battery connections avoids the setting up of inductive couplings.

As suitable concentric wires are not at present available, twin flex provides a very efficient substitute. On account of dielectric losses and high capacity, flex should not be used for the wiring to the grids (such as A B, Fig. 4) of the valves. The direct grid wires should be made as short and as thin as possible. In addition, the return wire connecting the secondary of a transformer to its negative bias should be run parallel and very close to its grid wire, *i.e.*, in Fig. 4, wires such as C D should run close to A B to reduce the area of the inductive loop to a minimum. The only limit to the closeness of these wires is, of course, the capacity between them, and this is often overestimated. The capacity between two bare or enamelled wires spaced ⅛in. apart is approximately 0.5 micromicrofarads per inch length with No. 30 S.W.G. wires, and 0.75 micromicrofarads per inch with No. 20 S.W.G. wires. The close running of these grid wires is important not only to reduce magnetic couplings, but also to reduce the external electric field round the "live" grid wire, the latter being the more important consideration in the grid circuits. Exactly the same applies to the live portions, such as E F and G H of the anode circuit wiring. To show this capacity coupling effect more clearly a rough diagram of the electric field associated with the wires A B, C D, and E F, G H, is given in Fig. 7 for the close wiring, and in Fig. 8 for the normal spaced wiring, at the instant when the potential of the anode is, say, +20 volts and that of the grid −1 volt with respect to the filament.

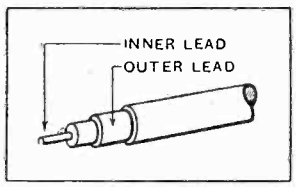


Fig. 6.—The ideal form of receiver connecting wire. It consists of concentric conductors as a wire and tube.

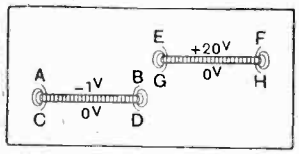


Fig. 7.—Stray capacity couplings must not be overlooked. In this diagram the electric field existing between the wires AB, CD and EF, GH of Fig. 4 is shown.

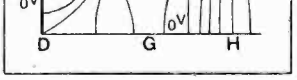


Fig. 8.—Capacity coupling exists between the grid and plate of the third valve of Fig. 4. This is, however, limited when GH, which is earth connected, is close to EF.

In Fig. 7 there is practically no capacity coupling between the anode lead E F and the grid lead A B. The variation of grid potential from zero is much less than that of the anode, so that there is little tendency for the field from E F to spread out to A B, while there is a conductor (G H) at zero potential much nearer to E F than is A B. With the normal wiring arrangement of Fig. 8, on the other hand, there appears a considerable capacity effect between the anode wiring E F and the grid wiring A B. The field from the former ends to a large extent on the latter, as it is near zero potential and also closer to E F than is the common L.T. bus bar D H. Thus, as stated above, the position of the −L.T. bus bar controls to quite a large extent the capacity interactions of the "live" parts of the circuits. Quite small changes in the location of the so-called "dead" wires of the receiver may lead to extensive changes in the electric field distribution.

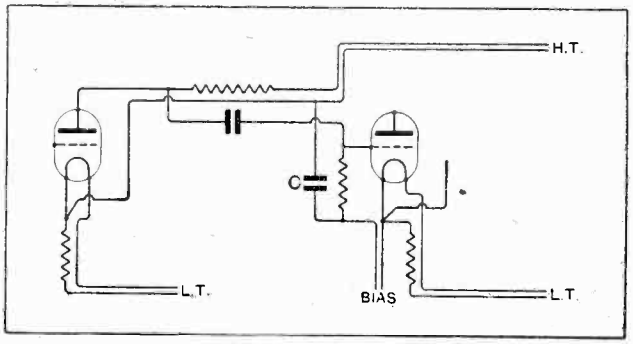


Fig. 9.—Modified interstage resistance coupling. The condenser C is introduced between the negative H.T. lead and the filament end of the grid leak.

De-coupling Wiring for Grid Leak Capacity Couplings.

With these couplings, which comprise the tuned anode circuit for H.F. amplification and choke or resistance couplings for L.F. amplification, the various A.C. circuits cannot be kept entirely separate. The reason for this is, of course, that the grid leak must be common both to the grid circuit of one valve and to the anode circuit of the preceding valve. With these circuits it is preferable to complete the anode circuit path through the leak by means of a condenser, as shown at C in Fig. 9, connected between the negative bias lead and the H.T. lead returning to the preceding valve filament. The complete wiring for this type of coupling is shown in Fig. 9. The connections are very nearly the same as one is familiar with in the normal diagrams for a stage of resistance-capacity coupling, the differences being:—

(1) The negative L.T. (and also the +L.T.) terminals of the valves are not joined together directly, but are given independent close run, go and return, paths to the battery terminals.

(2) The H.T. has also a separate close run circuit, the negative H.T. connection ending at the negative L.T. terminal of the first valve holder. This wire must be run as close as possible to the positive H.T. wire right through to the actual anode terminal of the valve holder. It must also be run very close to the

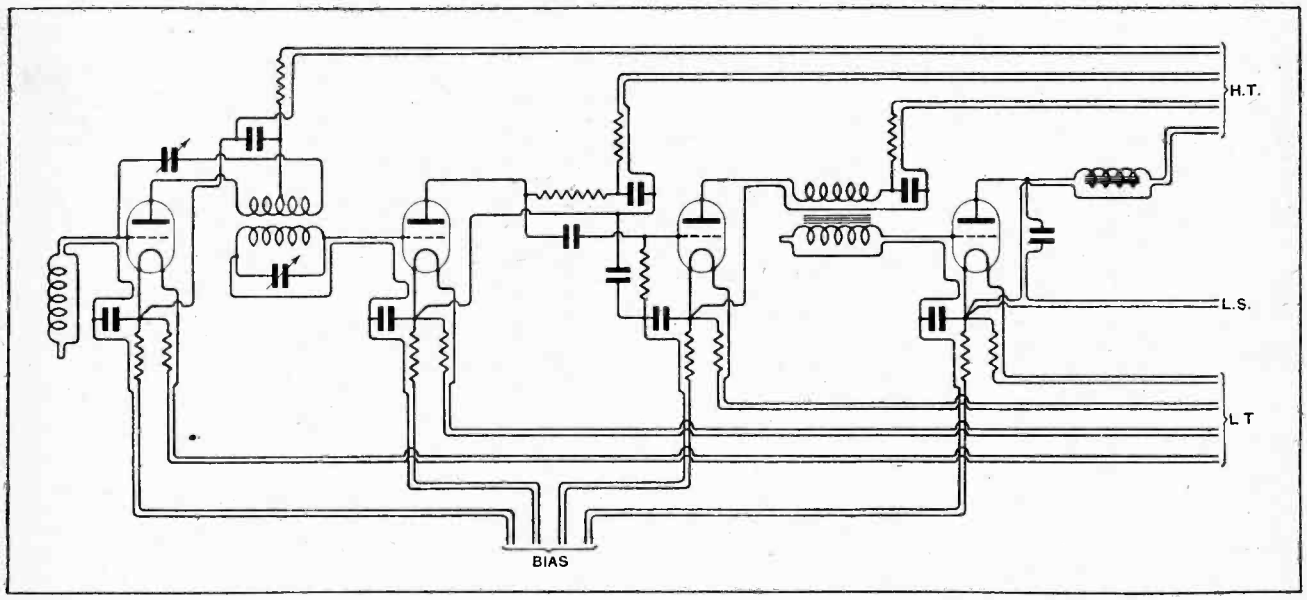


Fig. 10.—Method of wiring four-valve receiver in order to eliminate stray inductive and capacitative couplings as well as removing the coupling effect arising from battery resistance.

cross wiring from anode to grid. In actual practice the latter wiring would be completed first, and the H.T. wires deviated if necessary in order to shadow the anode grid wires.

(3) The return cross connection between the valves is supplied by a condenser wired as close as possible to the leak wiring and joined to the negative H.T. lead close to the point at which the leak is joined to the grid wire.

(4) The grid bias is given an independent go and return path of close run wiring.

(5) Each filament resistance is connected in series with the *negative* lead of its proper circuit and not in the usual position. This does not lead to any disturbance of the grid potential if the resistance is altered, as would be the case with the normal connections were the resistance transferred to the negative side of the filament leg.

Common Battery Receivers.

While the methods outlined above, when carefully applied, eliminate practically all undesirable couplings due to the internal wiring and to the battery leads, there remains the resistance coupling due to the batteries (or mains units) themselves when common H.T. and bias supplies are used. The most practicable method of eliminating the effect of this coupling has been given in *The Wireless World*,[1] and this method is shown in Fig. 10, applied, as an example, to a four-valve receiver using the de-coupling system of wiring.

As this article is merely intended to illustrate certain wiring principles, no constructional details, or values of such components as condensers and resistances are given. With suitable values of components multi-valve sets wired on the lines of Fig. 10 may be built for very large amplifications to run satisfactorily from a single H.T. bias and L.T. supply. The process of wiring a set on these lines is easy and rapid, and mistakes are less likely to occur as the circuits can be wired one at a time completely and independently; the method gives also complete flexibility as regards the battery supply to any single valve or group of valves, a point of interest to the experimenter.

In conclusion, the author many mention that he first tried out the system described above some two years ago in a ten-valve supersonic heterodyne receiver. Using common batteries and a negative bias on all valves (the least value used was three volts on the H.F. and intermediate frequency amplifiers) the set was unusually stable.

[1] "Low Frequency Oscillation," Jan. 4th, 1928.

CATALOGUES RECEIVED.

The Tudor Accumulator Co., Ltd., Parnmeadow Works, Dukinfield, Manchester. Complete illustrated list of all radio batteries, including slow-discharge and unspillable cells.

The Eton Glass Battery Co., 45, St. Mary's Road, Leyton, London, E.10. Booklet describing "Eton" wet-cell H.T. batteries with porous pots and sac elements; fully illustrated, with data in connection with chemical reactions taking place in the cells and discharge tests.

A. F. Bulgin & Co., 9-11, Cursitor Street, London, E.C.4. Illustrated 1928 catalogue of "Decko," "Deckorem," and "Competa" components and accessories.

J. Dyson & Co., Ltd., St. Stephens' House, 2, Coleman Street, London, E.C.2. Illustrated leaflet of "Godwinex" radio sets, "Microtune" condensers and "Airmax" low-loss coils and H.F. chokes.

R. I. & Varley, Ltd., 103, Kingsway, London, W.C.2. Illustrated leaflet with 16 circuit diagrams showing how to connect the new R.I.-Varley components.

Ferranti, Ltd., Hollinwood, Lancashire. Leaflet showing current-carrying capacity and prices of Ferranti power resistances.

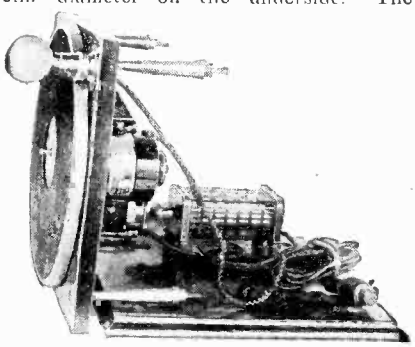
NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

"ERA" GRAMOPHONE MOTOR.

This electric motor is of French manufacture, and is obtainable in this country from The Cromwell Engineering Company, 81, Oxford Avenue, Merton Park, London, S.W.20. It is suitable for A.C. or D.C. mains, and the price is £10 for a supply voltage of 115. For voltages between 115 and 250 a variable resistance can be supplied for an additional 15s.; this may be seen in the accompanying photograph in which the motor and turntable have been detached from the baseboard.

The turntable is a machined aluminium casting with a raised driving rim of about 6in. diameter on the underside. The



"Era" universal electric gramophone motor with variable resistance for voltages from 115 to 250.

motor itself is pivoted and a rubber friction wheel is held in contact with the driving rim, the tension being applied by a light coil spring attached to the carcase of the motor. The advantage of this method is that the motor is under constant load, the speed regulator being driven off the turntable spindle. The governor is of the friction type used in clockwork motors.

A resistance lamp in series with the motor protects the windings from short-circuit and gives excellent current regulation. When running normally the current is 0.4 amp and this rises only to 0.41 amp. when the motor is deliberately stopped by hand; the starting current is, therefore, only 10mA, higher than the normal running current, and the current while playing must lie somewhere between these limits.

A test of several hours' duration showed the motor to be cool running and silent.

o o o o

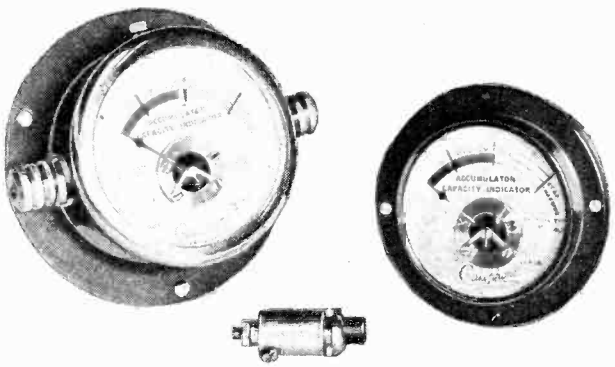
TRIX VALVE HOLDERS.

Two new types have recently been introduced by Messrs. Eric J. Lever, Ltd., 33, Clerkenwell Green, London, E.C.1. The Red-Leg Rigid type mounted

Trix "Rigid" and "Anti-microphonic" valve holders.

on a square moulded base is provided with hexagon nut terminals, and the legs are insulated with red and black sleeves, the red sleeve indicating the anode.

The other type is the Anti-Microphonic valve-holder which sells at 1s. 3d. Connections may be made to terminals or soldering tags, both of which are provided. The suspension springs are integral with the soldering tags, and the riveted joints to the sockets are soldered over to ensure continuity. Stops are provided to limit the movement of the holder when withdrawing a valve.



"Chakophone" accumulator capacity indicators for H.T. and L.T.; both switch-board and flush mounting types are shown together with one-hole fixing push switch.

ACCUMULATOR CAPACITY INDICATORS.

Assuming that the acid in a lead accumulator cell is of the correct specific gravity, the terminal voltage of the cell may be taken as an indication of the state of plates; thus a fully-charged cell has an E.M.F. of just over 2 volts, which falls to 1.8 in the discharged condition. A voltmeter may, therefore, be used to indicate the condition of an accumulator, and this principle has been made use of by the Eagle Engineering Co., Ltd., Eagle Works, Warwick, in their series of "Chakophone" accumulator capacity indicators. The scale, instead of being calibrated in volts is sub-divided into three regions marked "Low," "Medium" and "Full," each band being given a distinctive colour. A simple test revealed that the red or "Low" region covers a range of 1.5 to 1.7, the orange or "Medium," 1.7 to 2.4, and the blue or "Full," 2.4 to 2.7 volts per cell. The latter range, representing maximum potential, is for use while the battery is on charge, and indicates when the charge should be stopped.

The full-scale current is about 100 mA. so that it is inadvisable to leave the meter permanently connected across the batteries. In the switchboard type a press-button is incorporated in the top of the instrument, and a separate one-hole fixing push-button is included with the flush-mounting type.

The L.T. type gives ample warning before the filament current runs down, and the H.T. type must be the means of saving many accumulator H.T. batteries from ruin; too often a battery is left in service until signals fade away and three or four complete discharges of this nature are sufficient to damage the small plates beyond repair.

News from All Quarters: By Our Special Correspondent.

A New "Flying Squad."—Broadcasting the Derby.—International "S.O.S." Calls.—The Talks Syllabus.—More About Continental Relays.

A New B.B.C. Van

To the fleet of B.B.C. vehicles now roaming the country on various duties, such as the measurement of signal strength and the conveyance of amplifying equipment, there is now added a new van of singular interest. I hope to be able to say more about it next week, but in the meantime I am permitted to state that this van introduces new methods in the development of outside broadcasting.

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Flying Squad of the Future.

The need of such a van has more than once been pointed out in these columns. Some form of mobile microphone and amplifier plant, capable of being transported at a moment's notice to the scene of a good "news-story," is essential if outside broadcasting is to occupy an important place in the programmes of the future.

The ideal "O.B." arrangement would provide for a B.B.C. flying squad equipped with a number of high-speed vans carrying short-wave transmitters.

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Staggering Possibilities.

The new van is not a wireless transmitter, but is designed for linking up with the nearest telephone line and thence with Savoy Hill or the local main station. The need of a telephone line may restrict the van's usefulness to some extent, but even so, its possibilities are rather staggering, not to say embarrassing.

o o o o

Scouring the Country.

In effect, the "O.B." department might develop into a great eavesdropping organisation scouring the country in competition with the newspapers to provide the public with ears on the spot wherever an accident or some other event of human interest occurred.

Luckless passengers stepping off ocean liners at Liverpool or Southampton might be asked to "say a few words" into the gaping microphone, and there might come a time when an "O.B." van would follow hot on the heels of every ambulance and fire engine.

FUTURE FEATURES.

London and Daventry (5XX).

APRIL 29TH.—Band Concert and Vocalists.

APRIL 30TH.—"The Rheingold," relayed from Covent Garden. (Act I.)

Daventry Experimental (5GB).

MAY 1ST.—"May Day" or "The Little Gipsy," a musical play by David Garrick and Arne, revised and adapted by Julian Herbage and Perceval Graves.

MAY 2ND.—Vaudeville Programme.

MAY 3RD.—Military Band Concert and Vocalist.

MAY 4TH.—"Duffy," a play by R. Morton Nance.

MAY 5TH.—Eye-witness Account of the British Hard Court Championship Finals (from Bournemouth). Light Orchestral Music.

APRIL 29TH.—String Orchestral Programme and Soloists.

APRIL 30TH.—Ballad Concert.

MAY 1ST.—The Royal Philharmonic Society's Eighth Concert relayed from the Queen's Hall, conducted by Sir Hamilton Harty.

MAY 2ND.—"Feed the Brute," a play by George Paston.

MAY 3RD.—Arts Theatre Club Concert.

MAY 4TH.—Vaudeville Programme.

MAY 5TH.—Recital by Mark Raphael (baritone) and Edward Isaacs (pianoforte).

Cardiff.

APRIL 30TH.—Light Orchestral Concert relayed from the National Museum of Wales.

Manchester.

MAY 1ST.—"Manchester Man and Liverpool Gentleman," a debate between Sir Edwin Stockton (Manchester) and Sir Arnold Ruston (Liverpool). Chairman: Mr. Ben Turner.

Newcastle.

MAY 1ST.—"Robbery," a play by John English.

Broadcasting the Derby.

On the other hand, the broadcasting authorities might exercise a wise restraint in handling the new facilities and thus save the pastime of listening from becoming a waking nightmare.

During the coming summer the new van will deal chiefly with sporting events. It will probably be used to give us a realistic picture of the Derby.

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The Secret Out!

From a Dublin paper:—

"The fact is simply this, and it may be a fact which broadcasters in general do not much appreciate, and, therefore, say very little about, that what is really wanted to make broadcast programmes a success, and, indeed, the only thing that is wanted, and the only thing that can make broadcasting a success in the future, is *Excellence*."

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Controversy!

Controversy of the most vitriolic kind is not unknown on the football field, so it seems likely that the debate on "Association Football," to be broadcast from Newcastle on May 4th, may have some exciting moments. The protagonists are the captains of the Newcastle United and Sunderland teams respectively.

I think a referee might have been introduced to make the sparks fly and take the final knock-out.

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Poultry.

Poultry-lovers—do people *love* poultry?—should make a point of listening to a series of talks from 2LO on poultry-keeping, beginning on May 3rd. The speaker will be Mr. F. Y. Broomhead.

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Cecil Lewis's Scottish Disciple.

One of the most interesting of the many experiments that have been made in the technique of writing or adapting plays or stories for microphone presentation was that which the well-known radio playwright, Cecil Lewis, made in his narrative-cum-dramatic adaptation of Conrad's famous novel, "Lord Jim," which

had a "repeat" performance from 2LO the other night. In Mr. Lewis's hands this idea of a straightforward story told by a narrator before the microphone fading suddenly here and there into scraps of drama which are played out and give place again to the voice of the narrator so that the thread of the story is carried unbroken through the whole production, has achieved a striking success. Hitherto the idea has not been followed to any great extent, but a successful Scottish writer for the microphone, Arthur Black, has adapted it in his latest production, "Sandy McRowe," which is to be performed in the Aberdeen studio on May 8th by the Aberdeen Radio Players.

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Evensong in Edinburgh.

During the summer months the Edinburgh station is to relay the Evensong service from St. Mary's Cathedral, Edinburgh, on Thursdays, at 4 p.m., instead of the service from Westminster Abbey. The first broadcast is on May 3rd.

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S.O.S. Messages.

The recent broadcasting from 2LO of an S.O.S. message in Italian for the benefit of a traveller in Italy calls to mind the international value of distress calls and the steps which are being taken towards securing reciprocity among the nations.

The Union Internationale de Radiophonie at Geneva is giving attention to the question, and it is probable that at the next meeting a plan will be devised whereby the countries of Europe will be able to co-operate.

Under this plan an S.O.S. from, say, Clapham, to a wanderer in Berlin, would be passed on by the B.B.C. to the authorities at Koenigswusterhausen and broadcast from that station. The B.B.C. would, of course, reciprocate in the case of S.O.S. calls from Germany for people believed to be in England.

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An Interesting Revival.

"Feed the Brute," a one-act play by George Paston, will be broadcast from 5GB on May 2nd. It was first produced at the Royalty Theatre, London, twenty years ago.

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The Talks Programme.

Talks and lectures to be given from B.B.C. stations covering the period up to July are described in a new syllabus just issued. Listeners who succumb to wanderlust at this time of the year should find a special interest in the series of talks on Tuesday afternoons entitled "Holidays Abroad," and the six talks, starting on April 21st, on "Holidays in Britain."

Other subjects to be dealt with include "Common Garden Animals," "Finance in the Modern World," "The Psychology of Food and Dress," "Modern Transport," and "Chemistry in Daily Life."

Several well-known names figure in the syllabus, including those of the Right Hon. Philip Snowden, M.P., Mr. J. M. Keynes, and Edward Shanks. Reappearing in the syllabus are the familiar names of Sir Walford Davies, Basil Raine, Desmond MacCarthy, James Agate, G. A. Atkinson, and Percy Scholes.

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Continental Relays.

Postal experts of many countries are meeting at the Hague this week to consider, among other things, the establishment on the Continent of a network of telephone lines to facilitate the international exchange of broadcast programmes.

At the present time a Continental relay of the kind we sampled last month can only be staged after rather wearisome negotiation in regard to the use of and payment for the various telephone lines involved. The representatives at the Hague hope to simplify the business by standardising the arrangements as far as possible, giving every nation an opportunity to avail itself of foreign talent at short notice.

Mr. Arthur Burrows, of the Union Internationale de Radiophonie, is attending the meeting.

MUSIC IN FLEET STREET. The "Everyman Portable" picking up the 2LO lunch-hour programme.

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Money from Music.

I wonder how many listeners, looking back over the last two or three years, have discovered that the B.B.C. programmes have helped them to make money. Among these listeners I do not include the millionaires in the wireless trade, but the ordinary people, described so brilliantly in the B.B.C. education report as those who feel disinclined in the evenings to do more than go home, smoke a pipe, read the paper, or play a quiet game.

Can they cock a knowing eye towards a well-darned family stocking filled with sheckels? Can they say: "The Beethoven symphony on Wednesday last brought in 5s. 11½d."? or "Schubert is always good for a shilling"?

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New Vistas of Prosperity.

I confess that this aspect of musical experience had not been brought home to me until a day or two ago when I picked up a Canadian radio journal which opened up new vistas of prosperity on the very first page.

A writer, animadverting on the cheapness of radio reception, dwelt upon the ennobling influence of good music. "From it comes a new outlook on life. Probably the good in their (the listeners) character is strengthened and their material ambitions aroused in the determination to get more money so as to be able to see more of the good things in life."

So give us good music, Savoy Hill, and plenty of it!

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An Ambitious Scheme.

The B.B.C. announces that it is proposed to give at the symphony concerts of the newly constituted National Orchestra of Wales every classical and modern work worth performing; but the programmes will be so arranged that regular patrons may have as much variety as possible. Thus, in one week a classical symphony concert will be given, in the next a modern symphony, in the following week a standard symphony concert, and then a special concert to include either a new symphony or a collection of new works.

Throughout the present six-weeks' season concerts are being given in the National Museum, Cardiff, as follows: Monday, 1.0-1.45 p.m.; Tuesday, 4.0-5.0 p.m.; Wednesday, 1.0-1.45 p.m.; and Saturday, 12.0-12.45 p.m. The concerts in the City Hall, Cardiff, will take place on Thursdays and Saturdays from 7.45 to 10.0 p.m.

The public is to be admitted free of charge to the National Museum Concerts, while popular prices will be charged at the two-a-week evening concerts in the City Hall. All the mid-day and afternoon concerts will be broadcast from the Cardiff station of the B.B.C., and the majority of the evening concerts, or parts of them, will also be broadcast from the Cardiff and Swansea stations, with occasional relays to Daventry (5GB).

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A "Grand Little Opera."

Listeners may recall the charming music of Alfred Reynolds in "Lionel and Clarissa" and "Riverside Nights," both of which have been broadcast from 2LO.

A programme of his works will be heard from Belfast on May 2nd and will include "The Policeman's Serenade," described as a "grand little opera," and his settings to A. P. Herbert's witty "She Shanties."

LETTERS TO THE EDITOR.

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

Correspondence should be addressed to the Editor, "The Wireless World," Dorset House, Tudor Street, E.C.4. and must be accompanied by the writer's name and address.

"ELECTRIC SUPPLY."

Sir,—Your correspondent "John Bull's" readiness to find a grumble certainly justifies his choice of a *nom de plume*, and it is surprising that one who uses it should not realise that the "fine profit" about which I am supposed to be "bubbling over" is more apparent than real, since I can hardly realise it in cash without sacrificing the convenience and cheapness of mains H.T. supply.

I could bear this imputation against my common sense with fortitude, but modesty compels me to disclaim the credit for having got something for nothing out of a *municipal* authority! The Supply Company is merely a dividend-paying concern managed by business men to whom a saving in transmission costs is presumably well worth a few guineas' worth of apparatus here and there—an "impression" which "John Bull" will perhaps admit to be strengthened by the fact that in future we are to pay 1d. a unit less for our light.

If this does not "encourage" him, perhaps he will find a grain of comfort in the news that at the moment the gift eliminator is out of action! "SATISFIED.

Barnet.
April 11th, 1928.

Sir,—With regard to the letter in your issue of April 11th from "John Bull," as a very old reader I have always enjoyed the spirit of the letters in the correspondence pages and their freedom from bitter personal attacks.

I do think "John Bull's" letter reads like "sour grapes."

I do not know who "Satisfied" is, but I feel sure that his letter was not intended as an outlet for his "bubbling glee" on having his apparatus exchanged.

In any event, "John Bull's" conclusions are not necessarily correct.

If I am not mistaken, Barnet is supplied by the North Metropolitan Electric Supply Co., which is not a municipal trading body at all, and has no direct connection with ratepayers, as such.

Secondly, "Satisfied" is entitled to be placed in the position he enjoyed prior to the change-over from D.C. to A.C. regardless of whether his existing apparatus was worth one-tenth or one-hundredth part the commercial value of the new apparatus. As "John Bull" probably knows, these change-overs are not made by any hasty decisions of the suppliers, but only after long and careful consideration of the present and future capital and trading expenditure of the undertaking.

In conclusion, I should not be surprised, even although "Satisfied" is now the proud possessor of £10 10s. worth of apparatus plus an A.C. supply, that he is getting better, or even the same, results as he got with his home-made apparatus and a D.C. supply. J. H. MURISON.

London, N.8.
April 11th, 1928.

IS 5GB A SUCCESS?

Sir,—When the Birmingham Station—5IT—was working I never used more than two valves, detector and 1st L.F., on a three-valve set. I obtained full L.S. strength on a B.S.A. Kone. I now have a latest model five-valve set, and from the *five* valves I do not get as much power from 5GB as I did from 5IT on two. I now think that the thousands of wireless enthusiasts in Birmingham and district who have small sets certainly have cause for complaint. I can also endorse "W. H. McMillan's" observation on fading. It is more the exception than the rule to obtain ten consecutive minutes level strength.

Birmingham. SCHOOLMASTER.
April 4th, 1928.

5GB PROGRAMMES.

Sir,—I should like to endorse the whole of your correspondent Mr. W. H. McMillan's remarks on the transmission of 5GB as received in this district.

For scientific research into the phenomenon of fading, the Daventry Experimental station as an example would be ideal, for the manifestation is truly terrific during the hours after sunset, fading, as your correspondent mentions, from a distorted, almost inaudible minimum to a strength sufficient to overload a super power valve with 150 volts on the plate, and recurring every two or three minutes.

From what I have heard, this fading appears to affect a considerable area of the densely populated districts of Lancashire, making the value of the alternative programmes practically nil to listeners therein.

Surely this state of things does not warrant expressions of satisfaction with the working of 5GB from the chief engineer?

Blackpool, Lancs. A. K. McLERIE.
April 4th, 1928.

TALKS.

Sir,—I must congratulate Mr. F. G. Sackett on his excellent letter on this subject in your issue of April 4th. Let those who seek information—read, and let us listen to our music.

I was astonished at the article by Herr Lion Feuchtwanger in *The Radio Times* of March 30th.

He states rather dogmatically that the future of broadcasting lies in talks, but gives no good reason for his opinion.

I hope and feel confident that he is wrong. The only times when I have felt differently have been when Mr. James Stephens has read his stories to the microphone, but this is an exceptional case; Mr. Stephens' voice and diction are so individual that half the pleasure would be lost in the printed word.

Reading. MARGERET HOUSE.
April 4th, 1928.

B.B.C. DISTORTION.

Sir,—I have just read Mr. P. W. Parr's letter in to-day's issue, and I quite agree with what he says about 2LO. I have always, for over twelve months, found this station's quality so bad that speech is frequently unintelligible, and everyone to whom I have spoken about it has noticed the same thing.

I should like to know if anyone can explain the following "B.B.C. mysteries."

Why is the tone of the announcer quite different from 5GB and 5XX during a simultaneous broadcast such as the first news bulletin?

Why do German stations of similar power to the B.B.C. main stations come in at greater volume and with as good, if not better, quality?

Why is the strength of 5GB not as good as when transmissions first started? The strength here on a crystal set with a good outdoor aerial is not as good as 5XX on a short indoor aerial. J. H. BALLENY.

Birmingham.
April 4th, 1928.

Sir,—Could you tell me why British transmissions are subject to blasting in spite of violent modifications of output effected in the control room. On the other hand, I can run a German station at a much greater volume than I ever run 2LO, and a broadcaster can howl, shriek, and shout and there is no blasting and no cutting off in the control room. Is it the German microphone or their amplifier which is so vastly superior to ours, or is it the general technique of their transmission?

On the subject of the control room, is it not possible to set the amplifier so that it will not blast on the loudest transmissions and leave the modification in volume to be made by the performers. It must be extremely annoying to a conductor, e.g., Sir Henry Wood to know that his rendering of a piece of music is subject to variation (a) by the limitations of the microphone and (b) by the interpretation placed on the music by some unknown amateur in the control room.

Is it still necessary for the sake of the crystal user to transmit the announcers at about the strength of a brass band. Surely the reception end of broadcasting has now advanced to a point

when some relation might be maintained in the volume at which we receive various classes of matter transmitted. C. H.
Sutton, Surrey.

THE L.S.5 BRIGADE.

Sir,—I note in your issue of April 4th a letter from "Flux," who mentions a statement of mine made in a lecture at Manchester that "to obtain good loud-speaker reproduction the volume should make conversation practically impossible." This is, of course, an isolated statement forming part of a longish argument; and I feel that I should like to explain just what was meant.

I was developing the thesis that to obtain *perfect* reproduction it is necessary to work at the same volume as that at which the original performance was heard. I was very careful to explain that this was theoretically impossible for a small room, and that the people who preferred to have a sort of miniature picture of the performance were perfectly entitled to their view, but that of course such a miniature picture could not be considered a reproduction: it is a very delightful theme, but it did not happen to be what I was talking about.

Replying to the main point of your correspondent's letter, which is his view that it is not really sound to use a high-power set for low-power purposes, this must obviously depend upon the point of view. If one is after high electrical efficiency in the strict sense of the word, it is, of course, a foolish procedure. Nevertheless, I recommended it very strongly in my lecture; and I now repeat that recommendation for two reasons: (1) if one has a high-power set, one can reproduce at high volume on occasions when it does appear desirable; (2) the use of a high-power set for low-power work, although not economical nor strictly efficient, does lead to a very great improvement in quality, for reasons which I think are fairly well known by now. P. K. TURNER.
Crofton Park,
April 3rd, 1928.

Sir,—With reference to letter under the above heading, the views expressed therein very largely agree with my own.

Being—from this point of view—rather fortunately situated in relation to 5XX and 5GB, I get consistently good results on two valves, detector and one L.F. transformer-coupled, using D.E.5B and D.E.5A valves, a high-class L.F. transformer and plenty of H.T. from mains.

This set works a "Wireless World" moving coil loud-speaker at a comfortable strength when the transmissions are up to full value. P. DANSIE.
Coventry,
April 3rd, 1928.

Sir,—I agree with your correspondent "Flux" when he suggests that a loud-speaker should allow the ear to receive the same intensity of sound as it would pick up in, say, the concert hall wherein the broadcast originated. But does he realise what this intensity is?

To give a crude example, the intensity of sound produced at the back of the Queen's Hall by an orchestra playing loudly is enough to cause the programme sheet in one's hand to quiver sensibly. I trust that "Flux" does not require his P.M.6 to cause this amount of noise, even from his good cone speaker. He is probably content with much less sound; and he finds the balance is not apparently upset; but he is wrong. Unfortunately the ear is not uniformly sensitive to all frequencies, and as intensity is reduced, a given "spectrum" of sound becomes rapidly attenuated in the long-wave region, and the frequencies round about 500 predominate. Let "Flux" take a taxi in the interval of a B.B.C. public concert from the concert hall to a loud-speaker installation, making half a watt's worth of noise, and he will be forced to admit that the orchestral balance is not as he left it.

May I congratulate you, Sir, on the valuable work your paper is doing in increasing the total volume of sound emitted from the loud-speakers of this country. Unquestionably, practice is all that is required for the ear to enjoy broadcasting at a proper volume. I, for one, practise diligently: programmes will rattle in my hand, teacups (if unchecked) on their shelves; and (at the expense, admittedly, of a slight deafness), I have come to find that two L.S.5A's working a sensitive coil-driven cone are better than one. C. E. G. BAILEY.
Kensington, W.14.,
April 3rd, 1928.

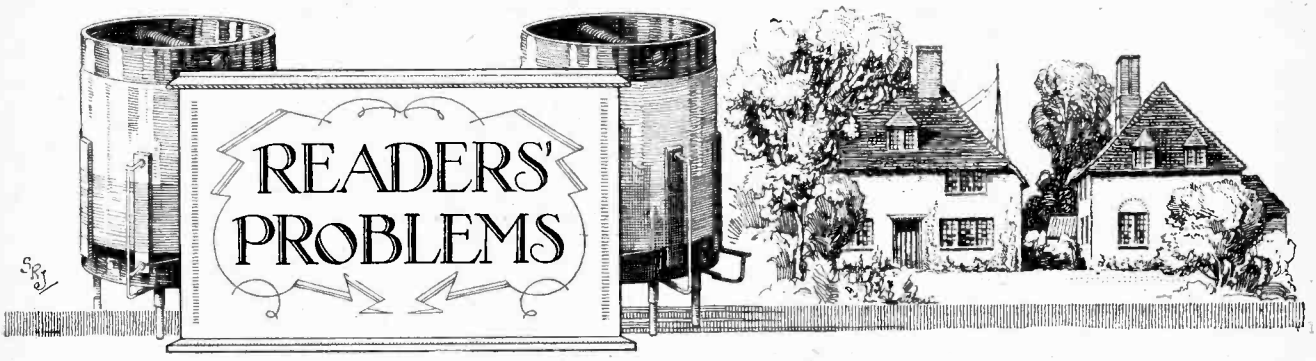
Sir,—Your correspondent who signs himself "Flux" raises a question of great importance to large numbers of listeners. His demand appears so extremely reasonable that it is desirable to examine it closely.

The problem may be restated thus. If we walk away from some large and imposing object (say a hippopotamus or the Albert Memorial) and look at it with one eye, we shall obtain a series of views of diminishing size, all equally accurate in their rendering of colour contrasts. Can we say the same sort of thing about an open-air band performance from which we steadily retreat, stopping one ear? The answer, provided by the American workers on such subjects, is that we cannot. We shall find as we walk away that the changes in actual pressure on the ear are accompanied not only by changes in the loudness, but also by changes in the character of the sound heard. Now, if the charateristics of a given electrical transmission system are really such as to convey to the ear the same intensities of all frequency components as would be heard at some preferred distance from an actual performance, for example, at 30 yards from the band, then for our present purposes we can ignore the American workers and their results and give "Flux" what he wants.

But what are the facts? With the best loud-speakers, free from resonance, the response falls off very rapidly in the bass, and it follows that if a straightforward amplifier with a substantially flat characteristic is adjusted so as to yield "30-yards-from-the-band" volume over the middle and upper frequency range (from which the general loudness will be mainly estimated), the bass will be disproportionately weak, and the result will be condemned as imperfect by a critical ear: "Flux" himself condemns it by implication, in his enquiry as to "whether it is possible to use a moving-coil speaker with small inputs and retain the admitted extra clarity and frequency range of this type of speaker."

Now when the intensity of a complex sound becomes great enough, the effect of the aural mechanism is to bring into greater prominence the lower frequency regions of the sound. Therefore, by increasing the overall intensity of reproduction, we shall improve the balance. This, I think, is the reason for the attitude taken up by the adherents of large volume, of whom, for the reasons given above, I am one. With loud-speakers having a certain amount of true bass, free from resonance, the argument may lead one to reproduce at a volume level actually greater than one might choose to hear during the actual performance, but with many types of reed-driven cone instruments having considerable resonance near the bass, a much lower level would give the best results.

We can now attempt to answer "Flux's" enquiry about moving coil loud speakers with small inputs (*very* small inputs, by the way, to judge from his figures!). In order to retain the correct proportion for "30-yards-from-the-band" audition it would be necessary with existing moving-coil speakers to intensify the bass in the amplifier, a process which could be achieved by putting up the whole gain of the amplifier and then deliberately suppressing all but the lowest frequencies. Such a course would obviously only commend itself to those who, like your correspondent, object to the actual volume, rather than to the expense of high power equipment. And it should be remembered that such an arrangement would labour under the same difficulties as all others inasmuch as the correct balance can only be obtained for one particular intensity, *i.e.*, if it is right for a band it will be wrong for a vocalist. We should have to re-cook the amplifier for each item. Nothing that we can do will give us correct results unless we have an absolutely perfect loud speaker *and* make a practice of reproducing everything at studio level, retreating from the loud speaker until the volume suits us. This, of course, is impossible to achieve at home, or anywhere else for that matter, and we all put up with results which are necessarily imperfect. But that even so the very finest results are attained by getting as near as we can to this condition is the considered opinion of
South Kensington. TENWATT.
April 7th, 1928.



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 interests 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.

Low-frequency Reaction.

My two-stage resistance amplifier worked well when first constructed, but recently an annoying fault has developed; signals from the local station vary in strength, with a more or less regular time interval between the periods of fading. It seemed to me that this was probably due to a high resistance connection or to a faulty anode resistance. However, a careful point-to-point test fails to reveal the trouble, and I should be greatly obliged if you could offer any suggestions. W. P. P.

We think it probable that your trouble is due to what may be described as incipient "motor boating." This is probably brought about by the development of a high resistance in the H.T. battery, as we take it from your letter that the trouble did not manifest itself until the amplifier had been in use for some time. We suggest that you cannot do better than apply the anode feed resistance method of preventing L.F. oscillation and "motor boating," which is discussed elsewhere in this week's issue.

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A Source of Leakage.

I have recently obtained a voltmeter and a milliammeter, and when conducting insulation tests with my receiver (a circuit diagram of which is given on the enclosed sheet) was perturbed to find that there is a serious leakage across the L.T. terminals. You will notice that each valve is fitted with a separate rheostat; the insulation of each of these appears to be perfect, and no current passes when they are turned to the "off" position. Can you give me any idea as to how to search for the trouble, as the leakage must impose a continuous drain on my L.T. battery? G. E.

You have neglected the fact that, according to your diagram, the potentiometer used for controlling the detector grid voltage is connected across the L.T. bus-bars, and, as there is no battery on-off switch, current will flow through its winding even when the valves are switched off. We do not think that there is any fault in the set, but as it is, of course, undesirable that the L.T. battery should be continuously discharging itself through the potentiometer, we suggest that you should fit a switch in the L.T. positive lead: or, more simply, that you should join the potentiometer resistance across the filament terminals of the detector valve instead of across the battery leads. This alteration is shown in Fig. 1, in which the present connections of your potentiometer are indicated by dotted lines, and the recommended alteration in full lines.

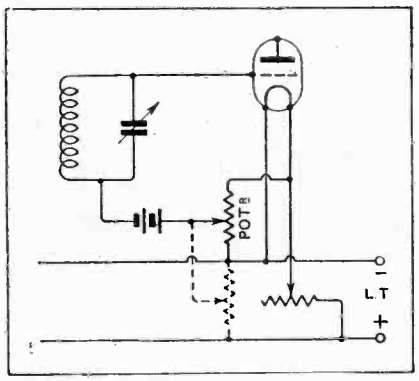

Fig. 1.—Modified potentiometer connections.

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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L.T. from A.C. Supply Mains.

My receiver is fitted with 2 L.S.5.A valves in parallel as an output stage, and in view of the heavy filament current taken I propose to derive this from the A.C. supply mains, using a step-down transformer. Is this likely to prove satisfactory, please, as I have not seen this advocated in your journal? H. B.

It is practicable to light the filament of a last stage amplifying valve from unrectified A.C., provided the valve used has a thick filament. It is necessary, however, to take precautions to keep the supply leads as far away as facilities will permit from grid wires oscillatory circuits, and we suggest that it would be advisable to employ twisted flex or parallel wires in close juxtaposition to each other for the filament wiring.

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A Balanced Armature Unit.

I have built up the straight logarithmic horn described in your issue of November 23rd, 1927, and am now looking for a suitable unit to use in conjunction with it. I notice that in the article it is suggested that a balanced armature movement will give best results; can you tell me where such an instrument may be obtained? M. S. L.

To the best of our knowledge, there are no balanced armature units sold in this country in a form suitable for use with a horn loud-speaker. However, good results will be obtained if you use an ordinary unit.