The Wireless World AND RADIO REVIEW

(14th Year of Publication)

No. 388. WEDNESDAY, FEBRUARY 2ND, 1927. VOL. XX. No. 5.

Assistant Editor: F. H. HAYNES. | Editor: HUGH S. POCOCK. | Assistant Editor: W. JAMES.

Editorial Offices: 139-40, FLEET STREET, LONDON, E.C.4 - - Editorial Telephone: City 4011 (3 lines).

Advertising and Publishing Offices: DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.

Telephone: City 2847 (13 lines). Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street. *Telegrams:* "Cyclist Coventry." *Telephone:* 5210 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street. *Telegrams:* "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 199, Deansgate. *Telegrams:* "Iliffe, Manchester." *Telephone:* 8970 and 8971 City.

Subscription Rates: Home, 17s. 4d.; Canada, 17s. 4d.; other countries abroad, 19s. 6d. per annum.

IMPROVING BROADCASTING.

THAT the public is not entirely satisfied with the broadcasting service to-day must now be accepted as a positive fact, and it is the duty of everyone who has at heart the desire to see the service maintain its fine record of the past to do whatever is possible to bring about an improvement. It may be coincidence that since the change in authority of the British Broadcasting Corporation, with the commencement of the New Year, the programmes have been the subject of strong comment and criticism, not so much, we believe, on account of the character of the matter broadcast as because of the peculiar arrangement of the programmes which has been introduced since last year. We have already commented on the arrangement of the programmes, and expressed our views, which, we are gratified to find, have been widely supported.

The Talks.

A further examination of changes in the programme since the commencement of the New Year also discloses the fact that the number of talks has increased very considerably. Now we have ourselves no quarrel with talks; we think that they should form an important section of the make-up of the programmes, but the vast majority of the microphone audience is unsympathetic towards talks unless they are given in small doses. We can understand the desire on the part of some of the lofty-minded heads of the B.B.C. to make broadcasting a factor in the education of the nation, but it is an easy matter to err on the side of too rapid progress in this direction.

Popularity First.

First and foremost broadcasting must be popular with the majority, because our aim should be to make it such an attraction that no home will be without a listening set. When this object has been achieved it will then be time to improve the educational standard of the programmes, little by little, as the public taste is cultivated. There is no doubt whatever that since broadcasting started public appreciation of good music has been brought up to a much higher level than it was in the pre-broadcasting days. By this statement we mean, of course, that the average level has been raised, in that music is now appreciated by vast audiences which formerly had little or no ear for good music, mainly for the reason that their ears had never previously had the opportunity of listening to it.

The B.B.C. must make up its mind whether broadcasting is to be a service to the whole nation or whether it is to be a restricted service appealing only to the more highly educated sections of the community. Nothing, in our opinion, would be more disastrous for the future of the service than that the programmes should, by the introduction of too much high-brow matter, result in checking the habit of listening, and perhaps even resulting in the discarding of apparatus already installed.

Other Troubles.

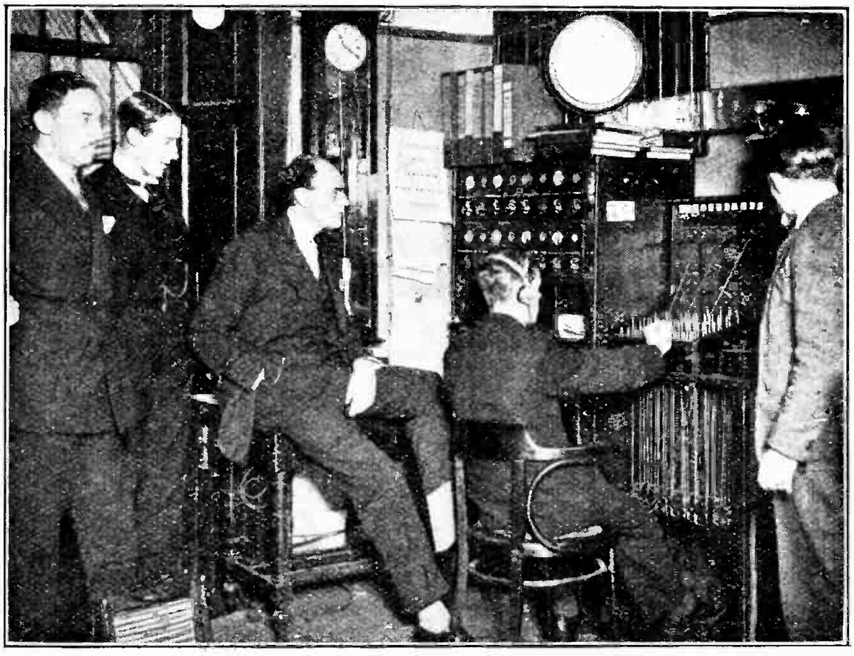
So much for what the B.B.C. may do directly to increase interest in the broadcasting service, but there are other

CONTENTS.

troubles which demand attention, and which are only second in importance to the programmes themselves. We refer to the man-made interference resulting from the ever-increasing number of broadcasting stations and the extension of their power, and, secondly, the ever-present interference from Morse transmissions, particularly those emanating from obsolete spark sets.

Our Early Views Confirmed.

As long ago as July, 1925, we expressed the view that if interference between broadcasting stations was to be limited that state of affairs could only be brought about by insisting on an international limit to the power of broadcast transmitters. Since then we have watched with apprehension the growing tendency in Europe for stations to increase their power in proportion as it was found that foreign transmitters began to interfere with reception. The Geneva Conference did good work in endeavouring to limit the number of stations and in distributing these as far as posible over wavelengths chosen so that interference one with another would be reduced to a minimum. But the time has come when the power of the stations must be considered internationally and a check given to this policy of each station endeavouring to shout down its neighbours. We think it would be reasonably possible to arrive at a standard of power which would allow every station to cover the area allotted to it without its power being such that its range extended far beyond its sphere of operations, as is the case at present. If what may be described as an international broadcasting station is insisted upon by every nation, then this station of high power should be given a wavelength such that it could radiate sufficiently for the purpose in view without interfering with the general schemes of what may be described as local or national broadcasting.



A VISIT TO GLASGOW. Sir John C. W. Reith (centre) in the control room of the Glasgow station; on the left is Mr. G. L. Marshall, station director, whilst standing next to him is Mr. D. Cleghorn Thomson, director of the northern area.

Morse Transmissions.

The other source of trouble, that from Morse interference, like the poor, is "always with us," and it seems as if no steps are being taken to reduce what must, in large part, be unnecessary interruption of the programmes. We are given to understand that when replacements of ship equipment are made valve transmitters are now usually installed, but unfortunately the spark apparatus originally built was not designed on the economical lines of some of our broadcast apparatus of to-day, with the result that many of the spark transmitters, as far as the plant is concerned, will not require replacement for many years to come. The question arises, is it not time that the Post Office obtained authority to insist upon spark apparatus being replaced by valve sets within a prescribed period?

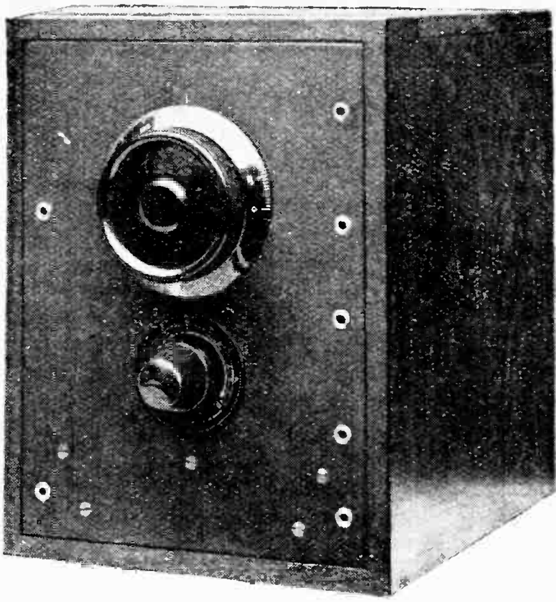
To insist on immediate replacements would probably mean that compensation would have to be paid to the owners of apparatus so scrapped, but this ought not to be necessary if a reasonable period were allowed in which to effect the change-over to more modern equipment. If we knew that in two, or even three, years' time the Post Office would no longer permit spark sets to be used, we should at least feel that we had some measure of comfort and hope, but unless some definite step is taken now we see no prospect for many years to come of uninterrupted reception of programmes for many thousands of listeners, however attractive the programmes may be made.

oooo

THE "EVERYMAN FOUR" RECEIVER.

AT the time when we described the "Everyman Four" receiver, in July and August of last year, we referred to it editorially as "the set of the season," and the interest aroused and the satisfaction which the set has given has more than convinced us of the accuracy of our forecast. Confident as we were of the enthusiasm with which the set would be received, we made arrangements to have a very large number of additional copies available of the issues in which the set was described, but some little while ago we found that these copies were quite insufficient to cope with the demand which there has been for descriptions of the set, and our publishers have therefore made arrangements to produce a booklet describing the "Everyman Four," with complete constructional details. This booklet is published at the price of 1s., or post free from our publishers at 1s. 2d., and is now available.

It has never been our practice in *The Wireless World* to devote much space in the pages of the journal to boosting our own wares, but with every set which we describe we feel that we have the confidence of our readers, who know our policy and are assured of the efficiency of the sets we describe.



SHORT-WAVE UNIT for the Nucleus Receiver

30-100 METRES

An Instrument Adaptable also to other Detector-L.F. Sets.

By H. F. SMITH.

THERE can be little doubt that, as far as amateur reception of telephony is concerned, the most consistent long-distance results are obtained on the short waves. It must not, however, be assumed that the well-known American stations KDKA (Pittsburgh) and 2XAF, with the other relays of WGY (Schenectady) can be received regularly every evening at good strength; there are times when their signals are just as elusive as those on the normal broadcast waveband. For instance, both the stations mentioned seem to have been receivable with extraordinary ease and at great strength during the early part of the present winter, but, in most parts of the country, reports indicate that there was a general falling off in December. At the time of writing we seem to be emerging from this period of bad reception.

The great majority of popular short-wave receivers comprise a regenerative detector with one or two stages of low-frequency amplification. Now the rectifying valve of the "Nucleus" receiver[1] has a high resistance connected in its anode circuit, and for this reason it is not easy to obtain smooth reaction control from it; this trouble is accentuated by the fact that it is operating on the lower bend of its grid volts-anode current curve, so, to obtain the critical and smooth reaction which is absolutely essential for short-wave work, the addition of a separate "reactor" valve is considered necessary. The circuit of the arrangement adopted is shown in Fig. 1, which also makes clear the connections of the detector; these are indicated by dotted lines. Except for the addition of the reacting valve, the system is in every way conventional. A single-tapped coil acts as both the aerial and secondary inductances; the former circuit is "untuned," and the degree of coupling is varied by increasing or decreasing the number of turns between the aerial tapping and the earth connection.

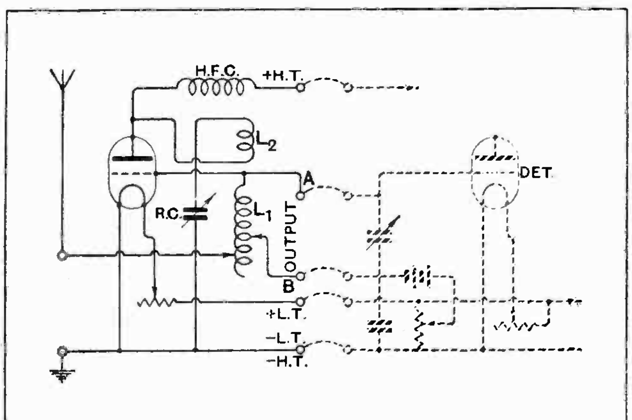


Fig. 1.—The circuit diagram, showing connections to the detector in dotted lines. R.C. = reaction condenser. 0·0002 mfd.

Reaction Control.

The reactor valve is fed with high tension through an H.F. choke, which deflects oscillatory currents through the reaction coil L_2; this is tightly coupled to the tuning inductance L_1, which, it should be noted, is common to the grid circuit of both valves. The intensity of the current passed through the reaction coil (and consequently the amount of reaction) is decided by the setting of the reaction condenser R.C., which may be considered as a variable resistance.

It will be seen that the grids of both reactor and detector valves automatically assume the same voltage, the value of which will depend on the adjustment of the potentiometer and bias battery in the "Nucleus" unit. The first valve should be working on the straight part of its curve, while the second, of course, must be on the bend, so if a common H.T. voltage is to be applied the two valves must obviously have different characteristics. One of the general purpose type, with a moderately high impedance, will be quite suitable

[1] *The Wireless World*, Dec. 1st, 1926.

Short-wave Unit for the Nucleus Receiver.—

for the short-wave unit, assuming that a "high magnification" detector is used, as was originally recommended.

For the sake of uniformity with other units, the panel is somewhat higher than is actually necessary. The baseboard is raised to allow of easier access to the inside of the set, although there are no components mounted on its underside. An aluminium screen is fitted behind the panel to minimise hand-capacity effects, which are always troublesome on the short waves; its construction is shown clearly in Fig. 3. It should be observed that the condenser makes contact with it, but the hole for the rheostat spindle should be sufficiently large to give complete clearance. The screen is in electrical connection with the negative L.T. lead; contact is made by inserting a metal soldering tag between the edge of the baseboard and the aluminium sheet.

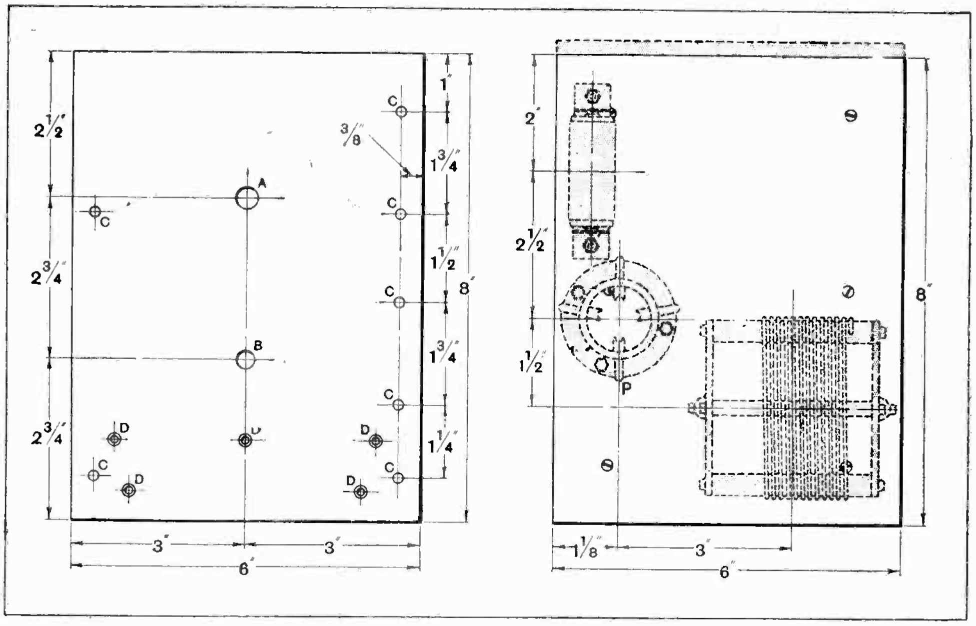


Fig. 2.—Drilling details of the front panel and layout of components on the baseboard. A, ⅜in. dia.; B, 5/16in. dia.; C, 1 B.A. tapped; D, ⅛in. countersunk for No. 4 woodscrews.

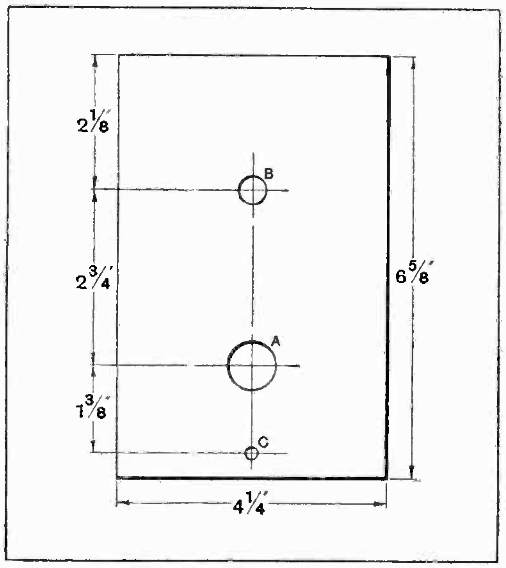


Fig. 3.—Details of the screen, which is of No. 28 gauge aluminium. A, ¾in. dia.; B, ⅜in. dia.; C, 3/16in. dia.

The construction of the coil is clearly shown in Fig. 4. Two ebonite rings, 3in. in external and 2¼in. in internal diameter, are cut with a fretsaw from ⅛in. sheet. Four longitudinal ebonite strips measuring 2¾in. long, ⅜in. deep, and ¼in. thick are prepared. These should be grooved for the coil, the 12 turns of which are spaced by ⅛in. between centres. The grooves in the first strip may start ½in. from the end, in the next 17/32in., in the next 9/16in., and so on, as there is obviously an advance of 1/32in. in each quarter turn. A very shallow groove, ⅛in. wide, is cut at a distance of ¼in. from the last turn to accommodate the reaction winding, which consists of six turns of No. 30 D.S.C. wire, wound in the same direction. The inner end of this coil connects direct to the plate of the valve, while the other is anchored to a soldering tag secured by one of the fixing screws. This connects to the fixed plates of the reaction condenser.

The aerial-grid coil is wound with No. 16 S.W.G.

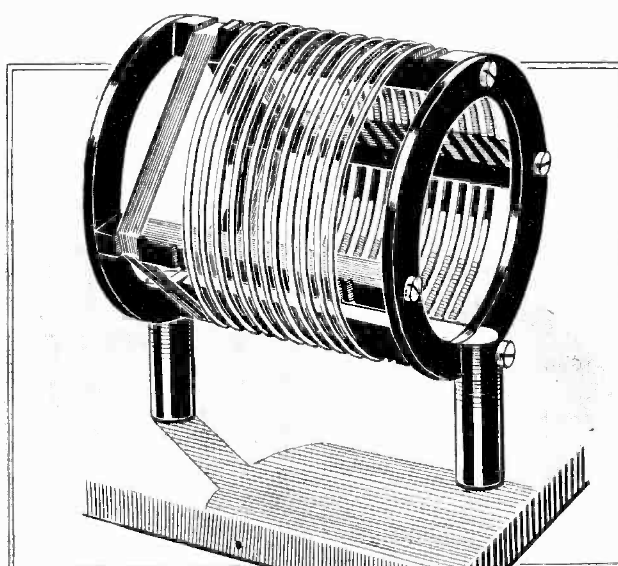


Fig. 4.—Detailed sketch of the aerial-grid and reaction coils.

Short-wave Unit for the Nucleus Receiver.—

bare copper wire (preferably hard drawn), which is stretched till it is quite straight and then cleaned with emery paper. It should now be tightly wound on a cylinder of about 2½in. in diameter, allowing an extra two or three turns. When the coil is removed it will be found to spring out to approximately the required diameter, and may be fitted on the skeleton former.

The construction of the choke is clearly shown in Fig. 5. It carries a single-layer winding of No. 42

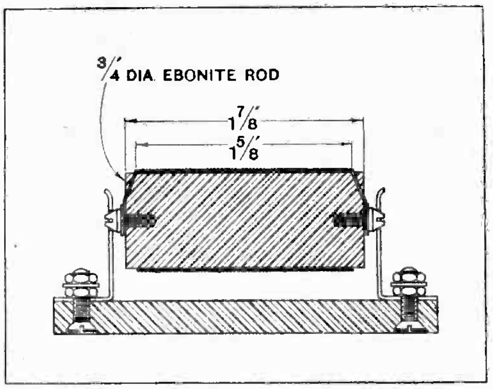


Fig. 5.—Sectional sketch of the H.F. choke coil and its base.

D.S.C. wire, and is supported in tin clips mounted on a small ebonite base measuring 3in. by $\frac{11}{16}$in. wide and ¼in. thick. The heads of the screws securing the clips are deeply countersunk.

The lower surface of the valve holder is raised 1in. above the baseboard by three lengths of ebonite tubing, through which the holding-down screws are passed into the baseboard.

Connecting Up the Unit.

The mounting of the components and the wiring are indicated in Figs. 2 and 7. The majority of the connections are made with No. 18 bare tinned copper wire, flexible leads being used for connection to the clips. These latter should be carefully chosen, as it is essential that they do not short-circuit adjacent turns. It will be seen from the photograph that the junction point between the flexible earth connection and the output terminal B is anchored to a small ebonite block screwed to the baseboard.

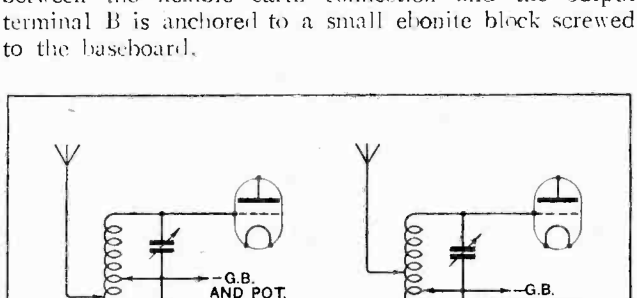


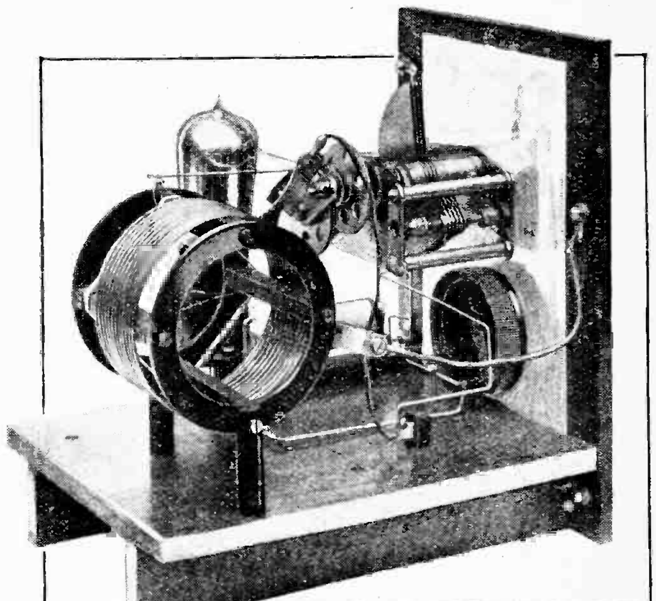
Fig. 6.—Optional aerial and earth connections to the coil.

LIST OF PARTS.

1 Ebonite panel, 6in. × 8in. × ¼in.
1 Cabinet and baseboard (Cameo).
1 Rheostat (Finston).
1 Variable condenser, square-law, slow-motion, 0·0002 mfd. (G.E.C.).
2 Spring clips (Baltic).
1 Valve holder (Excelsior).
7 Sockets (Lisenin).
Ebonite rod, tube, and strip, wire, screws, etc.

Approximate cost - £2 5 0

The unit is connected to the "Nucleus" receiver by bridging adjacent sockets by short leads fitted with suitable plugs; the aerial and earth leads are of course transferred. There is no particular reason why a separate H.T. + lead should not be taken direct to the battery, and this course should certainly be tried if the voltage applied by the inter-connection of the two



Rear view of the set.

positive sockets appears to be excessive for the particular type of valve being used for reaction.

Operating Instructions.

There are two possible methods of connecting the aerial and earth tappings, as shown in Fig. 6. The first (*a*) is perhaps the more effective. For reception on about 60 metres the earth lead should be joined to a point about 8 or 9 turns from the grid end of the coil, and the aerial to the extreme end, thus giving 3 or 4 turns in the open circuit. If reaction control is found to be difficult, it may be assumed that aerial loading is excessive, and the aerial clip should be moved nearer the earth connection. For work on shorter waves, about 6 or 7 turns in the closed circuit, and 2 aerial turns, will be found about right, although it is impossible to lay down a hard-and-fast rule, as so much depends upon incidental

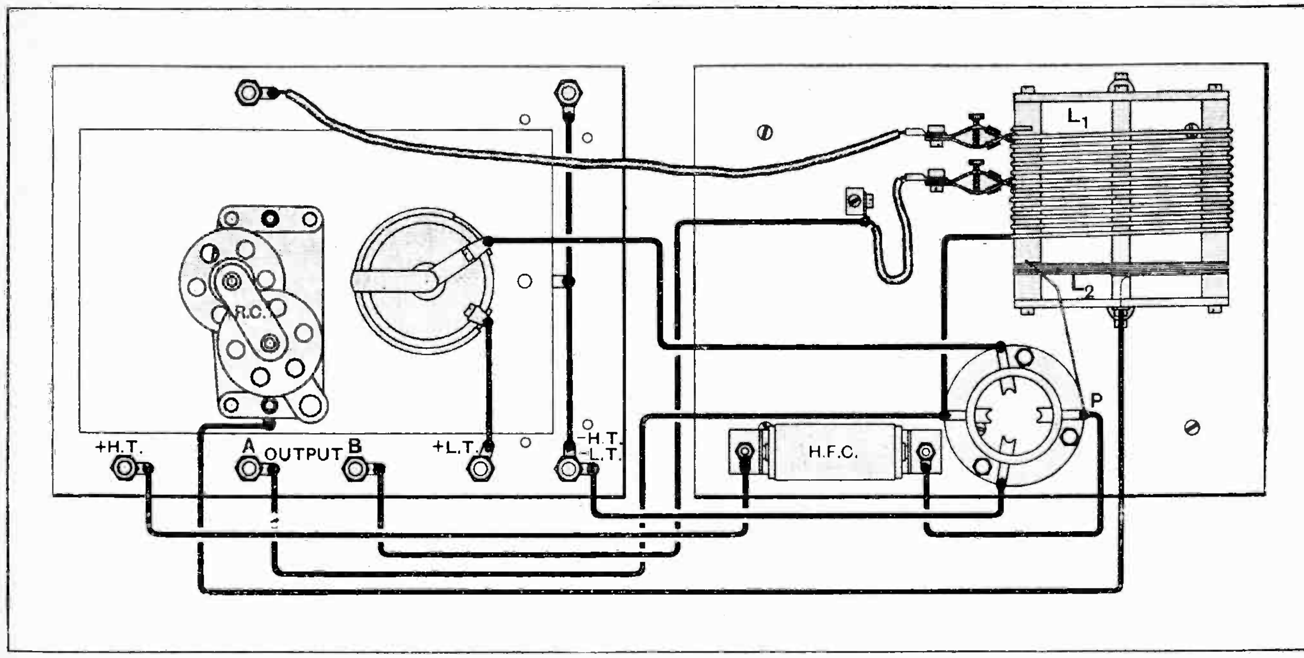


Fig. 7.—The practical wiring plan. The screen is connected to —L.T.

capacities. Generally speaking, it is desirable to use as much inductance as possible, and signals will generally be better if the number of grid turns are increased with a corresponding decrease in tuning capacity. Thus, the arrangement shown in Fig. 6 (*b*) may be preferable when receiving on the upper part of the wavelength range.

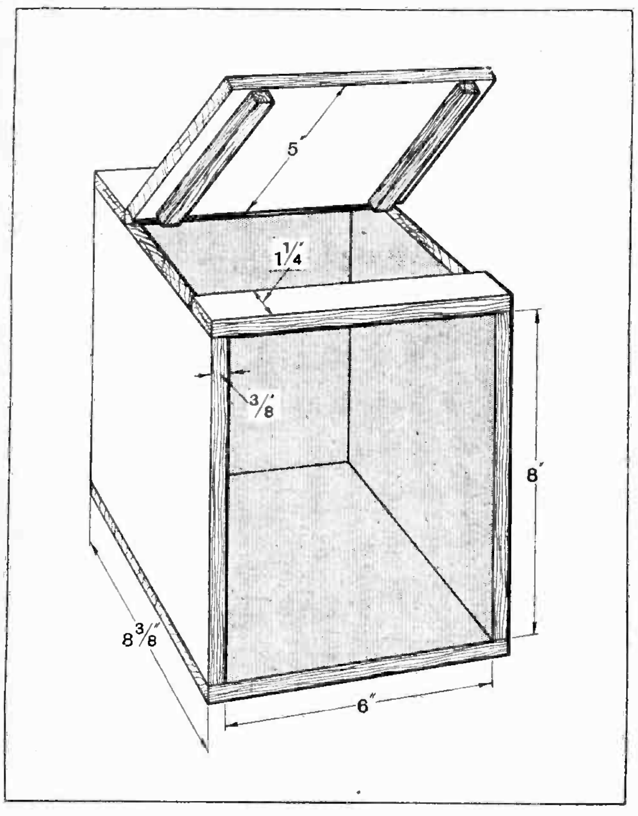


Fig. 8.—Details and leading dimensions of the cabinet. Wood of ⅜in. thickness is used throughout.

The operation of a short-wave receiver is distinctly an art, and one which can only be acquired by practice: the beginner will certainly find the extreme sharpness of tuning a matter of some difficulty at first. As already indicated, hand-capacity effects are likely to be troublesome, although they are not particularly bad in this receiver. An extension handle may, however, be necessary for the tuning condenser of the "Nucleus" unit, as it is unscreened; in any case, the grid lead is, as a matter of course, in close proximity to the hand of the operator.

Adaptability to other Receivers.

The unit is quite suitable for addition to the majority of well-designed and conventional detector-L.F. receivers with grid rectification and a direct-coupled aerial circuit. It is merely necessary to transfer aerial and earth leads, to remove the aerial tuning coil, and to connect to its socket the output terminals A and B. The reaction coil holder will be short-circuited. Both set and unit will be fed from common batteries, but care should be taken that the connection between negative H.T. and the L.T. battery is the same in both instruments. It is desirable that the grid leak of the detector valve should be connected between grid and filament battery rather than across the condenser. The former arrangement will maintain the reactor valve grid at a zero voltage which is fairly suitable.

Should there be difficulty in obtaining sufficient reaction it is advised that one or two turns should be added to the reaction winding; this addition is more likely to be necessary when leaky grid condenser rectification is used.

Measurements on RADIO-FREQUENCY AMPLIFIERS.

I.—A Review of Present Methods.

By R. L. SMITH ROSE, Ph.D., D.Sc., A.M.I.E.E., and H. A. THOMAS, M.Sc.

ALTHOUGH a good deal has been written on the subject of the valve amplifier, little credence can be attached to many of the statements made regarding the performance of this vital part of a wireless receiver. The theory of valve amplification has been attacked by many in diverse ways, and although much theoretical knowledge is available to the designer, there is still room for much more exact information as to the actual performance of an amplifier.

Classification of Amplifiers.

An amplifier may be defined as a combination of valves and suitable coupling components by means of which magnification of a small alternating E.M.F. is obtained. The frequency of this E.M.F. usually lies within one of two definite bands, viz., between 0 and 10,000 cycles per second, in which case the instrument is called a "note magnifier" or "audio-frequency amplifier" and is used for magnifying speech frequencies; or above 10,000 cycles per second, in which it is called a radio- or high-frequency amplifier. In either case the factors which play an effective part in the amplification process may be classified under the following headings:—

(a) The number and type of valves used.

(b) The method of coupling the output of one stage to the input of the next stage.

(c) The coupling which exists between the output of any stage and the input of the same or any previous stage. This may be intentional, as in the case of deliberately inserted retroaction or a neutrodyne stabilising agent, or it may be accidental, consisting of the stray capacities and leak resistances which exist between stages, or the inter-electrode capacities and leaks in the individual valves.

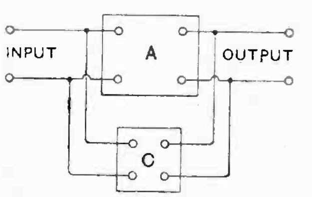


Fig. 1.—Schematic diagram to explain retroactive effects in high-frequency amplifiers.

The effects of the factors comprised under (c) usually place a limit to the total amplification obtainable at any frequency; although in certain cases, the stray coupling may act advantageously to give a larger coefficient of amplification than would normally be predicted from a consideration of the circuits, neglecting this factor.

In the case of audio-frequency amplifiers the coupling may be of the resistance-capacity, choke-capacity, or transformer type. In the high-frequency case the same type of coupling can be used, but serious modifications are usually necessary. The audio-frequency amplifier presents a somewhat simpler case than the radio-frequency instrument, due to the fact that stray capacities offer a higher impedance to the current, and are therefore not very important except, perhaps, at the highest audio-frequencies. The design of suitable types of coupling is not easy, but is certainly not so difficult as in the radio-frequency case. For the low-frequency amplification of telephony it is more important to ensure that the output wave-form is a good replica of the original input than that the amplification is a maximum. The two problems of distortion and amplification are unfortunately linked together in such a way that maximum amplification frequently involves serious distortion. It is necessary, therefore, to compromise between these two essential characteristics. For the amplification of high-frequency E.M.F.s it is usually not so important to maintain perfection of wave-form, and high amplification becomes the major consideration.

In the present articles, therefore, the radio-frequency amplifier will be chiefly dealt with, although the two cases are so interlinked that a definite demarkation cannot be made. Much has been said of freak high-frequency amplifiers, in which enormous amplification is obtained, but very few measurements which can claim serious scientific attention have been put forward. Although a particular amplifier can be built possessing very desirable characteristics, unless this instrument can be copied to a given specification, the apparatus can hardly be said to possess design. It is only by careful measurement under the actual operating conditions that the various characteristics can be analysed and the contribution made by each component studied.

It is often thought that the overall amplification is the product of the amplifying properties of each component portion. This condition is rarely obtained owing to the many stray couplings, electric and magnetic, that almost inevitably exist in the instrument. An amplifier does not usually act as a pure voltage device, but rather as a relay with a very large power ratio. Although the absorption of power on the input may be small, it is rarely negligible, especially at high frequencies, and this fact gives the amplifier another property, namely, that of imposing a load upon the input circuit.

Factors Governing Performance.

These are as follow:—

(a) The voltage amplification.

(b) The effect upon the circuit to which it is connected.

(c) The perfection of the output as a copy of the original E.M.F. impression.

The last of these three properties will not be dealt with at present owing to the lack of sufficient experimental information.

Measurements on Radio-frequency Amplifiers.—

If we connect an amplifier across a tuned circuit and produce a small E.M.F. in this circuit, we can compare the output obtained to the original E.M.F., and could call such a figure a measure of the amplification. If, however, the conditions of the input tuned circuit were slightly modified in any way, it would be found that the amplification had seriously changed without any change occurring in the amplifier itself. Clearly, then, this figure gives us, not a property of the amplifier, but of the combined system of a tuned circuit and an amplifier. This property is somewhat complex, due to the interaction of the tuned circuit and the amplifier on each other. This is the actual case which requires solution, since the reception of wireless signals almost invariably involves the amplification of an E.M.F. originally inserted in the tuned circuit. In order to study this case for various tuned circuits under all conditions, we must study the properties of the amplifier as a unit without its input circuit, and then study the input circuit alone. The combination of these two pieces of information gives the desired knowledge.

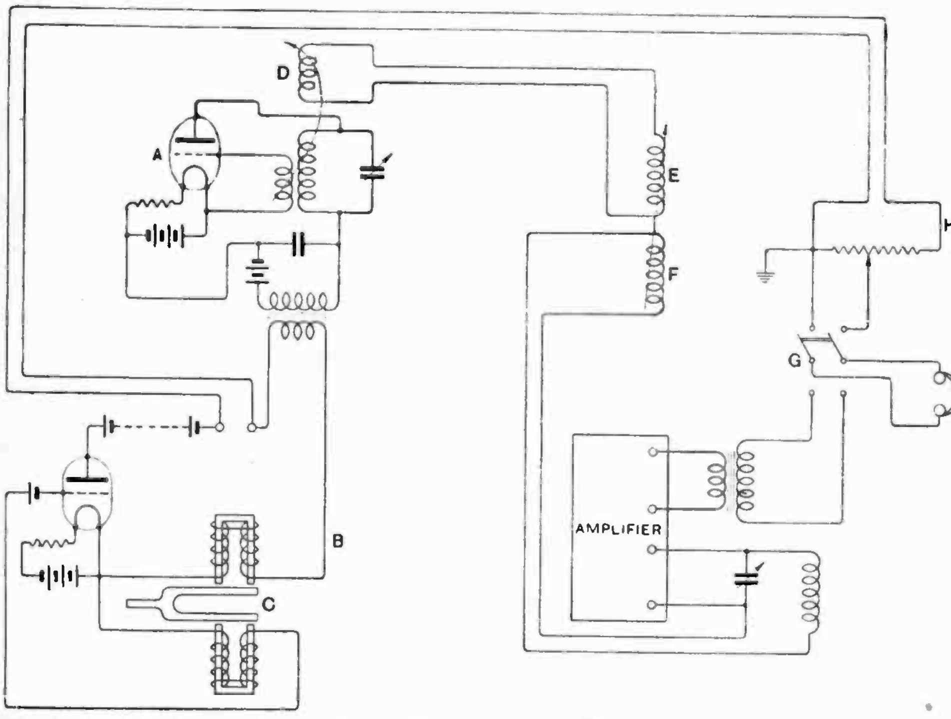


Fig. 2.—Method of measuring overall amplification due to F. W. Jordan. A radio-frequency input modulated by a pure sine wave is employed.

The meaning which we will attach, therefore, to the term "voltage amplification" is the ratio of the output E.M.F. to the input E.M.F., under specified amplifier conditions, and when the instrument is unattached to any input circuit. In general the voltage amplification will vary with the frequency employed to an extent which must be investigated experimentally in each case. It will be noticed that the output is expressed as a voltage; and therefore if we add a rectifying valve and an audio-frequency amplifier, we should consider the voltage amplification of the high-frequency stages as the ratio of the voltage delivered to the grid of the rectifier valve to that applied to the grid of the first valve. The audio-frequency stages could be treated in a similar manner. The characteristic of the rectifier is essentially different, as it converts a modulated high-frequency E.M.F. into the audio-frequency component, corresponding to the modulation. Any overall amplification figure which includes the rectification process has no meaning, since it will depend upon the percentage of modulation of the injected high-frequency energy.

For the purpose of a general discussion we can represent an amplifier as in Fig. 1, where A is the amplifier and C may be considered as a lumped coupling arrangement, having the same effect as the distributed coupling actually existing between the different members of the apparatus.

Let a small input E.M.F. be applied to the amplifier. This will give rise to a comparatively large output E.M.F., and, owing to the coupling, a certain portion of this E.M.F. is fed back to the input end of the system. Now this feed-back or retroaction may produce one of two effects. If the E.M.F. so delivered to the input is nearly in phase with that originally applied, the effective E.M.F. applied to the grid - filament circuit is greater than the actual E.M.F. supplied, and this extra E.M.F. will in turn be magnified, and a similar percentage of this will again be fed-back, so increasing the input. If each feed-back effect is less than the preceding one that produced it, the sum of all the input E.M.F.s will be finite and will obviously result in an increase in the amplification. If, however, the coupling is sufficient to feed-back an E.M.F. larger than the original input E.M.F. producing it, the sum of all the E.M.F.s will be infinite, since each one is larger than its predecessor. Under these conditions the amplifier will break into oscillation. By artificially controlling this feed-back or retroaction effect we can increase the overall voltage amplification to enormous values at the sacrifice of stability.

Load on the Input Circuit.

We have not so far considered the effect of an input circuit, but we have seen that the amplifier will introduce a load which may be considered as a shunt to the tuned circuit. It is found experimentally that this load may be represented by a resistance and a capacity, or a resistance and an inductance in series acting as a shunt to the tuned circuit. The effect of this load is two-fold. The tuning of the input circuit is slightly altered, and since energy is dissipated in the resistance component, the effective resistance of the tuned circuit is increased;

Measurements on Radio-frequency Amplifiers.—
therefore, for a given E.M.F. inserted in this circuit, the applied E.M.F. to the amplifier is reduced. By means of various types of coupling, however, a feed-back of energy from the amplifier is possible; and this will mean that a given small E.M.F. in the tuned circuit may supply a larger net E.M.F. to the amplifier. In other words, the shunt resistance due to the amplifier has a negative value. A point can be reached where the energy which is fed back exactly neutralises the loss of energy taking place in the input circuit. When this condition is obtained, the effective resistance of the circuit is obviously zero, since a small E.M.F. will give rise to an infinitely large current. This is a condition of instability. If now the coupling is still further increased, the feed-back energy is greater than the energy due to ohmic resistance and radiation, in which case a small E.M.F. applied to the input circuit will give rise to a constantly increasing E.M.F. which tends to augment the original. In other words, a large oscillation is obtained, the amplitude of which is controlled by limiting factors introduced by the valve, which is acting as the relay sustaining the oscillation.[1] For all stable conditions, therefore, we must satisfy the requirement that the feed-back voltage is less than the original applied E.M.F. in the input circuit.

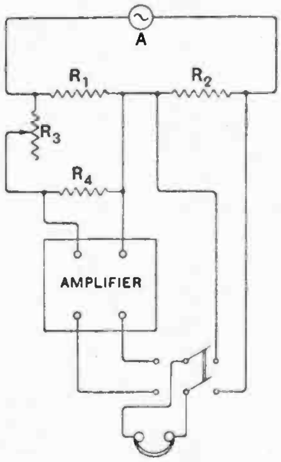


Fig. 3.—Circuit for measurement of L.F. amplification due to M. Pirani.

Retroactive Couplings.

The couplings referred to may be internal to the amplifier, or there may be a direct external coupling from the output to the tuned input circuit, inserting a back E.M.F. in this circuit which will naturally result in a greater E.M.F. being applied to the grid of the first valve, but which is essentially not a property of the amplifier but of the external circuit. Such coupling is usually called "reaction" or "retroaction." Now the resistance of the input circuit is defined in terms of the current produced at resonance for a given applied alternating E.M.F. If an external E.M.F. in phase with this is added by the reaction mechanism, we shall obviously obtain a greater current for the same input. This means that the "effective" resistance of the circuit has decreased. By increasing the reaction, we can therefore increase the overall sensitivity by reducing the resistance of the tuned circuit until, finally, when the resistance reaches zero, the input circuit will behave as an oscillator.

It is important to appreciate clearly the essential difference between the two types of coupling, the one a matter purely concerning the amplifier, and the other depending upon the nature of the coupling between the amplifier and the tuned input circuit. Considering the amplifier, it is apparent that since small stray capacities have a comparatively low reactance at high frequencies, the effect of stray capacities due to the distribution and arrangement of the components may be very serious; and although it is possible to analyse theoretically some simple cases, the designer will always have to resort to measurement to determine the performance of a complex amplifier.

Measurement of Amplification.

The accurate measurement of the voltage amplification given by a valve amplifier is not a simple process. It is obviously desirable to use inputs of the same order as those met with in practical wireless reception, since the amplification factor may change seriously if the input becomes large. To satisfy this practical condition it is necessary in most cases to use input E.M.F.s of the order of a few millivolts and to measure output currents of the order of microamperes. The direct measurement of such inputs and outputs presents many difficulties. It must also be remembered that any interference with the intermediate part of the amplifier is undesirable, since it may completely modify the behaviour of the instrument. For example, it would not be sufficient to measure each stage of a six-stage amplifier by injecting E.M.F.s internally and measuring the output at an intermediate stage, and then assume that product as the total amplification factor for the six stages. It is highly desirable that the amplifier may be considered as a piece of apparatus possessing but two pairs of terminals, and access to these terminals only is permissible if a measurement is to have any real value.

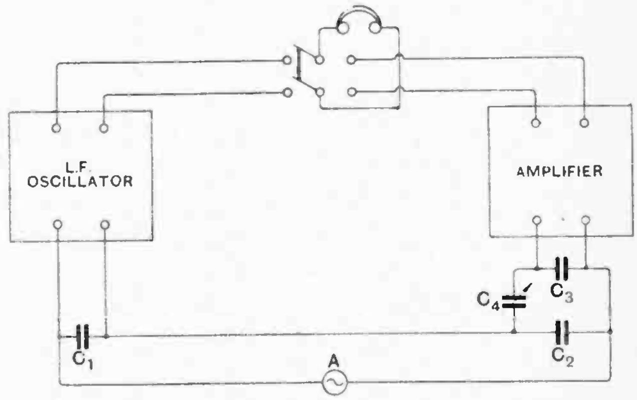


Fig. 4.—Circuit for H.F. measurements corresponding to Fig. 3. Use is made of a capacity potentiometer.

We will now consider briefly the chief methods that have been previously adopted for the determination of voltage amplification at radio frequencies. The first to be considered is that due to F. W. Jordan,[2] and may be understood by the aid of the circuit diagram given in Fig. 2. In the high-tension supply lead of a radio-frequency oscillator A is inserted the output from an audio-frequency oscillator shown at B. This oscillator com-

[1] All the energy comprising the feed-back or retroactive effect is, of course, supplied by the batteries connected to the valves in the amplifier.

[2] F. W. Jordan: "A Method of Measuring the Amplification of a Radio-Frequency Amplifier." *Proc. Phys. Soc.*, Vol. 32, p. 105, 1919-20.

Measurements on Radio-frequency Amplifiers.—
prises a valve maintained tuning fork, C,[3] which provides a constancy-frequency source of pure sinusoidal E.M.F. of a few volts only. The radio-frequency oscillator has a high-tension supply of only four volts above the negative end of the filament, and the oscillations are therefore exceedingly feeble. The inserted audio-frequency E.M.F. which acts as a modulator of the high-frequency oscillation is only about 1 volt, since these oscillations cease to exist if the anode potential is lower than about 3 volts. The anode potential is thus varying at an audio-frequency from about 3 to 5 volts about the mean value, and the amplitude of the radio-frequency oscillation varies from nearly zero to twice the value at 4 volts H.T. supply, *i.e.*, the wave is almost completely (or 100 per cent.) modulated.

The oscillating circuit is coupled to an intermediate untuned circuit, consisting of two coils D and E. The last coil forms the primary of a mutual inductance, the secondary coil, of which F forms part of a tuned circuit connected to the amplifier. By moving the coil E with respect to F, the E.M.F. induced in F, and hence the input to the amplifier can be varied. After rectification by the last valve in the amplifier the audio-frequency output is led to a telephone receiver *via* a switching arrangement shown at G, by means of which a comparison with a standard source can be made. When the telephone is connected across the potentiometer H, an E.M.F. from the original audio-frequency source is applied to it, and by adjusting the potentiometer any strength of signal can be fixed as the standard of comparison.

In making amplification measurements, the E.M.F. across the condenser of the tuned circuit is applied to the rectifier and the coil F is adjusted with respect to E until the output signal intensity is the same as that obtained when the telephone is directly connected to the audio-frequency source. The E.M.F. is now applied to the whole amplifier, and the mutual inductance EF is reduced until the signal intensity is the same as before. The ratio of the mutual inductances used in the above settings then gives the amplification of the high-frequency stages.

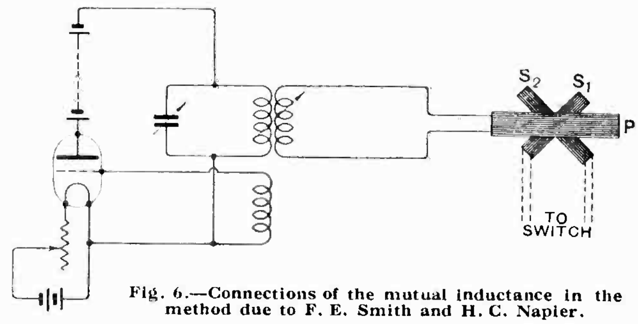


Fig. 6.—Connections of the mutual inductance in the method due to F. E. Smith and H. C. Napier.

In considering the application of this method for really accurate measurement work the following points must be noted. In the first place, the limiting accuracy with which any telephone balance can be obtained is of the order of 5 per cent., since the human ear is very insensitive to small changes of intensity. Secondly, the accurate determination of the mutual inductance at radio-frequencies is not a simple matter, and the difficulties are increased if the range of calibration has to be very large in order to measure large overall amplification factors. Thirdly, the presence of a tuned input circuit will seriously modify the behaviour of the amplifier, and the result obtained cannot therefore be regarded so much a property of the amplifier alone as of the tuned circuit and amplifier together. It may further be pointed out that in any method of measuring amplification to be used for research purposes, it is very desirable to provide means for measuring the actual value of the input and output employed, and also of the percentage modulation.

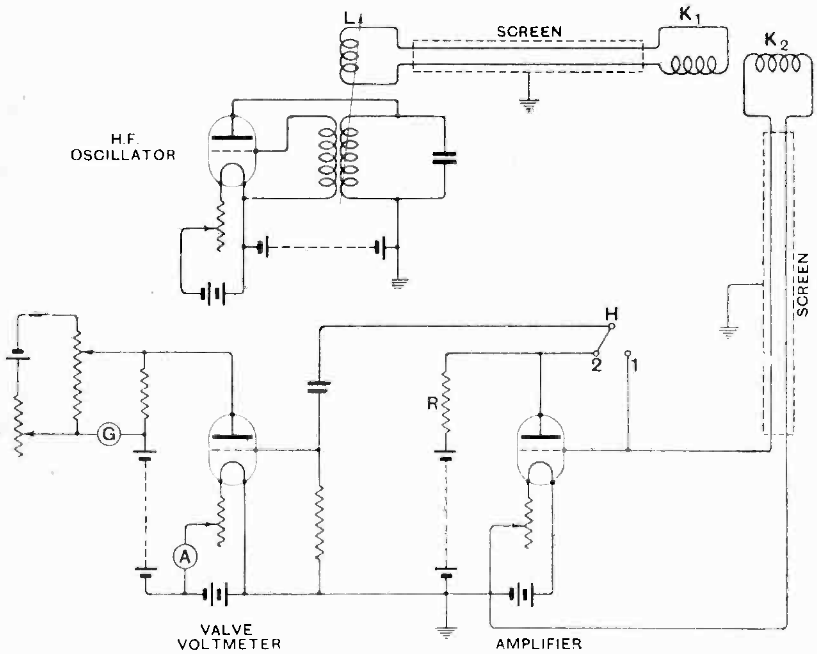


Fig. 5.—The method due to A. Bley which does not use a modulated source.

The Capacity Potentiometer.

Another method due to Pirani,[4] and used chiefly at audio-frequencies, also employs a telephone comparison, but with a potentiometer arrangement in place of the mutual inductance described above. The circuit diagram is given in Fig. 3, from which it will be seen that a valve oscillator A supplies current to the resistances R_1 and R_2, and by means of R_3 and R_4 a small known E.M.F. is applied to the amplifier. The output balanced by means of the tapping across R_2.

[3] W. H. Eccles and F. W. Jordan: "The Maintenance of the Vibration of a Tuning-fork." *The Electrician*, June 20. 1919.

[4] M. Pirani: "On the Study of the Efficiency of Amplifiers for Reception." *Jahrb. der Drahtl, Tel. und Tel.* Vol. 16, p. 2, 1920

Measurements on Radio-frequency Amplifiers.—

For radio-frequencies the resistances are replaced by a capacity potentiometer arrangement as shown in Fig. 4. The radio-frequency oscillation from the source A is modulated at an audible frequency, and the condensers C_2, C_3 and C_4 are arranged to obtain a small, known E.M.F. for application to the input of the amplifier. The comparison standard is given directly from the audio-frequency source. The effect of the capacity input load used as above is important, although not so serious as that of a tuned input circuit.

Other Methods.

A modulated source is not used in the method due to Bley,[5] the circuit arrangements are shown in Fig. 5. Here a mutual inductance, consisting of the coils K_1 and K_2, is used to provide the input. The primary K_1 forms part of an intermediate circuit, the other coil L being coupled to the high-frequency oscillator. The leads forming part of this circuit are screened to prevent direct induction from the oscillator, and the leads from K_2 to the amplifier are similarly screened. The output is measured by a thermionic voltmeter, consisting of a grid current rectifying valve with a sensitive galvanometer in the anode circuit. The direct anode current is balanced out by means of a primary cell and potentiometer in the usual manner. Such an instrument gives deflections of the galvanometer, which are approximately proportional to the square of the applied E.M.F. and can be calibrated at moderately low frequencies by means of a potentiometer or a calibrated mutual inductance. The latter method was actually used by Bley.

If the switch H is put into position 1, the input E.M.F. is measured; in position 2 the oscillating voltage of the output across the resistance R is determined. The ratio of these two values gives the amplification. While the method is superior to those previously described, the possible shunting effect of the voltmeter at radio frequencies is one for investigation. As already stated, if the amplification is large the calibration of the mutual inductance becomes rather difficult, although it appears from Bley's results that the method has been used for voltage amplifications as high as 1,200.

A novel method has been devised by Smith & Napier,[6] the principles of which can be understood with the aid of Fig. 6. A valve oscillator supplies a primary coil P, which has coupled to it two secondaries S_1 and S_2 fixed together at right angles, but capable of rotation with respect to P about their common axis. When the mutual inductance is a maximum for one coil it is a minimum for the other, and by calibrating this mutual inductance for various positions, the ratio of the E.M.F.s induced in the secondaries is known. The two coils are connected to the input of the amplifier and to a standardised last stage respectively by means of a switch, and the position of S_1 and S_2 is adjusted until the signal strength heard in the telephones is the same for both positions of the switch. The ratio of the mutual inductances of S_1 and S_2 with P then gives the voltage amplification. The method is very quick and useful for the measurement of voltage amplification of one or two stages at audio-frequencies under the exact conditions at which the amplifier operates. As previously pointed out, the calibration of the mutual inductance for high voltage factors becomes very difficult.

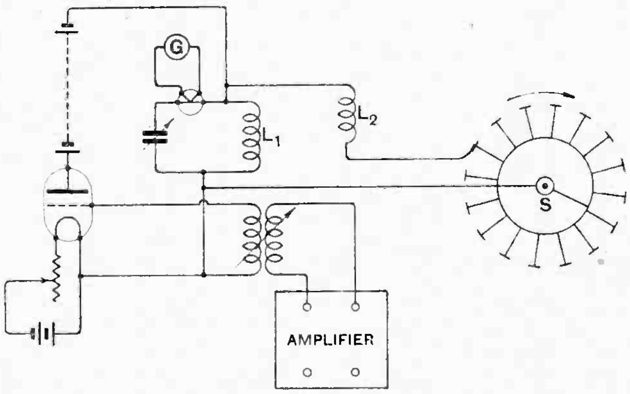


Fig. 7.—Method of modulating the H.F. source employed by F. E. Smith and H. C. Napier.

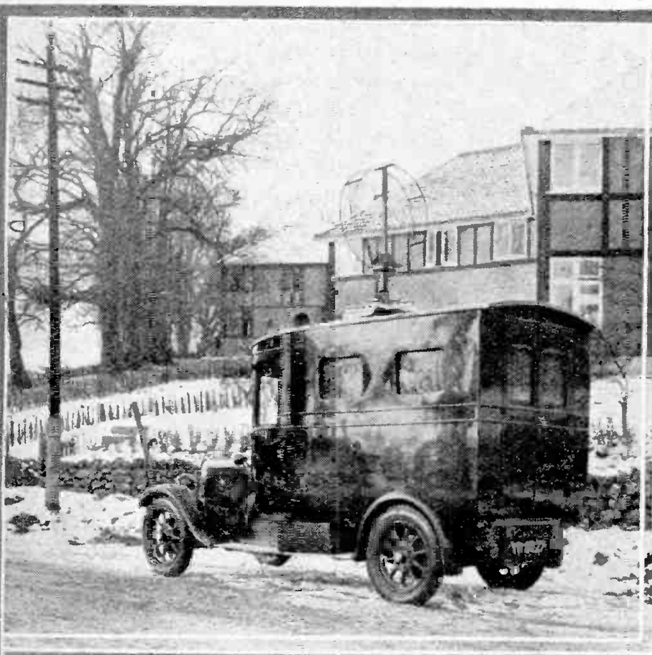
For modulating the source for radio-frequency measurements the method employed is depicted in Fig. 7. A coil L_2 is connected in series with a rotating switch S across the main tuning inductance L_1. The circuit is thus detuned at an audible frequency by the revolving switch S. Such an arrangement will tend to give a modulation with a square wave-form, and it is possible that serious harmonics may be produced and that the shock impulses given to the amplifier will produce transient phenomena of a complex nature.

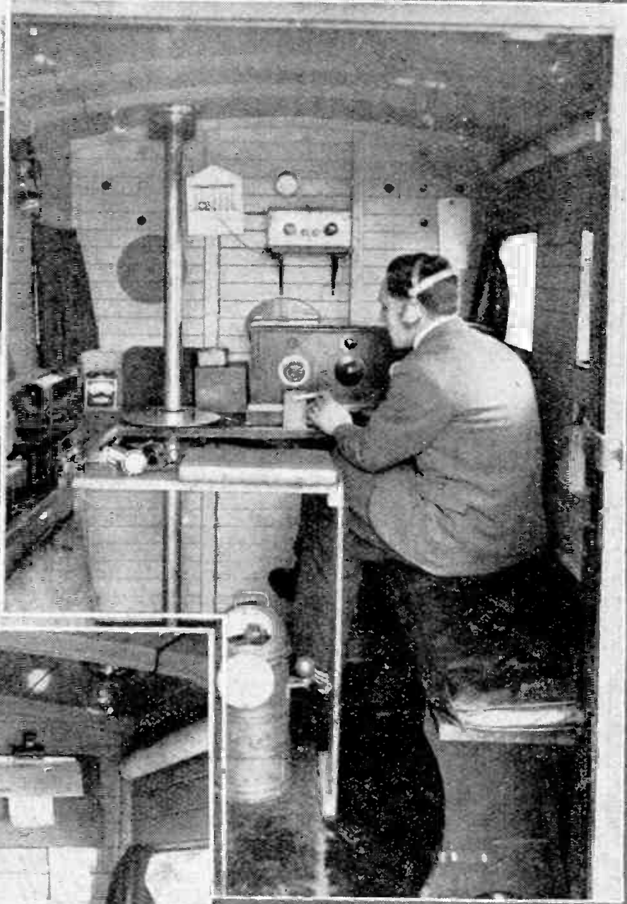
The main criticism of all these methods is that they do not measure the actual E.M.F. applied to the amplifier or the output current obtained, and that the range of amplification factors that can be measured is limited. In the next article a description will be given of a method in which an attempt has been made to overcome these drawbacks and which has been used for investigating in detail the voltage amplification given by different types of radio-frequency amplifiers operating under the conditions employed in wireless receivers.

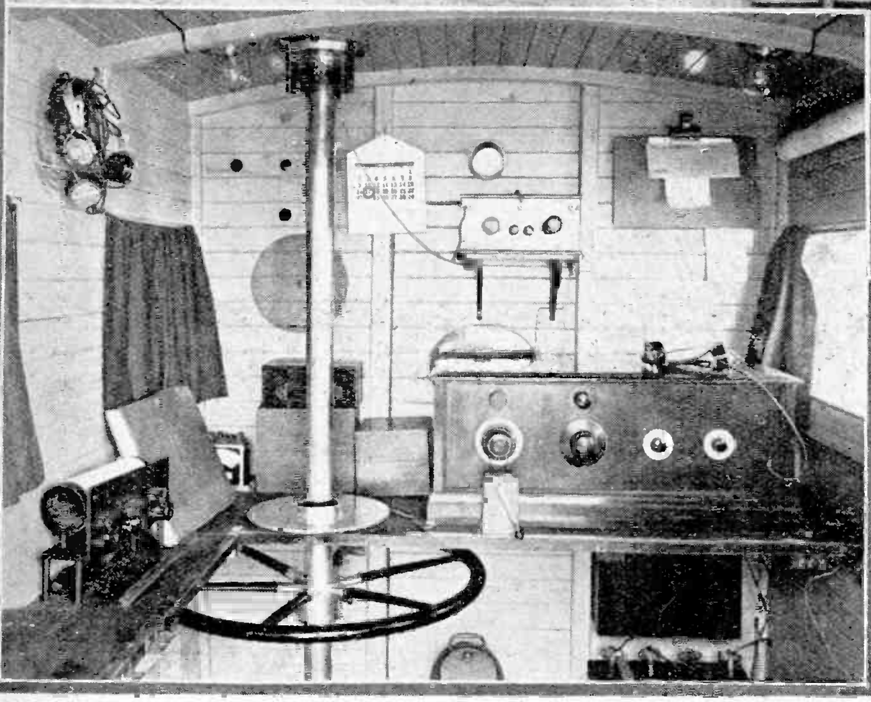
[5] A. Bley: "Experimental Investigation of High-Frequency Amplifiers." *Archiv. für Electrotechnik.* Vol. 12, p. 124, 1923.

[6] F. E. Smith and H. C. Napier. "On the Measurement of Amplification given by Triode Valves at Audible and at Radio Frequencies." *Proc. Phys. Soc.*, Vol. 32, p. 116, 1920.

POST OFFICE PATROL VAN.

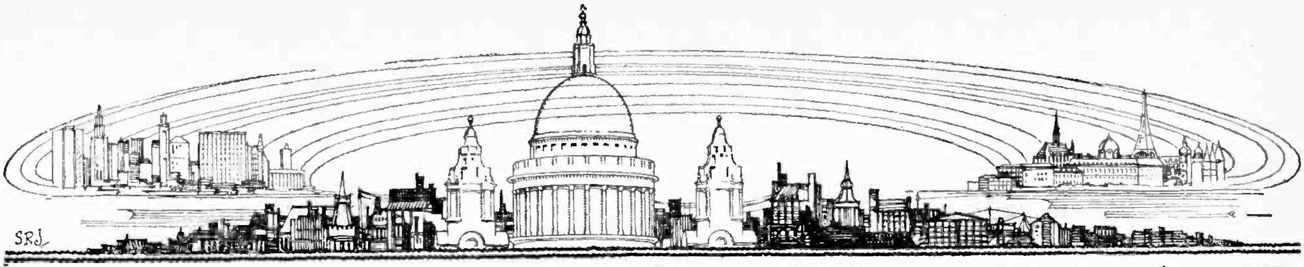






(Top Left) The Mobile Direction Finding Station to be used by the Post Office Engineering Department for the tracking down of oscillators. (Above) The direction finder and its three-valve receiver-amplifier. The small handle critically controls the geared dial, holding it secure against vibration.
(Left) The wheel rotates the external frame. Beneath the clock is a balancing tuner to compensate for errors. On the receiver panel, the left-hand dial is the tuning condenser, next capacity reaction, other controls being three filament rheostats and a potentiometer.

STATED to be for the purpose of locating oscillating receiving sets, this 20 h.p. motor van has been equipped with direction finding gear and a receiver covering the short wavelengths as well as the broadcast band. Bearings from three or more points within about the radius of a mile are taken on the offending station (assuming that it persists and can be identified!). It is finally located by an excursion along the suspected street, the pointers on the direction finder indicating when the position of the offender is at exact right angles to the direction of travel of the van, that is when the van is directly outside premises where a call might be made. Reaction users need not be so alarmed as the over-enthusiastic transmitter who exceeds the privileges of his licence, assuming he possesses one. To the transmitter who is not anxious to receive a rather unwelcome report of the reception of his signals, let this be a warning.



CURRENT TOPICS

Events of the Week in Brief Review.

NOT COUNTING THE PIRATES.

The Post Office states that 2,179,000 receiving licences were in operation at the end of December last.

oooo

WORKHOUSE "WIRELESS."

2,200 yards of wire have been used for installing wireless in the Fulham Workhouse. The institution possesses 402 pairs of headphones.

oooo

A NEW EXCUSE.

Fined for working a wireless set without a licence on December 6th last, a Birmingham "pirate" said that he thought he could not take out a licence until New Year's Day.

oooo

A BUDGET BROADCAST?

When Parliament reassembles Captain Ian Fraser, M.P., will raise the question of broadcasting the proceedings of the House. It is suggested that the Budget would be especially suitable as a subject for broadcasting.

oooo

TRANSATLANTIC TELEPHONY SERVICE.

A further extension in the Post Office Transatlantic Telephony Service took place at 1.30 p.m. on Saturday last, when the service became available to and from all places in England and Wales. Simultaneously the service was extended in America to include the States of New Jersey and Pennsylvania.

oooo

BROADCAST CONTROL BY MUSICIANS.

Fifteen microphones were employed by the American National Broadcasting Company on January 21st when transmitting a performance of "Faust" given by the Chicago Civic Opera Company. The microphones, distributed throughout the stage and orchestra pit, were connected to a specially constructed "mixing" panel where competent musicians attended to the correct balancing of the various effects. Trained musicians, it is reported, were also in attendance at many points on the land line linking up the chain of stations participating in the event.

HAPPY CRIMINALS.

Convicts in the Horsens prison at Jutland are to be allowed to construct their own broadcast receivers.

oooo

LICENCES IN NORWAY.

There are approximately 100,000 owners of wireless receiving licences in Norway and the number is increasing daily. Denmark has 92,000.

oooo

LINER'S WIRELESS RECORD.

The Cunard liner "Carinthia" is believed to have created a wireless record by establishing two-way ship-to-shore communication over a distance halfway round the earth. The "Carinthia," which is now on a voyage round the world, accomplished the feat by exchanging messages with the New Brunswick station (N.J.) while 12,500 miles away.

THIRTY-ONE YEARS AGO. To-day marks the anniversary of the arrival of Senatore (then Signor) Guglielmo Marconi in England in 1896. The above portrait of the famous inventor was taken shortly afterwards.

WORLD WIRELESS CONFERENCE POSTPONED.

It is understood that the proposed International Radio Telegraph Conference, originally arranged to take place in Washington next spring, will be postponed until the autumn.

oooo

OUR POOR POST OFFICE.

During the financial year ended March 31st, 1926, the Post Office collected a net amount of £784,305 in respect of broadcast receiving licences. £500,000 was handed to the B.B.C., leaving a comfortable balance of £284,305.

oooo

AN OSCILLATOR IN PETERBOROUGH.

Alleging that some unknown person is deliberately oscillating and thereby spoiling broadcast reception, a number of listeners residing within three and four hundred yards of each other in the Fletton Avenue district of Peterborough have sent an appeal to the B.B.C. for advice and help.

oooo

AUSTRALIAN BEAM TESTS.

As indicated in last week's *Wireless World*, the official tests with the new Marconi beam stations at Grimsby and Skegness showed that communication with Australia could be maintained over long periods at a higher speed than that required by the Post Office. During the tests, however, certain defects developed in some of the auxiliary apparatus, and the company states that, as further time will be required in which to remedy them, it is not applying to the Post Office to accept the stations until the trouble is overcome.

oooo

A NOTABLE ANNIVERSARY.

On February 2nd, 1896, the young Guglielmo Marconi arrived in England, bringing with him the crude apparatus which formed the nucleus of practical wireless telegraphy. In the same year he took out the first patent for Hertzian Wave Telegraphy (No. 12039 of 1896) according to which, besides many improvements in the apparatus, one end of the Hertzian dumb-bell oscillator was buried in the earth and the other end elevated in the air.

In July, before officials of the Post Office, he conducted successful experiments over a distance of 100 yards, and shortly afterwards established communication between points $1\frac{3}{4}$ miles apart.

B.B.C. IN LIQUIDATION.

As a matter of formality under the Companies Act, a meeting of creditors of the British Broadcasting Company is to be held at the Hotel Cecil on February 7th. Sir John Reith, the liquidator, states that all creditors have been or will be paid in full.

oooo

THE PURPOSE OF BROADCAST RECEIVERS.

Mr. C. F. Phillips will introduce an informal discussion on "The Purpose and Design of Broadcast Receivers" at this evening's meeting of the Wireless Section of the Institution of Electrical Engineers, to be held at Savoy Place, W.C.2, at 6 p.m.

oooo

BUYING A LOUD-SPEAKER.

Advice from a Welsh newspaper:—"Go to a dealer who carries a large stock (of loud-speakers), get him to demonstrate all he has, and ask him to let you have the one that appeals to you most for an evening's trial on the understanding that you may change it."

And mind the step.

oooo

NOT PAYING THE PIPER.

It is reported that the Johannesburg broadcasting stations ceased transmissions on Monday last, January 31st, owing to lack of funds.

Strenuous efforts are being made by private interests to secure a resumption of the broadcast service at an early date. The Johannesburg Chamber of Commerce recently telegraphed to the Minister of Posts and Telegraphs submitting that the discontinuance of broadcasting from Johannesburg would be a "disaster" and detrimental to national and commercial interests.

oooo

U.S. RADIO COMPASS DISPLAY.

The part played by the radio compass when the crew of the wrecked "Antinoe" were saved through the bravery of Captain Freud and his men on the s.s. "President Roosevelt," was recently demonstrated in a vivid manner in the radio department of the John Wanamaker store in New York.

A model lighthouse, equipped as a radio beacon station, sent out signals similar to those heard by the "Roosevelt," while S.O.S. calls as transmitted by the distressed vessel were heard on loud-speakers distributed throughout the department. Models of the two ships were manœuvred in life-like fashion, and the public were enabled to see how the Kolster radio compass, with which the "Roosevelt" was equipped, succeeded in locating the "Antinoe," although that vessel gave a bearing which was 100 miles out.

oooo

PICTURE TRANSMISSION ON THE CONTINENT.

The broadcasting stations at Kœnigswusterhausen and Vienna are expected to co-operate in about a fortnight's time in the regular exchange of pictures by wireless. The Telefunken system will be used with a wavelength rather higher than the ordinary broadcast band.

oooo

U.S. LISTENERS PROTEST.

Even the worm will turn, and American listeners, who have borne the inconvenience of a turbulent ether for at least two years, are waxing impatient. Printed coupons are being sent in thousands to the Washington Congress bearing the inscription: "I wish to enter my protest against the existing chaotic radio conditions," together with the sender's signature, street, city and state.

It is hoped that this persistency will be rewarded by the speedy enactment of suitable legislation. A basis for legislation is reported to have been reached by a joint congressional conference committee, and it is understood that jurisdiction over broadcasting will probably be divided between the Department of Commerce and a special commission to be appointed by the President.

oooo

THE LAW AND THE LISTENER.

A Salford listener who was recently fined for operating a wireless set without a licence pleaded that he was not aware, before he was told by an inspector, that a licence was required to use a crystal set. "I should not have erected an outside aerial, to be seen by everybody," he said, "if I had thought I was doing wrong."

In this case ignorance of the law was not accepted as an adequate defence.

oooo

AUSTRALIA AND THE BEAM RATES.

The Australian Associated Chamber of Commerce has approached the Federal Government, strongly urging a revision of the proposed fixing of beam wireless rates at 2s. per word, which is on the same level as the new cable rates recently announced. The rate of 2s. a word for beam messages, when originally fixed, was two-thirds of the then prevailing rate of 3s. per word, and was also based on the high power stations costing over £1,000,000. The capital expenditure on beam stations is a quarter that of high power stations. Since then the cable rates have been reduced considerably.

The business community in Australia hopes that the matter will also be raised by British Chambers of Commerce and other organisations.

CATALOGUES RECEIVED.

Radio Communication Co., Ltd., Barnes, London. Catalogues of *Polar* Components and *Polar* Receiving Sets.

Okonite Company, Passaic, New Jersey, U.S.A. (sole British Agents: Wm. Geipel and Co., Vulcan Works, St. Thomas Street, London, S.E.1). Brochure concerning Splices and Tapes for Rubber-insulated Wires.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2. Catalogue B.C. 4221 (52 pp.), listing and illustrating *Gecophone* Wireless Receiving Sets, Components and Accessories.

Wright and Weaire, Ltd., 740, High Road, Tottenham, London, N.17. Leaflet describing *Wearite* Low Loss Coils, Anode Resistances, Multi Plug Distributor, etc., etc.

Carborundum Co., Ltd., Trafford Park, Manchester. Booklet: "Round the Stations on the Carborundum Stabilising Detector Unit," with details of a Carborundum Circuit.

American Hard Rubber Co. (Britain), Ltd., 13A, Fore Street, London, E.C.3. Brochure: "The Gentle Art of Choosing One's Panel," with notes of *Radion* and *Resiston* Panels.

Dubilier Condenser Co. (1925), Ltd., Ducon Works, Victoria Road, North Acton, London, W.3. "Concerning Dubilier"—28-page brochure dealing with Dubilier products.

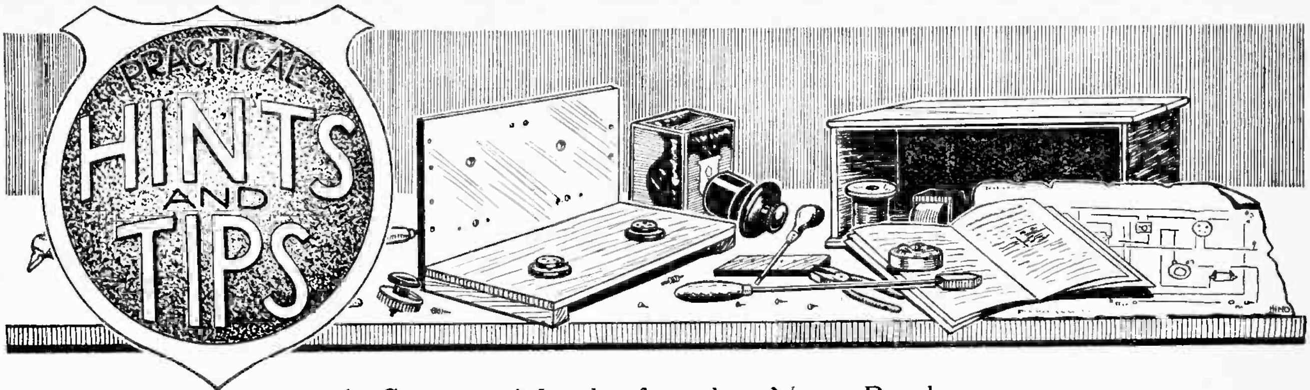
Hart Accumulator Co., Ltd., Marshgate Lane, Stratford, London, E.15. "The Right Way to Use Wireless Batteries"—a booklet giving useful hints for all users of accumulators.

Houghton-Butcher (Great Britain), Ltd., 88-89, High Holborn, London, W.C.1. Houghton's "Radio News," December, 1926, for the Retailer.

A PROGRAMME SUGGESTION.

THE general approval which has greeted the suggestion, made in a leading article in *The Wireless World* of January 12th, that the B.B.C. should cater for all tastes by devoting different evenings to different types of entertainment, is admirably voiced by the Broadcasting correspondent of our esteemed contemporary *The Observer*. In the issue of Sunday, January 23rd, he writes:—

"I have very little sympathy with the man who turns on his receiver at, say, seven o'clock in the evening, and expects to have provided for him a programme completely to his liking until eleven at night. It cannot be done. 'If A is happy, B is not.' Amidst all the welter of criticism levelled at the new directorate of the B.B.C., I have read only one constructive article. That was in the doyen of radio papers, *The Wireless World*. It advocated a daily allocation of programmes so arranged that 'A' could have his chamber music, or his symphony concert on one day, 'B' his light music on another, 'C' his jazz and comedians on a third, and so on through the week. This seems to me to be an eminently sensible idea. It would enable those with many social arrangements to make plans ahead, without having to put off another engagement because something particularly attractive is to be sandwiched between a great deal of unattractive matter on one particular evening. Even now full programmes are published, and there is no compulsion to listen the whole evening. If one is not likely to be interested before 8.30 there is no need to switch on the set at seven o'clock."



A Section Mainly for the New Reader.

A SELECTIVE TWO-VALVE RECEIVER.

The tuning and absorption circuit used in the "Wide-range Receiver," described in the issues of this journal dated January 19th and 26th, 1927, lends itself particularly well for adaption to a simpler arrangement of two valves, on the lines shown in Fig. 1. It is probably true to say that such a circuit affords the maximum possible degree of selectivity, combined with considerable volume, which is attainable with two valves, without taking advantage of the filtering effect of tuned high-frequency amplification, with its inevitable complications and extra cost.

The aerial-grid transformer and the inductance L of the rejector circuit should be wound strictly in accordance with the instructions given on page 109 of last week's issue. A reaction coil must be added; this should be wound in a narrow slot with fine wire (about No. 36 D.S.C.). It may be spaced about ¼in. from the end of the secondary coil, and will have about 30 turns. To reduce the inevitable damping caused by grid rectification, which is, nevertheless, the most suitable for this particular modification, it is suggested that the grid condenser should be connected to about the 20th turn from the high-potential end of the secondary, as shown by an arrow-head in the diagram. The inclusion of more or less inductance in this circuit may be tried experimentally, as results will be influenced by the characteristics of the detector valve and the operating potential of its grid.

The reaction condenser R.C. may have a maximum capacity of 0.0002 or 0.00025 mfd.; if it is appreciably smaller, a larger reaction coil may be required.

A potentiometer for controlling the detector grid voltage is shown; this is a refinement which may be omitted, but its inclusion will be found of very real advantage, as a correct adjustment will improve reaction control.

The variable and fixed rejector tuning condensers C and C_1 may have the values suggested in the article referred to, and should be of good quality, as heavy losses in this part of the circuit cannot be tolerated.

A switch for changing over from loud-speaker to headphone reception is suggested and has been included in the diagram; this arrangement will be found convenient, as a simple two-valve can hardly be expected to give great volume on distant signals except under "freak" conditions.

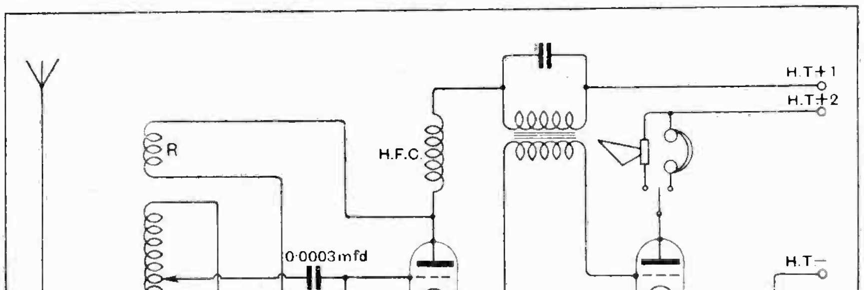


Fig. 1.—A selective receiver with absorption circuit for eliminating the local station.

oooo

A USEFUL RULE.

A good idea of the correct grid bias for any amplifying valve may be obtained by dividing the H.T. voltage applied by twice the amplification factor. This must not be regarded as a scientifically exact formula; it is merely a rule of thumb which is useful as a rough guide. It does not, of course, take into account the value of inductive load in the anode circuit, or several other points which should, strictly speaking, be allowed for.

To consider the case of a popular type of power valve, with an amplification factor of 6 and an H.T. voltage of 120, we apply our formula and get 120 divided by 12, which gives us 10 as the value of bias voltage. This is very close to the truth; the majority of such valves, under average working conditions, would be biased to 9 volts.

The formula is particularly applicable to the more modern and efficient type of valve; it generally errs on the high side, which is perhaps a point in its favour.

○○○○

SIMPLIFYING THE H.T. ELIMINATOR.

Those who are about to undertake the construction of a unit for the supply of high tension current from the mains, whether D.C. or A.C., would be well advised to consider the possibility of modifying their receivers to permit of the application of a common anode voltage to all valves. By doing so, the design of the eliminator is simplified very considerably, and its cost is reduced.

This modification may very often be accomplished without any noticeable falling off in efficiency; there can be little doubt that designers in the past have been unnecessarily liberal in the provision of a multiplicity of high-tension connections.

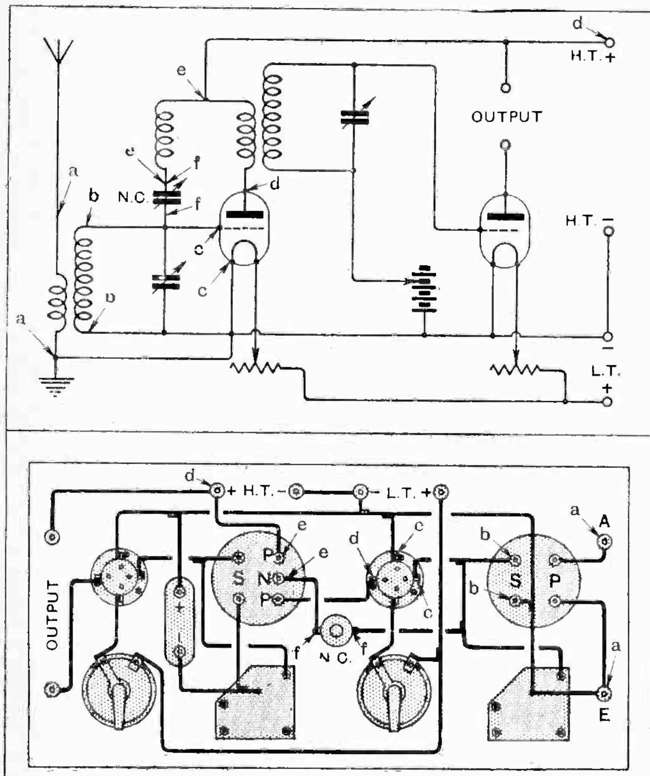
The anode voltage for the detector, if it operates as a grid rectifier (with leaky condenser) should not be too high; it is in arranging for the feeding of this valve that we are most likely to encounter difficulties. These may generally be overcome by coupling it to the first L.F. valve through a resistance of higher value than usual (about 150,000 ohms is suggested) rather than by means of a transformer. By adopting this plan the voltage actually applied to the anode is very considerably reduced.

DISSECTED DIAGRAMS.

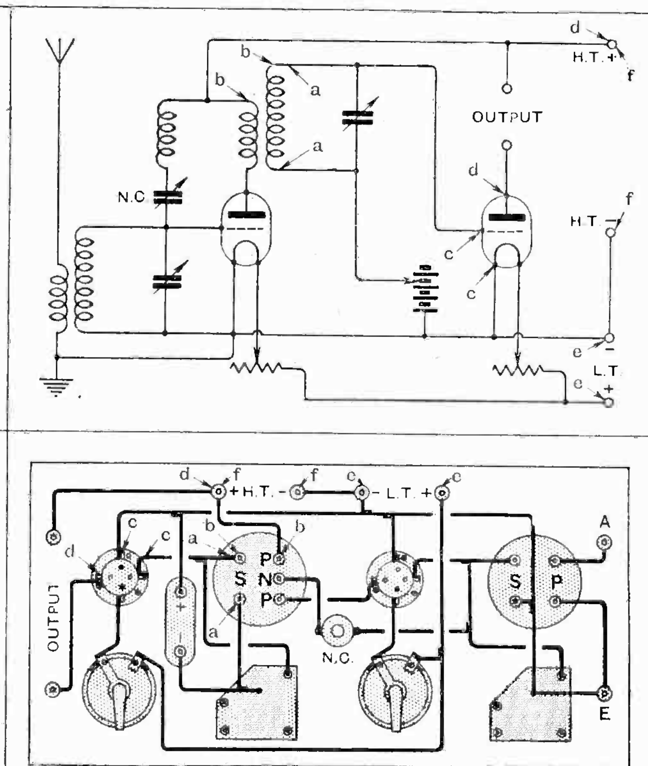
Point-to-point Tests in Theory and Practice.

No. 58.—A 1-v-0 Neutralised Receiver.

The present series of diagrams is intended to show simple methods of locating faults in typical wireless receivers. Failing a sensitive galvanometer, it is suggested that a pair of telephones with a small dry battery should be used as an indicating device. These tests will show not only actual faults, but will reveal the small leakages which are so often responsible for poor reception and flat tuning. Batteries should be disconnected before testing.



1



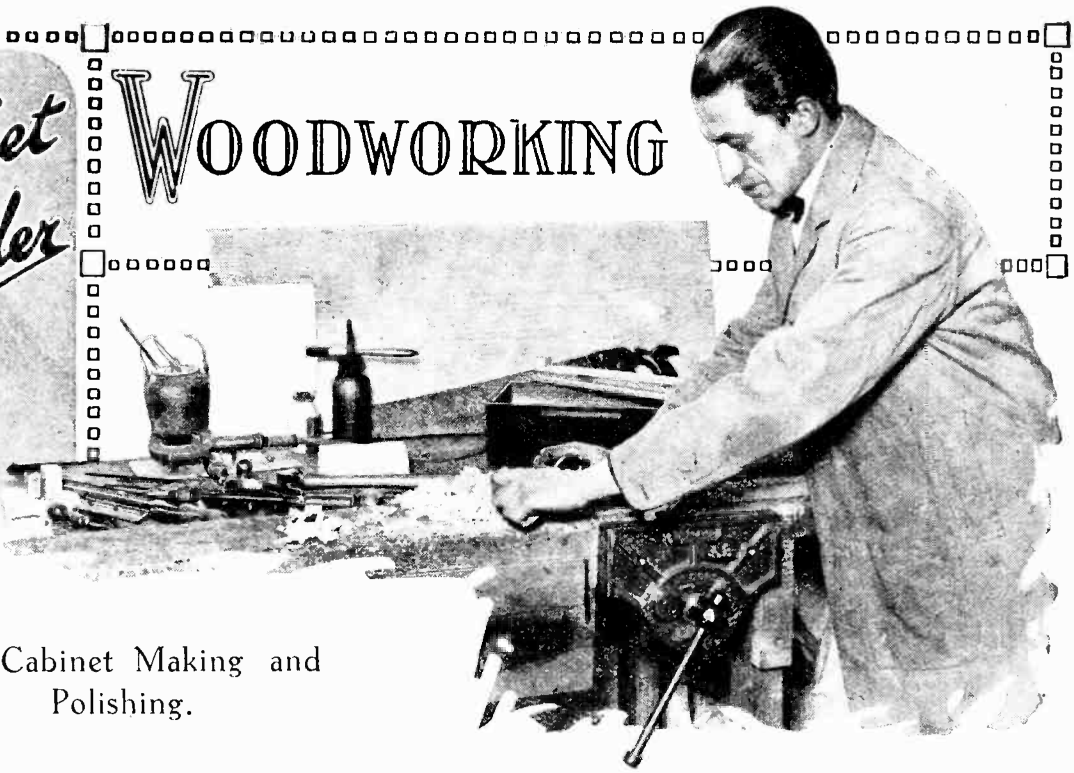
2

Continuity in the aerial and secondary windings is shown, respectively, between *a* and *a*, and *b* and *b*. The variable tuning condenser must be disconnected before testing it for short-circuits. Remove the connection between aerial-grid transformer secondary and −L.T. before testing between *c* and *c* for insulation of the grid circuit as a whole. Continuity of the complete plate circuit is shown between *d* and *d*, and of the neutralising winding between *e* and *e*. The insulation of the neutralising condenser (an important matter) is tested between *f* and *f*.

Continuity of the secondary is shown between *a* and *a*. This test is not absolutely positive unless the tuning condenser is disconnected and tested separately. The insulation between the windings (which should be high) is tested between *b* and *b*. The insulation of the complete grid circuit is indicated between *c* and *c*. A test between *d* and *d*, with output terminals short-circuited, will show continuity in the anode circuit. The filaments and rheostats may be tested, if necessary, at *e* and *e*, while the insulation of both anode circuits is shown across *f* and *f*.

The Set Builder

WOODWORKING



Home Cabinet Making and Polishing.

A GOOD set demands a good cabinet. Poor cabinet work or indifferent polishing detracts from the value of an instrument, and a badly designed set is often disguised by an attractive and well-finished cabinet. Comparatively recently a number of cabinet manufacturing firms have come forward with ranges of cabinets moderate in price and finished in a manner with which the amateur can scarcely compete. The majority of the commercial products are machine made with well-fitting slotted or dovetailed corners and all long boards stiffened at the ends with cross battens.

Apart from the labour expended in making a cabinet, the amateur will not find that he can save a great deal in setting about the job himself; in fact, it can only be said that, cabinet work being by far the most difficult part of wireless receiver construction, the task should only be undertaken by those desirous of qualifying in a new field of amateur work.

Boards Planed to Exact Dimensions.

Woodworking as applied to wireless cabinet making of necessity does not call for the highly skilled workmanship of the enthusiastic cabinet maker. The home constructor usually has no special interest in cabinet making. He purchases his wood in the form of planed boards exact to thickness, and the past two years have seen a large increase in the demand for wood in this form for wireless cabinet making, which is, perhaps, not surprising, as almost every published receiver design calls for a special cabinet. Cabinet manufacturers are alive to this difficulty, and, apart from a listed series of standard sizes, readily produce cabinets to published designs.

Planed boards exact to thicknesses, increasing by $\frac{1}{8}$in. from $\frac{1}{4}$in. to $\frac{3}{4}$in., are now easily obtainable in American white wood, satin walnut, mahogany, and oak. The small difference in price scarcely warrants the use of American white wood as compared with mahogany or oak, though it looks quite well as a baseboard, particularly if finished with a white polish such as is made up by dissolving white shellac, in preference to orange shellac, in methylated spirits. Satin walnut has a pleasing dark colour resembling walnut, though it is practically a useless wood, for, as well as being soft, twists and warps badly. Mahogany is sufficiently soft to work easily, and has a good natural colour. Oak, on the other hand, is a hard durable wood, though difficult to finish attractively either with a light yellow polish or a fumed finish, unless it is required to match its surroundings.

Direction of the Grain.

In designing a simple cabinet, the primary object is to avoid the exposure of end fibres, which, in the process of polishing, assume a much darker colour than the faces. The end fibres at the base of the cabinet cannot be disguised, and will take from the appearance unless some form of beading is applied to the front edge and the ends, the back edge being flush with the back of the cabinet. As very few wireless amateurs possess beading planes, it is not an unusual expedient to secure strip beading to the edges of the baseboard. Unless very skilfully carried out, the appearance of a cabinet will be spoilt by the added beading, while steps will have to be taken in polishing by way of using coloured polish in order to counteract small differences in colour.

In making wireless cabinets, the home constructor is scarcely involved in the use of the plane, and all edges

Woodworking.—
can, with care, be sawn and filed true in the manner described for working in sheet ebonite. A small iron plane is, of course, useful, and, except for the first long straight edge, the pieces are brought down to size by working to a line. In woodworking, as apart from shaping an ebonite panel, it is more convenient, after having finished one edge perfectly straight and square with the faces as tested by straight-edge and square, to set out the width, and plane down to a line, finally finishing the ends to give the required length by working to lines at right angles to the first trued edge. The need for working perfectly square and exact to size cannot be over-emphasised in cabinet making.

To avoid the exposure of end fibre, the sides of the cabinet must be arranged with the grain vertical, and, as it is assumed that dovetailing cannot be adopted, the back will need to be fitted to stand between the sides. The grain of the back piece will, of course, be horizontal. The bottom of the cabinet is usually made from a ⅝in. board, the sides and back of ⅜in., and the top ½in.

In the usual American type cabinet a cross piece bridges the two front corners of the end pieces. This strip, which should be from 1in. to 2in. wide, and made from ⅜in. wood, is fitted to come flush with the sides under the lid. In the absence of dovetailing, it must be securely glued in position and pinned through the ends. Although it is quite common practice to secure the lid to the back of the cabinet, it is better to fit another cross strip to give stronger support to the hinges. This strip need only be 1in. wide, but may, with advantage, be ⅝in. thick, for, unlike the front piece, its edge is not exposed.

The lid is made to overhang slightly on three sides, and the amateur is recommended to cross-batten it on the under side to prevent warping, though the battens cannot, of course, extend across the full width. The battens should be screwed as well as glued in position. The lid should be secured by a pair of good quality brass hinges, which are fitted by chiselling away slots in the top of the back piece only and to a depth just exceeding the total thickness of the folded hinge.

Filling and Polishing.

After any surplus glue has been wiped off with warm water the surface is rubbed down with medium and, finally, fine glass-paper, wrapped round the "face" of a cork rubber or piece of planed wood. Before attempting to polish, it is advisable even in amateur cabinet making to "fill" the grain. Several grain fillers are obtainable all ready mixed, but one cannot do better than use a spirit filling consisting of finely crushed whiting mixed to a paste with methylated spirits, and to which has been added rose pink colouring for use with mahogany and ochre for oak. The wood is rubbed down after the filling has dried, then treated with just a trace of raw linseed oil.

Detailed instructions cannot be given here as regards French polishing, but, as many experience difficulty through no other cause than using polishes of uncertain composition, it might be mentioned that a good polish suitable for general use is made up by dissolving one pound of orange shellac, one ounce of gum arabic, and one ounce of gum copal in half a gallon of methylated spirits. Alternatively, two ounces of gum sandarach or two ounces of gum mastic may be used instead of the gums copal and arabic.

As an alternative to staining the wood with a water stain, dyes can be conveniently added to the spirit polish. A yellow is obtained by dissolving gamboge or yellow ochre in white polish. Brown is produced by the addition of vandyke brown; red by adding bismarke brown (quarter ounce to one pint of polish). A pleasing and less fiery red is given by the addition of red sanders (two ounces to the pint), while a walnut colour is produced by the addition of spirit walnut (quarter ounce to the pint). A good black is obtained by the addition of a half-ounce of spirit black and a small quantity of ordinary washing blue.

NEWS FROM THE CLUBS.

Short Wave Competition.

In response to a large demand, the Lewisham and Bellingham Radio Society has formed a Morse instruction class, members of which will receive tuition from a qualified instructor.

At the Society's annual general meeting it was unanimously agreed to fix the Society's subscription at 5s. per annum.

An interesting competition open to all members is to be held on February 15th, when their abilities in the construction of sets for short wave reception (20 to 120 metres) will be tested, the sets being judged on their results. A prize will be awarded to the constructor of the winning set.

Hon. Secretary: Mr. J. A. Clark, 35, Boones Road, Lee, S.E.13.

oooo

Where Accumulators are Best.

The intriguing subject of "Battery Substitutes" was dealt with very thoroughly by Mr. K. Riley, M.Sc., in a lecture before the Nelson and District Radio Society on January 13th. The lecturer dealt with the three methods of rectifying A.C., viz., S tube, valve, and electrolytic, and he proceeded to give much useful information on smoothing devices of all kinds.

At the conclusion, it was agreed that in the Nelson district, taking into consideration the electricity supply and interference from motors, etc., accumulators were better for ordinary reception purposes, but not nearly so convenient.

Hon. Secretary: Mr. Harry Stow, 30, Swame Street, Nelson, Lancs.

oooo

Good Reproduction and How to Get It.

In consequence of many complaints from residents in the Golders Green and Hendon districts regarding poor reproduction of broadcasting, Mr. M. L. Kirke, one of the engineers of the B.B.C., kindly gave a lecture entitled "Good Reproduction on the Loud-speaker" at the last meeting of the Golders Green and Hendon Radio Society.

Mr. Kirke dealt ably and comprehensively with the whole subject of good reproduction, tracing step by step the causes of distortion, *e.g.*, poor H.F. amplification, bad rectification, oscillation, incorrect valves, poorly constructed transformers, incorrect grid bias, and, lastly, inefficient loud-speakers. He demonstrated in an interesting manner the difference between good and bad inter-valve transformers, but the most instructive demonstration was the testing of various loud-speakers by means of a "Tone Source." This piece of apparatus very clearly showed that the great majority of loud-speakers are insensitive to many notes in the musical scale. The "Rice-Kellog" instrument, though not perfect, was shown to be far superior to any other type exhibited.

The conclusion reached was that the

best components are essential for good work, and that although their first cost is higher, in the long run they are cheapest.

Hon. Sec.: Lt.-Col. H. A. Scarlett, D.S.O., 347a, Finchley Road, N.W.

oooo

Madrid Without Aerial.

A striking demonstration with the Igranic "Neutro-Sonic Seven receiver" was conducted by Mr. Alford at the last meeting of the Kensington Radio Society. Having given a brief and interesting history of super-heterodyne receivers from their first introduction into this country from America, Mr. Alford set out to prove the capabilities of the set he had brought. Its dimensions were remarkably small, as were those of the frame aerial, but he succeeded in tuning in on the loud-speaker a large number of foreign stations with good tone and volume, and a minimum of interference. Finally, the frame aerial was dispensed with, and using an ordinary 50 Igranic coil, it was found possible to tune in Madrid!

The Hon. Sec. will be pleased to welcome new members, and applications should be addressed to Mr. G. T. Hoyes, 29, Upper Phillimore Place, Kensington, W.8.

oooo

"Comic" Circuits.

"Circuits" was the laconic title of an entertaining and instructive lecture delivered by Mr. J. Hollingworth, M.A., M.Sc., of the National Physical Laboratory, at the meeting of the Sheffield and District Wireless Society on January 21st. He began by declaring that such is the efficiency of present-day valves and components, that if three condensers, two inductances, and a valve were put in a hat and shaken up quite a workable wireless circuit would come out! But the fact seemed to be forgotten to-day, said the lecturer, that the fundamental principles are still essential in a successful wireless circuit.

Referring to valves, the lecturer stated that it was impossible to make a valve possessing no grid-anode capacity, so one way of avoiding this was to introduce another capacity across the grid and anode, so setting up an opposing E.M.F. and neutralising the unwanted capacity.

In conclusion he expressed the opinion that there was nothing to beat the old-fashioned straight circuit, though much fun could be obtained from some of the present day "comic" circuits.

Hon. Sec.: Mr. T. A. W. Blower, 129, Ringinglow Road, Sheffield.

oooo

Echoes of the Southend Exhibition.

"Distortionless Reproduction, and How it May be Obtained," was the title of an interesting paper supplied by the Igranic Electric Co. and read by Mr. Plaistowe on January 14th, at the Southend and District Radio Society's fortnightly meeting. With the aid of a lantern, various amplification circuits were shown on the screen, and comparisons were made between choke, resistance, and transformer-coupled amplification.

FORTHCOMING EVENTS.

WEDNESDAY FEBRUARY 2nd.

Institution of Electrical Engineers (Wireless Section).—Informal Meeting. At 6 p.m. (Light refreshments at 5.30.) At the Institution, Savoy Place, London, W.C.2. Informal Discussion on "The Purpose and Design of Broadcast Receivers," introduced by Mr. C. F. Phillips.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture and Demonstration: "Fine Reproduction," by Mr. Dudley Wallace.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Demonstration on Transmitter.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Lecture: "Battery Eliminators." by Mr. F. H. Haynes, Asst. Editor, The Wireless World.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Business Meeting.

THURSDAY, FEBRUARY 3rd.

Institution of Electrical Engineers.—Ordinary Meeting. At 6 p.m. (Light Refreshments at 5.30.) At the Institution, Savoy Place, W.C.2. Lecture: "Some Recent Advances in A.C. Measuring Instruments," by Lt.-Col. K. Edgcumbe, R.E. (T.A.), and F. E. J. Ockenden.

FRIDAY, FEBRUARY 4th.

Sheffield and District Wireless Society.—At the Dept. of Applied Science, St. George's Square. Competition.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street, Leeds. Lecture: "Short-wave Transmission and Reception," by Mr. J. W. Wright, of Bradford.

Edinburgh and District Radio Society.—At

Radio Experimental Society of Manchester.—Experimental Evening.

Bristol and District Radio Society.—At 7.30 p.m. In the Physics Lecture Theatre, Bristol University. Lecture by Messrs Joseph Lucas and Co., Ltd.

MONDAY, FEBRUARY 7th.

Ipswich and District Radio Society.—At 8 p.m. At 55, Fonnereau Road. Lecture by Mr. J. M. Colbert (of A. C. Cossor, Ltd.): "The Co-Axial Mounting of the Valve."

Hackney and District Radio Society.—At 8 p.m. At 18-24, Lower Clapton Road, E.5. Explanation of Members' Sets.

Northampton and District Amateur Radio Society.—At 8 p.m. At the Cosmo Café, The Drapery. Question Night.

TUESDAY, FEBRUARY 8th.

Lewisham and Bellingham Radio Society.—At 136, Bromley Road, Catford, S.E.6. Lecture: "Speech Amplification," by Mr. E. J. Chapman.

SMTN, the amateur transmitting station owned by Mr. Göran Kruse at Djursholm, Sweden. The input is 18–35 watts pure D.C. at 550 volts, and the circuit employed is the Split Meissner–Hartley with an S.F.R. E 301 valve.

The chairman, Mr. H. H. Burrows, referred to the great success of the exhibition conducted by the society at the Boys' High School on January 8th, and to the high standard obtained by members in their entries in the amateur section. Special commendation was due to Mr. A. C. Webb, the winner of the silver challenge cup given by Mr. Pocock, Editor of *The Wireless World.* Mr. Webb has indicated that he hopes in the near future to give a demonstration at the club-room of his winning ten-valve supersonic receiver.

Hon. Secretary: F. J. Waller, Eastwood House, Rochford, Essex.

oooo

Freaks of Sound.

The problem of obtaining ideal acoustic conditions for the loud-speaker was tackled in an entertaining manner by Mr. A. G. Stanley, B.Sc., A.C.G.I., at the Muswell Hill and District Radio Society's meeting on January 19th. Curves were drawn representing the period of reverberation under varying conditions, and it was mentioned that the reverberation period of a new speech room at 2LO was three-quarters of a second, but in a special studio with sliding curtains in the roof the reverberation period could be varied between ½ to 1¾ second. Very often in a large hall, said Mr. Stanley, the audience proved to be the "densest" thing present; he cited the case of a certain dance hall, which had been provided with powerful loud-speakers, but on test, yielded peculiar thin and toneless reproduction. Immediately the dancers arrived, however, the reproduction became well-nigh perfect. The lecturer suggested that better results could sometimes be obtained in an ordinary room if more furniture were put into it.

A copy of the Society's syllabus, together with membership form, will be forwarded on request to the Hon. Secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.W.10.

oooo

The "Straight-eight."

Some products of the Marconiphone Co., Ltd., were described by Messrs. Fraser and Walker at the meeting of the Bristol and District Radio Society on January 21st. The lecturers dealt principally with the "Straight Eight" receiver, a set incorporating five stages of H.F. amplification, each stage being shielded and balanced so as to prevent oscillation. Mr. Fraser drew attention to the fact that the tuning controls for the H.F. stages were calibrated in wavelengths to simplify tuning. When the instrument was tested on Daventry and the ordinary broadcast wave band, the quality and volume of reproduction were noteworthy. The lecturers then explained other receivers of the Marconiphone range, including types 31 and 41.

At each meeting of the society a valve is balloted for among the members present, the winner at this meeting being Mr. W. A. Andrews, perhaps better known as "5FS."

Hon. Sec.: S. J. Hurley, 460, Cotswold Road, Bedminster, Bristol.

TRANSMITTERS' NOTES AND QUERIES

Transatlantic Telephony.

Referring to the note in our issue of January 12th, a correspondent at Thornton Heath states that he also heard the Canadian station sending gramophone records at 1410 G.M.T. on Sunday, January 2nd. Speech was very clear and steady, the wavelength being about 20 metres. Gramophone records by the Montreal Dance Band were transmitted, and between each record the operator announced "Canada Calling England." He also stated that reception from England was being received by land-line from their "Montreal office," which fact seems to indicate that the transmission was a test in connection with the new Beam system.

Our correspondent states that he often picks up this station, but as a general rule high-speed C.W. Morse is being transmitted.

o o o o

A correspondent in Guildford relates that while listening to U 2XAF between 2240 and 0020 G.M.T. on January 18th-19th, he found that he could hear the signals better when tuned to about 50 metres than on the stated wavelength of 32.79 metres. He attributes this fact to harmonics, and would like to get into communication with any other experimenter who had the same experience. We suggest, however, that the phenomenon is more likely to be due to retransmission by someone on this side of the Atlantic.

o o o o

General Notes.

Apropos the note in our issue of January 19th concerning the reception of s.s. *Carinthia* by the wireless operator at Walvis Bay station, we understand that this vessel, which is cruising round the world, is fitted with special apparatus for conducting long-distance wireless experiments, with which, while at Fremantle, Australia, she was in direct communication with London, New York, San Francisco, and Sydney, all within a period of twelve hours, and when nearing Auckland, New Zealand, at Christmas she despatched 700 greetings direct to New York and San Francisco.

o o o o

M. Joseph Scalabre (F 8LC), 57, rue des Carliers, Tourcoing, Nord, asks us to state that he is conducting some tests on wavelengths of 20 to 45 metres with inputs of 5 to 80 watts and will welcome any reports from British listeners. Besides his authorised call-sign, given above, he also uses F 8TSP, which, incidentally, has occasionally been mistaken for 8ESP, one of the "QRA's Wanted" in our issue of January 19th.

o o o o

Mr. Donald B. Fry (G 5UY), The Laurels, Mayfield, Sussex, asks if anyone who heard a station 5AA with prefix thought to be BR (Roumania), which called him on Thursday, January 20th, between 2015 and 2115 G.M.T., will kindly communicate with him as he was unable to obtain the QRA correctly.

A BELGIAN AMATEUR. The amateur transmitting station B.CH2 owned and operated by M. Maurice Meunier at Mons. Evidence of the activity of this station is shown by the number and variety of the mural decorations.

Mr. L. H. C. Lawler (G 6LR), 67, Lucien Road, S.W.17, tells us that at 1915 G.M.T. on January 17th he succeeded in establishing two-way communication with IC SX1, Mr. P. B. Arner, in Reykjavik, who reported the signal strength as R6. G 6LR, who was working with an input of only 8 watts, believes this to be the first time a British amateur has worked with Iceland.

He also had an interesting experience when working with the Belgian station B S5, whom he heard calling CQ at 1421 G.M.T. on January 14th. Wishing to get into touch with him and arrange a schedule he took 20 volts from his receiver accumulator, as his H.T. rectifier was then undergoing alteration, and gave the Belgian station a short call, hardly expecting to get a reply. Much to his surprise, however, B S5 replied at once, reporting the signal strength at R7, the input being 0.08 watts. Mr. Lawler was incredulous, but the Belgian assured him that there was no mistake, and suggested a reduction of power. 6LR then reduced his plate voltage to 10, when the signals were still reported as R7. Further reductions to 6 and 4 volts resulted in reports of signals as R5 and R2/3 respectively. The type of receiver used is not stated, but Mr. Lawler informs us he was transmitting with a Marconi LS5 valve.

o o o o

Mr. W. S. Davison (GI 5WD), Dunmore, Taunton Avenue, Belfast, tells us that he worked the following stations on January 16th between 1715 and 1940 G.M.T., using an input of 0.3 watt (60 volts 5 milliamperes):—

GW 14B Dublin, who reported signals as R4.

G 5MF London, who reported signals as R5.

G 2ZC Jersey, who reported signals as R3.

K 4KA Cassel, Germany, who reported signals as R4/6.

o o o o

New Call-Signs Allotted and Stations Identified.

G 2RO P. N. Langham, 94, Wilberforce Rd., Leicester. (Change of address.)

G 5IO (ex 5MO) W. G. Dixon, "Dipwood," Rowlands Gill, Co. Durham, transmits on 8 metres (37.5 megacycles), crystal controlled. This call-sign was formerly that of Mr. R. H. Brown, Shepherd's Bush.

GC 6MS A. H. Mason, 30, Marlborough Rd., Cathcart, Glasgow, transmits on 23, 45 and 150-200 metres.

G 6XH (ex 2BPC) C. C. Stevens, Almora, Andover, Hants, transmits on 8, 23, 45 and 150-200 metres.

D 7FP F. Philip, 12, Berggreensgade, Copenhagen.

D 7LO K. Lund, 40, Smallegade, Copenhagen.

D 7XU H. Norgaard, 33, Livjaegersgade, Copenhagen.

SS 8MAX The French Destroyer, "Léopard."

o o o o

QRA's Wanted.

G 5HR. GI 5ZY.

News from All Quarters: By Our Special Correspondent.

Daventry Developments — Alternative Programmes — Disappearing Stations — Talks — Broadcasting in China.

First Regional Station.

While the new station now under erection at Daventry is primarily intended for test purposes, we need not suppose that the apparatus which is being assembled will be scrapped when the tests are over. In fact, I learn from a reliable source that "Daventry Junior" will probably launch out early next autumn as the first active station under the projected regional scheme.

oooo

The Daventry Site.

Something of this sort was anticipated by the old B.B.C. when the Daventry site was purchased, sufficient land being acquired to permit of the erection of a second station. The new station will work on a power not far short of that of 5XX, and, as already stated in *The Wireless World*, will have a wavelength within the ordinary broadcast band.

oooo

A Real Alternative Programme.

It is hoped to transmit from this station a first-class alternative programme entirely independent of those given from 2LO and 5XX. The studio will be situated at Savoy Hill.

oooo

Studios Everywhere.

Although the regional stations will be few in number there will be no diminution in the number of studios. In fact the ideal at which the Corporation will aim will be the installation of new studios in as many important towns as possible, each being linked up to the regional chain.

oooo

Disappearing Stations.

Many of the present main stations will certainly disappear, although their studios will remain. Bournemouth, for example, will probably close down in due course, though the present studio in Holdenhurst Road will still be used when local talent is to be invoked.

But no matter how many of the present stations are doomed to extinction, we can take it as certain that the melancholy event will not take place until all crystal users are assured of alternative programmes. Valve users may expect three or more programmes from which to choose.

oooo

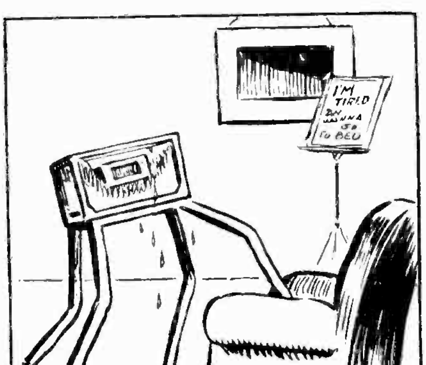
"Those Programmes."

From talk of the regional stations to a discussion on the present-day programmes may seem a big jump, but I fear that the two topics have something in common. In other words, until the regional scheme is proceeded with it seems extremely unlikely that the programmes will show much indication of falling into line with the needs of the public. The only way to that happy goal is *via* alternative programmes.

oooo

Variety with a Vengeance.

The B.B.C. are fully alive to this fact already, but they are making the mistake of attempting to send alternative programmes from the same studio and the same microphone on the same evening. Hence we have Bach at 7.50 p.m. and Variety at 8, with a flavouring of history a few minutes later, followed by a cheap excursion to the Muses. Then the pendulum swings back to the foundations of music, pauses a moment to recover balance, and then whisks us off down the labyrinths of economic cross-talk till we find ourselves back at Bach.



THOSE TALKS. Our artist captures an impression of a humble microphone's feelings after an evening of "Talks."

oooo

Talk, Talk, Talk.

On January 25th 2LO's programme included five talks in a single evening's entertainment. On the other hand, I learn that when a Peckham listener tuned in 2LO the other night he actually heard music. The patient is progressing as well as can be expected.

oooo

A Rumour Denied.

WLW, the Crosley broadcasting station at Cincinnati, U.S.A., has taken the lead in a National Laugh Month Campaign. There is absolutely no truth in the rumour that the present B.B.C. programmes represent an attempt in the same direction.

oooo

A Dickens Broadcast.

The anniversary of Charles Dickens' birthday on February 7th will be signalised by Dickens characterisations, broadcast from 2LO by Fred Grove.

oooo

To-morrow's National Concert.

The seventh B.B.C. National Concert from the Albert Hall takes place tomorrow, February 3rd, when the conductor will be Hermann Scherchen, with Pouishnoff as solo pianist. The programme will include Overture, "Oberon" (Weber); "Berklarte Nacht" (Schomberg); Concerto in E Flat (Liszt), pianist Pouishnoff; Beethoven's Symphony No. 3 in E flat (the Eroica).

oooo

Broadcasting in China.

With China looming large in the panorama of international affairs, more than usual interest attaches to some notes I have received from a Shanghai correspondent concerning the present state of broadcasting in that tumultuous country.

The Chinese authorities have always laid an embargo on wireless which has seriously hindered its development out there, but there are many individuals who have bravely overcome all obstacles and are in possession of receiving sets. In the last two years 700 sets have been sold in Shanghai, where the restrictions are not so severe, and a broadcasting station, KRC, owned by the Kellog Switchboard Company of America, is in regular operation.

○○○○

The Shanghai Station.

KRC supplies a large proportion of the broadcast entertainment enjoyed by set owners in the foreign concessions, and its regular programmes consist of six hours of American entertainment and six hours of Chinese music. The studio is in the business section of the city, but the operating room and transmitter are situated far out in the French settlement, near the boundary line. Most of the programme is broadcast from churches, concert halls and theatres. The majority of the Japanese stations can be picked up direct without much difficulty.

○○○○

Mr. Baldwin to Broadcast.

The Prime Minister's speech at the annual dinner of the Chamber of Shipping of the United Kingdom will be relayed from the Hotel Victoria to 2LO and 5XX on February 16th.

○○○○

Filming a Broadcast Play.

"The White Chateau," the broadcast play written by Captain Reginald Berkeley, is to be produced on the screen by Piccadilly Pictures, Ltd., in the coming spring. This is the first occasion on which a play specially written for broadcasting has been adapted for either stage or screen purposes. "The White Chateau" won a prize of £100, which was offered for the broadcast item which by popular vote was adjudged to be the best of the year. It has been twice broadcast, and is estimated to have been heard by at least 12,000,000 people. No play or film has ever had such an audience, and it probably exceeds the aggregate audiences of any play produced during the past fifty years. Captain Berkeley will prepare the scenario for film purposes.

FUTURE FEATURES.

Sunday, February 6th.

LONDON.—Military Band Concert.
BIRMINGHAM. — Beethoven Centenary Concert.
NEWCASTLE.—Recital of Rutland Boughton's Music.

Monday, February 7th.

LONDON.—"The Red Pen," a short opera by A. P. Herbert.

Tuesday, February 8th.

CARDIFF.—"The Man, The Maid, and the Muddlehead," a cameo by Gordon McConnell.
MANCHESTER.—The Chamber Music of Dvorak.
GLASGOW.—Scottish Town Series—No. 8, Kilmarnock.
BELFAST.—Programme of Nautical Music.

Wednesday, February 9th.

LONDON.—Programme from New Verrey's Restaurant.
NEWCASTLE.—"Better Times," a Radio Revue by E. A. Bryan.

Thursday, February 10th.

CARDIFF. — "Guy Weatherby's Dilemma," a comedy by Hilda P. K. Chamberlain.
GLASGOW.—"Le Villi," an opera by Giacomo Puccini.

Friday, February 11th.

NEWCASTLE. — "A Tale of the Hebrides," by D. G. Couzens.

Saturday, February 12th.

LONDON.—"Heterodyned History," Broadcast Revue by L. du G., of "Punch."
BIRMINGHAM.—"King Arthur," an opera by Henry Purcell.
GLASGOW.—Abraham Lincoln Anniversary Programme.

○○○○

An Unusual Announcement.

That was an unusual announcement from 2LO one evening last week, to the effect that the station would close down while endeavours were made to track an interfering station. Often between items the Keston station checks the wavelengths of Continental as well as British stations, but I understand that the reason for 2LO's announcement on this occasion was that it was expected that the London station would remain silent for at least two minutes. One of the B.B.C. regulations provides that an announcement must be made if a station ceases transmission for a period longer than one minute.

○○○○

Innocent Suspects.

At first it was thought that the interference was being caused by Leipsic or Graz, which, according to the Geneva plan, are separated from London by 10 kilocycles above and below respectively. But tests showed that both stations were working with a margin of more than 11 kilocycles from 2LO; so the culprit remained undetected.

○○○○

Describing a Soccer Game.

The Soccer game between Wales and France on February 26 will be described by an eye-witness at Swansea for the benefit of listeners. His comments are to be relayed to 2LO and 5XX.

BROADCAST TRANSMISSION OF PHOTOGRAPHS IN AMERICA. An interesting contrast is afforded by the two pairs of photographs shown above—both transmitted by wireless and recorded by Dr. E. F. W. Alexanderson's system. The pair on the left are the result of a modulated signal sent by a broadcasting station; those on the right—reproduced in a newspaper—were recorded from a telegraphic signal.

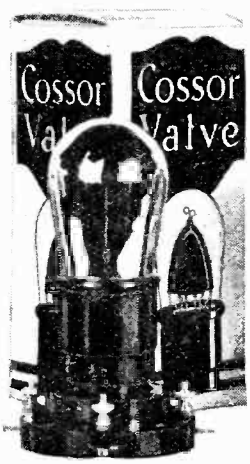
VALVES WE HAVE TESTED

H.F. and L.F. Valves with Low Filament Current.

THIS week we give the results of our standard tests of quite a variety of valves. Three of them are of the type having a high anode A.C. resistance with a correspondingly large amplification factor. These are the new Cossor Point One 2-volt R.C., Ediswan R.C.2, and Mullard P.M.5B, while in the Marconi and Osram series is the new D.E.H.612 of medium A.C. resistance and amplification factor. There are also three power valves of the moderately low A.C. resistance class for 2-, 4-, and 6-volt filament-heating batteries.

Cossor Valves.

The first Cossor valve tested was the new Point One 2-volt R.C., which, as its name implies, requires a 2-volt filament-heating battery and consumes 0.1 ampere. Being designed primarily for resistance capacity coupling, it has a high amplification factor, the average of those we tested varying from 33 to 37, as shown in the table.


Cossor Point One 2-volt. R.C.


Cossor Stentor Four.

With the anode voltages and grid bias values given in the table the anode A.C. resistance varied between 77,000 and 105,000 ohms. Considering that the valve has a 2-volt filament, the A.C. resistance is quite low for the amplification obtained, and the valve is a particularly good one of its class. It is silent in operation and works very well as a rectifier.

It can be used successfully in the "Everyman's Four-valve" receiver. Readers interested in this set will remember that two fixed resistors are used to reduce the filament voltage from 6 to the required amount. The two resistors required when this valve is used as the rectifier have a value of 15 and 30 ohms.

It will be noticed that quite a small anode current is taken by the valve, so that the resistance coupling used can be of the grid-leak type, provided quiet ones can be obtained. The anode resistances should not be too high; about 0.5 megohm will be satisfactory.

COSSOR VALVES.

TYPE POINT ONE 2-VOLT R.C.

Filament voltage, 1.8–2. Filament current, 0.1 ampere.
Anode voltage, 75–125. Total emission, 20 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
75	0.26	−0.75	105,000	33.3
100	0.44	−1.0	93,000	34.8
125	0.60	−1.25	93,000	36.1
125	0.9	−0.5	77,000	37.0

TYPE STENTOR FOUR (POWER).

Filament voltage, 3.8–4. Filament current, 0.1 ampere.
Anode voltage, 80–120. Total emission, 40 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
80	6.3	−1.5	9,100	6.9
100	7.5	−3.0	6,900	6.9
120	9.0	−4.5	6,900	6.9

The second Cossor valve tested was of the power type and is known as the "Stentor Four." This valve requires a 4-volt filament-heating accumulator and consumes 0.1 ampere. Suitable operating values of grid bias and anode voltage for the valves of this type are given in the table. For an amplification factor of 6.9 the anode A.C. resistance is 6,900, that is, the mutual conductance, in milliamperes per volt, is 1.0. This valve is suitable for working in the output stage of a receiver and will give signals of sufficient strength to operate a normal loud-speaker. It can also be used in a transformer-coupled low-frequency amplifier, the transformer having a ratio not exceeding about 4 : 1.

Ediswan Valves.

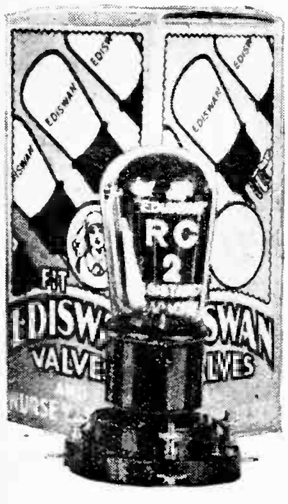
Samples of the new Ediswan R.C.2 valve have been tested, and the results are given in the table below.

This valve requires a filament-heating current of 0.1 ampere at 2 volts, and has an amplification factor of about 40, with an A.C. resistance varying from 280,000 to 240,000 ohms, according to the anode voltage and grid bias used. The makers state in their leaflet that, in general, grid bias is unnecessary when the valve

Valves We Have Tested.—

is used for low-frequency amplification, but when used as a detector employing anode bend rectification a bias of negative 3 volts should be connected.

When used with resistance-capacity couplings, however, it is very important to prevent grid current; and for this reason it is advisable to employ a small negative grid bias, the drop across the filament rheostat being sufficient in many cases. The A.C. resistance of this valve is very high for its amplification factor. As the makers recommend that anode resistances of 1 to 5 megohms should be used for this valve, possibly the fact that the valve has a high anode resistance is not of vital importance, but when the lower value of anode resistance is used the amplification obtained would be greater if the valve had a lower A.C. resistance.



Ediswan R.C.2.

Marconi and Osram D.E.H.612.

The Ediswan 2-volt power valve is known as the "P.V.2." This takes 0.15 ampere at 2 volts and is designed for use in the output stage of a receiver. It can also be used in a low-frequency transformer-coupled amplifier with appropriate grid and anode voltages. The table shows that the specimen tested had an amplification factor of about 7.5 for an A.C. resistance of 13,000 ohms.

EDISWAN VALVES.

TYPE R.C.2.

Filament voltage, 1.8–2. Filament current, 0.1 ampere.
Anode voltage, 75–125.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
75	0.142	−0.25	280,000	40.0
100	0.224	−0.25	244,000	40.9
125	0.3	−0.25	238,000	49.4

TYPE P.V.2.

Filament voltage, 1.8–2. Filament current, 0.15 ampere.
Anode voltage, 80–120. Total emission, 30 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
80	4.6	−1.5	13,300	7.5
100	5.1	−3.0	13,300	7.8
120	5.5	−4.5	15,200	7.2

Marconi and Osram Valves.

The two valves tested are new products; one is known as the D.E.L.612, and the other as the D.E.H.612, from which it should be understood that one has a high amplification factor and requires a filament current of 0.12 ampere at 6 volts, while the other has a low amplification factor and requires a similar filament current.

MARCONI AND OSRAM VALVES.

TYPE D.E.L.612.

Filament voltage, 5–6. Filament current, 0.12 ampere.
Anode voltage, 40–80. Total emission, 40 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
40	1.15	−1.5	10,800	6.0
60	2.1	−3.0	8,100	5.3
80	4.5	−4.5	8,100	5.3

TYPE D.E.H. 612.

Filament voltage, 5–6. Filament current, 0.12 ampere.
Anode voltage, 70–150. Total emission, 40 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
70	0.46	−0.5	54,000	18.8
90	0.65	−1.0	50,000	20.8
110	0.84	−1.5	39,000	19.8
130	1.09	−2.0	36,400	19.0
150	1.36	−2.5	30,600	18.5

The D.E.L.612 should, according to the manufacturers, be used with an anode voltage not exceeding 80 volts. At this voltage a grid bias of negative 4.5 is satisfactory, the amplification factor being 5.3, and A.C. resistance 8,000 ohms approximately.

Full results are given in the table; from these it will be seen that the valve can be used in a low-frequency amplifier with transformer coupling and as the output valve of a receiver when signals of moderate strength only are required. Actually, the valve can be used with an anode voltage of 120 with a grid bias of −9; it will then deal with far larger inputs and give an output sufficient for many of the medium-size loud-speakers. It will be noticed that the A.C. resistance of the valve is rather high compared with the amplification factor, but as it is below 10,000 ohms the valve can be said to be quite suitable for working a loud-speaker.

The D.E.H.612 has an average amplification factor of 19 to 20, and an A.C. resistance of 54,000 to 31,000 ohms. This valve can be used in a resistance or choke-coupled amplifier and as a high-frequency amplifier, provided a high anode voltage is applied. The D.E.H. and D.E.L. valves are similar in appearance to the well-known D.E.5, but on test they were inclined to be noisy.

Mullard P.M.5B.

Valves We Have Tested.—

The Mullard P.M.5B.

This valve is designed for use in resistance-capacity coupled amplifiers; for this reason it has a high amplification factor, for the specimen tested varying from 36 to 41. Under the conditions of the test, the A.C. resistance varied from 70,000 to 150,000. The valve requires a filament current of 0.1 ampere from a 6-volt accumulator; it is fairly silent in operation. A valve of this type can be used as an anode rectifier when a high resistance should be connected in its anode circuit.

The valve is similar in appearance to other valves of the well-known P.M. series, no glow being visible when the filament is heated. It should be noted that a valve of this type cannot be used in a transformer-coupled amplifier, as its A.C. resistance is far too high. Neither can it be used in a high-frequency amplifier employing a tuned high-frequency transformer. It could be used in a choke-coupled amplifier, provided the choke connected in the anode circuit had an inductance of at least 200 henries. If a P.M.5B is used in the detector and first L.F. position, a P.M.6 or a P.M.256 should be used in the output stage.

MULLARD VALVE.
TYPE P.M.5B.

Filament voltage, 5–6. Anode voltage, 75–150. Filament current, 0.1 ampere. Total emission, 40 milliamperes.

Anode Voltage.	Anode Current. Milliamperes.	Grid Bias. Volts.	A.C. Resistance. Ohms.	Amplification Factor.
75	0.17	—0.75	154,000	41.5
100	0.28	—1.0	95,000	36.0
125	0.41	—1.25	87,000	38.2
150	0.61	—1.5	69,000	36.4

Calls Heard.

Extracts from Readers' Logs.

London, N.17.

(January 3rd-9th.)

England and Wales:—G 2GF, 2NH, 2VJ, 2WJ, 2WN, 2XO, 5AD, 5BH, 5DH, 5HS, 5HX, 5JW, 5KU, 5MS, 5XY, 6CL, 6OT, 6QB, 6TA, AP4, AZ4, GLQ. Scotland:—GC 2WAI, 6NX. Irish Free State:—GW 3XU, 11Z. Belgium:—B A2, 9B, O8, S5. France:—F 8CP, 8FLM, 8FU, 8FWB, 8GDB, 8GZ, 8HS, 8IL, 8JJ, 8NN, 8OLU, 8SM, 8WEL, FL, FW, OCNG. Holland:—N ORO, ONM, OPM, OWB, OWM, 3TW, PCLL, PCMM, PCRR, PCTT. Denmark:—D7FJ. Sweden:—SMUV, SAB, SIC. Finland:—S2NM. Russia:—RCRL. Germany:—K 4ABR, 4RTT, 4XR, 4XW, 4YAE, AGB. Austria:—Ö HL, PY. Italy:—I 1DO. Egypt:—SUC, SUC2. French Somaliland:—OCDJ. U.S.A.:—U 1AZR, 1BHS, 7XM, 2CVJ, 2CYX, 2FJ, 2UO, 2XO, 2XAF ('phone), 3AGG?, 3BLC, 4HY, 8AMU, 8CUA, WIZ. Canada:—C 2BE. Brazil:—BZ 1AD. Java:—ANF.

Unknown:—GBH, UTM, SGL, SP.

(0-v-2 Schnell.) On 15 to 90 metres.

W. T. Ford.

Dublin.

(November, 1926, to January 10th, 1927.)

Australia:—A 7CS, 7LA. Belgium:—B K5, N33, H6, L14, V33, 4AA, A2, M2, 4AA, 4RL, O8. Baghdad:—1DH. Brazil:—BZ 1AK, 1AW, 2AS, 2AB, 2AG, 1AB. Canada:—C 1AR, 2AX, 3MP.— China:—BXY. Czecho-Slovakia:—CS 2UN, AA2, OK1, 2YD. Denmark:—D 7MT, 7XZ, 7NI, 7FP, 7XU, 7ZG, 7FJ, 7WA, 7UJ. Spain:—EAR6, EAR18. Algeria:—FA 8VX. Morocco:—FM 8ST, 8OX. Corsica:—OCT. France:—F 8BRN, 8VVD, 8ZB, 8YOR, 8FK, 8PAM, 8SO, 8GI, 8RBP, 8ZET, 8KL, 8XA, 8ARO, 8NOX, 8APO, 8CP, 8BLA, 8UT, 8ALU, 8OQP, 8YA, 8JO, 8KL, 8FFR, 8RV, 8QW, 8DX, 8BP, 8VX, 8KP, 8FY, 8TIS, 8KP. Great Britain:—G 2WL, 2BM, 2NT, 2NH, 2HQ, 2VQ, 2ABF, 2VZ, 2NP, 2CC, 2WJ, 2DX, 2NM, 2DL, 5FQ, 5UW, 5XD, 5UY, 5AX, 5WF, 5GO, 5VL, 5TD, 5JW, 5MS, 5DH, 6LR, 6FT, 6RY, 6TA, 6YD, 6KO, 6TG, 6VP, 6YU, 6CL, 6NK, 6AI, 6UG, 6GF, 6DA, 6TD, 6NF, 6BD, 6NX, 2RG, 2WN, 2CB, 5LB, 5RU, 5AU, 5XH, 5XD, 5DH, 5JW, 6WK, 6UZ, 6FA. Irish Free State:—GW 11B, 18B, 14C. Italy:—I 1CE, 1CO, 1DR, 1MT. Germany:—K 4EY, 4XY, 4SA, 4LDK, 4LD, 4AW, 4ACA, 4UAG, 4QA, 4UL, 4ORA, 4MCA, 4HA, 4XU, 4ABG, 4ABF. Norway:—LA 1A, 1E, 1F. Holland:—N PCRR, 0WB, 0WM, 0WR, 0UK, 0GG, 0ZI, 0XZ, 0TH, 0PM, 0QQ, 0DK, 0UC, 0NM, 0AG, 0CI, 0PY, 0AE, 0RF, 0VN, 0RY. Austria:—Ö PY, FZ, HL. South Africa:—O A3B, A4L, A5X. Portugal:—P 1AO, 1AF. Sweden:—SM ZN, RT, UA, UV, SS, YG. Poland:—TP AX, AV. Lithuania:—TL LIT 1B, U.S.A.:—U 1AYL, 1AKZ, 1ASA, 1ASC, 1CKP, 1CKJ, 1CXL, 1GA, 1KL, 1NQ, 1XAM, 1AQ, 1AF, 1UZ, 1AXA, 1AAO, 1CMF, 1ALL, 1BUZ, 1DL, 2ARM, 2BUM, 2CIB, 2EM, 2MD, 2NZ, 2UO, 2VSX, 2PV, 2EJ, 2CVJ, 2CZR, 2CTF, 2AMJ, 3AHL, 3LW, 3CKL, 3BWJ, 3QW, 4IZ, 4ALG, 4LQ, 8ABG, 8AFL, 8BTH, 8DJG, 8AFQ, 8ALF, 2XO, 3JO, 8AT, 9EF. Y 2ZY. Miscellaneous:—GLKY, GFU, GMD, OZB, SFV, XMO, 2BM, SPM, AGB, SPL, CBI, AOP, GFT, GMD, SKC.

J. B. and R. D. Scott.

Northampton.

(December 12th to January 10.)

Australia:—A 2DS, 2RT, 5BG, 5HG, 5KN. Belgium:—B A2, B1, B7, B82, CH5, D2, H6, K3, K44, N33, O5, O8, R2, Y8, 4AA, 4AR, 4XS, 4ZZ. Brazil:—BZ 1AF, 1AP, 1AW, 2AF, 2AG, 2AS, 3AB, 5AA, BZL, POA. Canada:—C 2BE, 8AZS. Chile:—CH CH. Czecho-Slovakia:—CS 2UN. Denmark:—D 7EW, 7LO, 7NI, 7ZG, 7ZM, OXF, OXZ. France:—F 4BM, OCDJ, OCNG, FUT, 8ABC, 8AG, 8ARM, 8BNH, 8BW, 8CP, 8DD, 8DGS, 8FK, 8FR, 8FU, 8FWB, 8GAM, 8GBD, 8GI, 8GZ, 8HSG, 8IF, 8IL, 8JJ, 8JNC, 8KP, 8LB, 8LZ, 8NDX, 8NOX, 8OLU, 8OXO, 8PY, 8RBP, 8REN, 8RVL, 8RZ, 8SSW, 8TIS, 8UDI, 8UGA, 8UT, 8VX, 8YA, 8YOR, FL, FW. Algeria:—FA 8MCO. French Indo-China:—FI 8FOK. Great Britain:—G 2AK, 2BM*, 2CC, 2CS, 2DB, 2MN* 2NH*, 2NM,* 2NT, 2OW, 2SW, 2TB, 2TO, 2VG,*, 2VR*, 2VS, 2WN, 2XO*, 2XV*, 2XY, 2YX, 2ZC, 5AD*, 5DA, 5DC*, 5DH, 5GU, 5GW, 5HX, 5JW, 5KZ, 5MA, 5MS, 5OC, 5QG, 5RU, 5SZ*, 5TR*, 5TZ*, 5UL*, 5US*, 5UW, 5XD, 5XY, 5YK*, 5YM, 6BT*, 6CI, 6CL, 6FT, 6FZ, 6HT, 6HW, 6HZ*, 6IA*, 6JV*, 6KA, 6KK, 6LB, 6LR, 6NH, 6OH*, 6QH, 6QO*, 6TA, 6TX*, 6TY*, 6UT, 6UU, 6UV, 6UZ, 6VP, 6YC, 6YV, 6ZA, BVJ, GBM, GFA. Scotland:—GC 2VX, 2WL, 6IZ, 6KO. Northern Ireland:—GI 5WD, 6MU. Irish Free State:—GW 3XO, 3XS, 3XU, 11A, 11P, 18B, 19B. Italy:—I 1CR, 1GW, 1MT, 1XA. Jamaica:—JM 2PZ. Germany:—K 2DO, 4AAP, 4ABF, 4ABG, 4ABN, 4ACI*, 4DKA, 4HA, 4LD, 4LS, 4RM, 4SA, 4SAR, 4UA, 4UAO, 4UL, 4VO, 4XR, 4XU, 4XY, 4YA, 4YAE, AGB, AGC. Norway:—LA 1E, 1R, 1SF, 1X. Holland:—N OAG, OAX, OCMX, OCX, ONM, ORF, OVN, OWB, OXX, PCG, PCLL, PCMM, PCRR. Austria:—O GP, HL, KE, PO, PY. Portugal and Madeira:—P 1AJ, 1AO, 3FZ, 6PE. Russia:—R 1UA. Argentine:—R FC6. Finland:—S 2NM. Sweden:—SM 1P, SMRP, SMTN, SMUK, SMUS, SMWS, SMXR, SMYG. Straits Settlements:—SS 2SE. Poland:—TPAV, TPVV. U.S.A.:—U 1ADS, 1AFF, 1APK, 1ASF, 1ASU, 1AZR, 1BDW, 1BDX, 1BES, 1BHM, 1BLB, 1BLF, 1BUX, 1CMF, 1GA, 1RD, 1VZ, 1XM, 1ZA, 2AGN, 2APV, 2AYJ, 2BBB, 2CVJ, 2CYX, 2FJ, 2FO, 2KC, 2OR, 2PE, 2VH, 2XS, 3AFQ, 3AGG, 3BLC, 3BWT, 3LD, 3QF, 4AAN, 4BL, 4QB, 4RN, 8ADM, 8BEN, 8BRC, 8CAU, AB1, NKF, NRRG, WIK, WIZ, NEM. India:—Y 2BG. Uruguay:—Y 1CD, 2AK. New Zealand:—Z 4AR, 4AA. Miscellaneous:—ABC, AP4, AZ4, CB3, CT4, CW3, DNSC, DU4, FU9, MIZ, PTR, SAD, SBM, SIC, .1DH, 7DE, 9PZ, 9RN, 9SJ, 9YU.

(0-v-1 Reinartz) On 30-50 metres.

* Indicates telephony.

P. H. Brigstock Trasler.

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.

MANUFACTURERS AND THE RADIO SOCIETIES.

Sir,—In reply to Mr. P. K. Turner's letter in your issue of 12th inst., may I ask you to insert this refutation? We had already applied to Messrs. Burndept before the date of the letter he quotes. I have a letter from them dated November 2nd in answer to a recent one of ours asking for a lecture or demonstration, and, moreover, Messrs. Burndept, through Radio Accessories (of which they are proprietors), arranged a most excellent lecture illustrated by lantern slides and given by Mr. Samuelson, their chief technical adviser, on "The Manufacture of Thermionic Valves" on Tuesday, December 7th, 1926, which was much appreciated by all our members. Under the circumstances, and as our Mr. Pegram, hon. sec. of the Experimental Section, was at the moment in communication with Messrs. Burndept I did not consider the letter needed a separate answer. I must say that since your courteous publication of this correspondence we have had no cause of complaint against any of the radio manufacturers to whom we have written, and I should like to take this opportunity of thanking you on behalf of the members of our society for your kindness.

A. H. BANWELL,
Hon. Sec., The Thornton Heath Radio Society.
January 21st, 1927.

WET BATTERY FOR H.T. SUPPLY.

Sir,—As there are so many amateurs using wet Leclanché cells for their H.T. supply, I wonder if my experience is unusual, and I should be glad to have the views of other users.

Some months ago I made up a battery of fifty cells in the large-sized pots—1½in. square; these were carefully soldered, waxed, and fixed in bitumen compound in a box. The battery is still functioning correctly, and, of course, does not cause any crackling in the loud-speaker, but the voltage has dropped remarkably in a few weeks, being now only 0.7 per cell. The receiver uses three valves, with an H.T. demand of 8 milliamps, and the number of hours is the usual—say two or three hours per day at the most. It would seem that the wet cell is not all that we have been led to believe both in convenience and economy. I should be glad to hear other users' experiences.

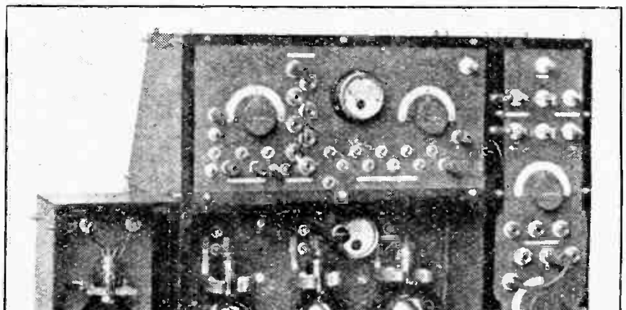
January, 1927. SAL AMMONIAC.

ARRANGEMENT OF PROGRAMMES.

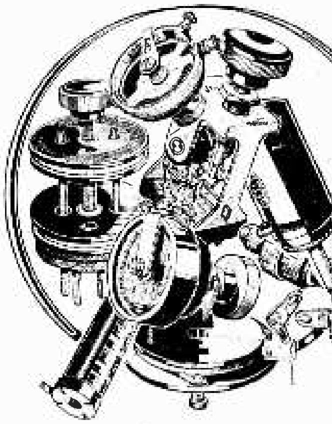
Sir,—I am glad to see that your recent Editorial has provoked so much interest amongst your readers, to judge from the correspondence in to-day's issue, and other comments which I have seen in the daily Press.

The change in the programme arrangement and the introduction of more talks will not, in my opinion, do wireless any good. We know that things were very much better under the old *régime*, and it is most unfortunate for everyone concerned if the new controlling body is going to insist on putting us back to school when we look for recreation and entertainment during the evenings. The listening public supported the recommendations of the Broadcasting Committee when they advised that the wireless trade directorate of the B.B.C. should be replaced by a national body, and I believe you also endorsed that recommendation. The reason, I think, that we approved of that change was because, in typical British fashion, we aimed at an ideal, and the presence of interested persons on the Board of Direction seemed incompatible with our ideals. We trusted the new Board to see to it that, although they (unlike the trade representatives) did not depend for their bread and butter on the popularity of broadcasting, they would, nevertheless, see to it that we were entertained at least as well as we had been in the past. As things are at present it looks as if the Government-appointed Board means to sacrifice us on the altar of our own ideals, which have put them in authority. In less polite language, we might say that we seem to be the victims of a confidence trick.

January 26th, 1927. IDEALIST.



TRANSMITTER FOR SUBMARINES. The Marconi 1½ kW. transmitter specially designed for use on submarines. The range of this transmitter for telephony is 100 miles and it can be used for telegraphy up to 300 miles.



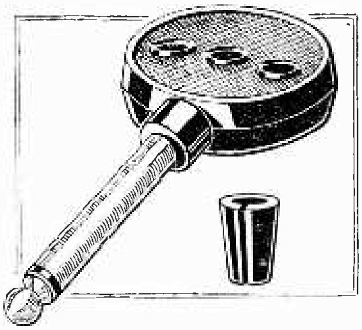
MANUFACTURERS' NEW APPARATUS

HIND

A Review of the Latest Products of the Manufacturers.

NEW LOTUS PLUG.

The form of construction in which the insulating pieces take a part for securing the connectors is now practically obsolete in the manufacture of telephone plugs. With this old type of plugs, small screws have to be manipulated in the interior and several minutes are required for the changing of the leads. In the new Lotus plug, made by Messrs. Garnet Whiteley and Co., Ltd., Lotus Works, Broadgreen Road, Liverpool, the connecting wires are secured by giving half a turn to each of two screw heads which appear on the body of the plug. Rotat-



New type of Lotus telephone plug. A particularly long stem is provided and by the use of a split sleeve the plug can be adapted to suit the modified form of jack.

ing the screws slightly drags the leads further into the plug, where they become securely locked. This action is produced by the screws actuating cams which force the ends of the inserted wires hard up against suitably shaped bronze springs. These springs connect with the tip and stem of the plug.

The body of the plug is a clean, polished moulding, and has an attractive finish, and in outline and proportioning as well as the general details of construction it shows the merits of really good design. The plug on test proved to be electrically perfect.

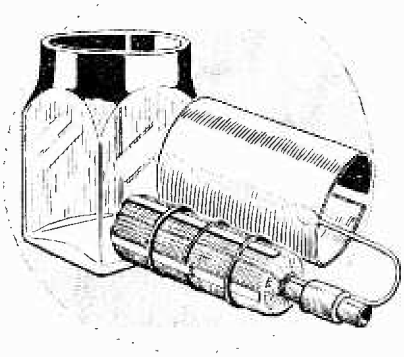
o o o o

WET H.T. BATTERY.

The problem of maintaining a H.T. battery has led many amateurs to interest themselves in the possibility of building a high voltage battery from wet Leclanché cells.

To meet the demand for a H.T. battery which can be recharged by renewing the electrolyte the Eton Glass Battery Co., 46, St. Mary's Road, Leyton, London, E.10, now manufacture a miniature cell having sufficient capacity for normal use.

The small glass container is $2\frac{1}{4}$in. in height and square shaped with $1\frac{1}{2}$in. sides. It accommodates a circular carbon surrounded by the depolariser of similar construction to that adopted for the making of dry cells. The cylindrical zinc is of liberal area, being $1\frac{5}{8}$in. in height by 1in. in diameter, and before being brought into use should be amalgamated by dipping into a weak solution of hydrochloric acid and then rubbed with a clean cloth on the surface of which are a few beads of mercury. Immersion in a slightly acid solution of mercuric chloride is an alternative method of amalgamating zinc. The jars are supplied either plain, waxed at the top, or treated with a compound to prevent creeping.



Small Leclanché cell for constructing a wet H.T. battery which can be recharged by renewing the electrolyte.

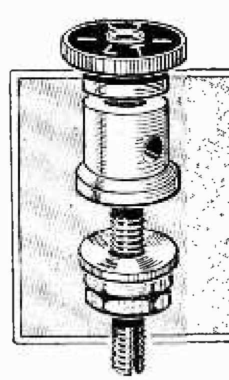
These little cells are quite suitable for operating a receiving set using one or two valves and will require very little attention, but if the receiver includes a power amplifying stage the electrolyte will require frequent renewal.

To protect the cells from damage and to prevent evaporation the battery should be enclosed in a box provided with a closely fitting lid.

EELEX TERMINAL.

Messrs. J. J. Eastick & Sons now manufacture a terminal suitable for accommodating the end of a lead, a spade or plug connector. The top screws down to grip the end of a lead, or the usual form of spade, or a plug may be inserted in the head. The terminals carry indicating labels.

The indicating tops can be completely



The new Eelex terminal suitable for accommodating plug, spade or wire connector and fitted with a connecting top.

unscrewed, and one must be careful, therefore, not to interchange them, should they become detached.

The terminal is cleanly machined, has a nickel-plated finish, and is supplied complete with washer and two back nuts.

o o o o

LITZENDRAHT WIRE.

To meet the growing demand for Litzendraht wire, Ward and Goldstone, Ltd., Frederick Road, Pendleton, Manchester, have added to their range a reliable form of wire in which the individual strands are single silk covered and stranded together with a green silk outer covering.

As is usual, the wire comprises twenty-seven strands layed up by twisting together in threes, grouping these to form nine strands, three of which again are twisted together to form twenty-seven.

The green silk finish gives an attractive appearance, and in the length of wire examined all strands were found to be continuous throughout the length.

READERS' PROBLEMS ANSWERED

"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Valves for "Everyman Four" Receiver.

I have built an "Everyman Four" receiver, and I do not obtain such strong signals as a friend of mine with his "Everyman Four." I rather suspect my valves, which are of the 2-volt type. Actually I use a DE2 H.F. for the H.F. and detector positions, and a DE2 L.F. in the first low-frequency and output positions. Should valves make such a tremendous difference to the performance of a receiver? P. R. R.

Valves are a great factor in the performance of a receiver. The DE2 H.F. valve which you are using in the H.F. position has an amplification factor of 12 and an A.C. resistance of 45,000 ohms. Now the high-frequency transformer was designed for a valve having an A.C. resistance of 20,000 to 30,000 ohms, and the actual valve used in the author's receiver had an amplification factor of 20. This resulted in a high frequency amplification of about 40, whereas with the DE2 H.F. the amplification obtained will be only about 15 —possibly not as much as that. This is because the DE2 H.F. valve has a much lower amplification factor and a much higher A.C. resistance.

With the DE2 H.F. valve the selectivity will be better simply because valve damping is less, but the signals will be very poor by comparison.

So far as the detector valve is concerned the DE2 H.F. is satisfactory, but the DE2 L.F. used in the first L.F. stage will give an amplification of only 24 approximately, as compared with about 70 when the valve recommended by the author is used. This is because the DE2 L.F. has an amplification factor of only 7 for an A.C. resistance of 22,000 ohms; many valves on the market have an amplification factor of 20 for this value of A.C. resistance.

To use a DE2 L.F. valve in the last stage is to ask for trouble, particularly if the loud-speaker is one of large size.

A power valve must be used in the output stage of "Everyman Four" receiver, with proper H.T. and grid bias. In the original article an anode voltage of 160 was recommended with appropriate grid bias, the valve being a DE5 type. The reason for the use of such a valve with a high anode voltage was to keep the total anode current required by the set to a reasonable figure. Those who are prepared to use accumulators for the anode supply or dry cell batteries of the larger size will find it advantageous to employ one of the so-called super power valves in the output stage, such a valve being of the type requiring a grid bias of 20 to 30 volts with an anode voltage of 120 to 160.

One of the most common forms of distortion is that due to overloading the last valve. Good quality and loud signals cannot be obtained unless ample battery power is available.

○○○○

Single-Valve Reflex Receiver.

I wish to build a single-valve receiver which will give me the best results for one valve as regards both range and volume. Would you please give me a suitable circuit and specify, where necessary, the values of components required? C. P. A.

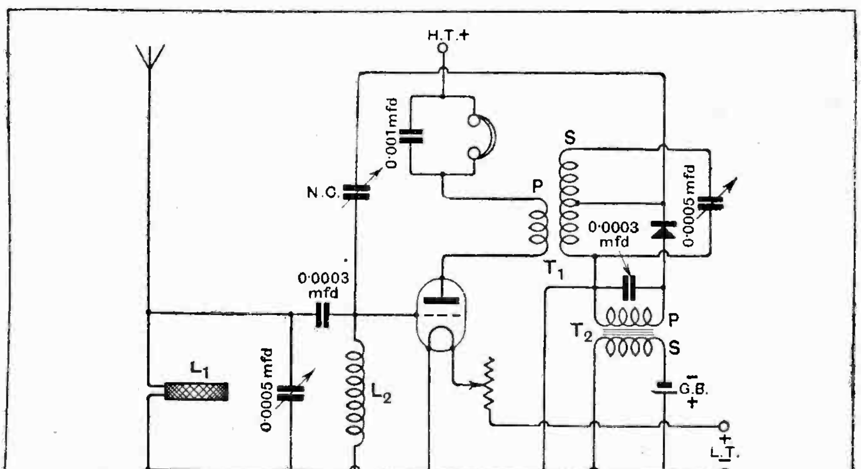
The circuit shown below, which uses the valve both for high- and low-frequency amplification, with a crystal for rectification, will be suitable.

The operation of the circuit is as follows: H.F. signals are tuned in on coil L_1 with the 0.0005 mfd. condenser and applied to the grid of the valve through the fixed 0.0003 mfd. condenser. In the plate circuit of the valve is an H.F. transformer T_1 stabilised by the neutralising condenser N.C., so that magnified H.F. voltages are produced across the secondary of this transformer.

A crystal rectifier is used, tapped part of the way across the secondary of the H.F. transformer so as not to overload the latter, and the rectified currents passed through the primary of the L.F. transformer T_2. The H.F. component of the rectified current is by-passed by the 0.0003 mfd. condenser shunted across the primary of T_2.

The secondary of T_2 is connected to the grid bias battery and to the grid of the valve through an H.F. choke L_2 (which may be a Cosmos or Varley), this latter being necessary to prevent the input H.F. signals being shunted away from the valve.

The L.F. signals are amplified in the valve and operate telephones or loud-speaker placed in the plate circuit as shown. An L.F. valve is essential for satisfactory operation of this circuit—preferably a power valve such as a P.M.4 with 120 volts H.T. and the grid bias −9 volts.



A single-valve dual circuit.

The Wireless World AND RADIO REVIEW

(14th Year of Publication)

No. 389. WEDNESDAY, FEBRUARY 9TH. 1927. VOL. XX. No. 6.

Assistant Editor: F. H. HAYNES. | Editor: HUGH S. POCOCK. | Assistant Editor: W. JAMES.

Editorial Offices: 139-40, FLEET STREET, LONDON, E.C.4 - - Editorial Telephone: City 4011 (3 lines).

Advertising and Publishing Offices: DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.

Telephone: City 2847 (13 lines). Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street. Telegrams: "Cyclist Coventry." Telephone: 5210 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street. Telegrams: "Autopress, Birmingham." Telephone: 2970 and 2971 Midland.

MANCHESTER: 199, Deansgate. Telegrams: "Iliffe, Manchester." Telephone: 8970 and 8971 City.

Subscription Rates: Home, 17s. 4d.; Canada, 17s. 4d.; other countries abroad, 19s. 6d. per annum.

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

HAS FINALITY BEEN REACHED?

In certain American papers a report has recently appeared to the effect that Dr. Palmer H. Craig, Head of the Department of Physics at the Mercer University, has invented a simple device which, he states, will displace batteries and valves in radio receiving sets.

If the facts as stated are to be accepted literally, this announcement is indeed startling. One cannot casually dismiss the statement as unimportant, because, coupled with it, is the announcement that the inventor has received an offer of $100,000 for his invention from the Westinghouse Electric Co.

The invention is stated to consist of small blocks of a substance resembling sulphur, 1in. thick, 3in. long, and 2in. wide, whilst tiny wires protrude from the top of the block. The device is described as an application of bismuth plates as detectors and amplifiers.

Without further information it is, of course, quite impossible to form any opinion as to the importance of the device, but this announcement should serve to remind us once again of the dangers of assuming that we have reached anything like finality in wireless. The valve is a wonderfully perfect instrument as developed to-day, but whilst research is being carried on to improve the valve still further, and the efforts of numberless research workers are concentrated on this particular component, we must not be blind to the possibility of some new device being produced which may be a rival or even a supplanter of the valve itself. The very fact that the valve is so remarkably suitable for our present requirements may tend to divert the attentions of inventors from endeavouring to develop a substitute. We must always guard against attaching importance to fantastic claims of novelty and invention which are frequently thrust upon us, but at the same time we must be equally ready to accept the possibility of startling new discoveries and developments when these are based on some phenomenon hitherto undiscovered.

CONTENTS.

THE BRUSSELS CONFERENCE.

As *The Wireless World* recently announced, the Conference which was held in Brussels, from January 26th to 29th, considered the question of the broadcast transmissions in Europe on the longer wavelengths, and we understand that just as after the Geneva Conference the short wavelength stations readjusted their wavelengths with a view to reducing mutual interference, so experiments will shortly be carried out after broadcasting hours on the longer wavelengths, with the same object in view.

The average listener does not pay so much attention at present to the longer wavelength stations as to those on the shorter band, but the long-wave stations are growing in importance and in power. With sets which are not particularly selective difficulty is at present experienced in listening in England to foreign long-wave stations without interference from Daventry, and listeners will welcome any readjustment of wavelengths which will improve this state of affairs.

A TOUR ROUND SAVOY HILL.

Part I.—Problems of Sound in Relation to Broadcasting Studios.

By A. G. D. WEST, M.A., B.Sc.

A FEW days ago I took a friend round Savoy Hill. He said : "The last time I came here was nearly four years ago. Then you had only one studio and part of one side of the square. What a change to find that you now occupy more than half the block, with seven separate studios, and yet your programme time is not nearly as many times greater." It is a curious comparison to make, but none the less a true one. The seven studios are almost as fully occupied all day now as was the single one when it existed by itself, because rehearsals, auditions, and tests are continuously being carried on as being necessary and important details that go towards the perfecting of the final product—the broadcast transmission itself.

Exact knowledge of the acoustic conditions in the immediate vicinity of the microphone is just as important for faithful reproduction as perfection in the electrical circuits of the broadcast transmitter.

This article is the first of a series dealing with theoretical and practical aspects of sound in relation to studios, with particular reference to the conditions prevailing at Savoy Hill.

The first article deals with the question of echo effects and absorption of sound by the walls of the studio; subsequent articles will contain descriptions of the various studios at Savoy Hill and their associated microphones and electrical equipment.

Four years ago the one and only studio would be taken for transmission, the audition would take place in a small office with just a piano and a table in it, the rehearsal would be conducted, perhaps, in a waiting-room, and the microphone would be tested in some passage way or other. Now these things can be done in the manner that they should be, under actual working conditions—provided that the audition holder and the producer and the engineer have the foresight to book their studio requirements well in advance!

Sound Effects in a Studio.

But the multiplication of studios has not been by any means the result of purely practical requirements. During the last three years or so the development of studio technique, and of studio design, has been extremely rapid, and has kept well in line, and in many cases gone well ahead, of the requirements of the programme producer. Such questions as the effect as regards the listener, the effect as regards the artist, and the effect as regards the microphone have each been thoroughly tackled, and each has an important place in the whole general problem. Before going into this further it would be as well to consider a few of the important ideas in sound that have a bearing on this work.

A broadcasting studio, whatever its shape or size, must be considered just as a room; that is to say, it is confined by the walls, the ceiling, and the floor. Each of these surfaces is in general a good reflector of sound, and any sound produced in the room, either in the form of speech, or music, or noise, will radiate in all directions from the source and be reflected successively by the walls until its energy is either transmitted through the walls or is dissipated in the form of heat, generated at each reflection. Such heat represents absorption of sound energy by the material of the walls. The amount of reflection of sound in any ordinary room is much greater than one would at first expect. Professor Sabine, the first investigator to put room acoustics on a practical basis, estimated that the walls of an ordinary room reflected over 90 per cent. of the sound, and that for two people conversing in a room the greater part of the sound from one would reach the other's ears by reflection from the walls, only a small part being that travelling direct. This result is in some respects astonishing, and translated into the terms of broadcasting would mean that a similar proportion of sound would reach the microphone from a singer in an ordinary undraped studio by reflection from the walls. Naturally, on increasing the size of a room to that necessary for broadcasting purposes, difficulties are experienced. There are three reasons for this. First, on account of the comparatively slow velocity of sound, the various reflections, after an initial sound impulse set up, say, by the singer, will arrive at the microphone at widely different times, and will give a confused result. Secondly, the sound strengths due to these various reflections and the direct wave will in some places be additive, in others subtractive, giving greatly different results for only slight changes in position of the microphone. Thirdly, the reflective power of the walls may vary considerably for different frequencies. The sum total of all these three effects—which may be respectively termed, for convenience, the echo effect, the standing wave effect, and the differential reflection effect—means a considerable amount of "distortion,"

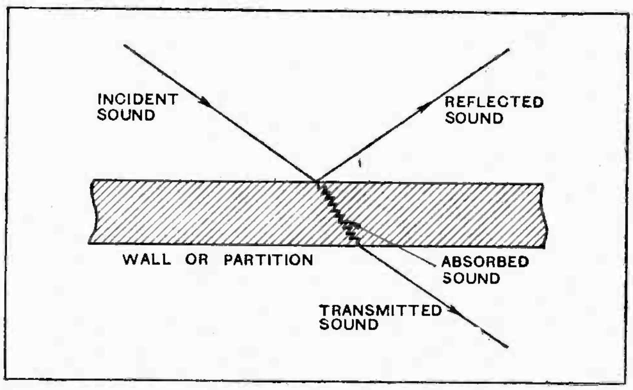


Fig. 1.—Reflection and absorption of sound by a wall. For a thick solid wall, the absorbed and transmitted components are very small and the reflected sound is nearly equal to the incident sound. For a thick partition of felt the absorbed component is large, the reflected and transmitted components being small.

A Tour Round Savoy Hill.—
which is a useful general term used in connection with broadcast transmission or reception covering a departure from faithfulness in passing through successive stages of

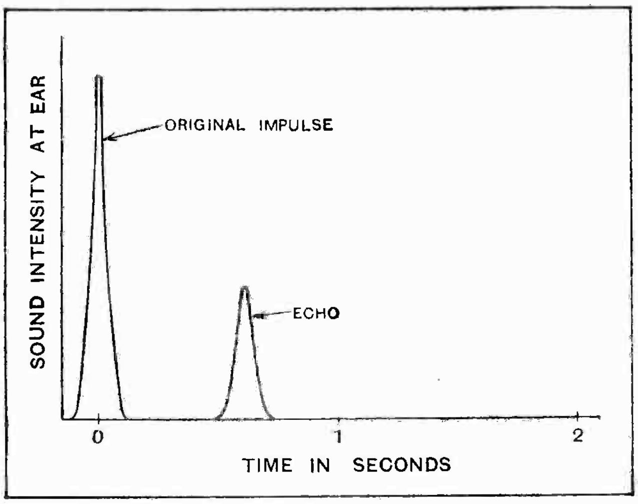


Fig. 2.—Example of single echo.

the broadcasting chain. If there is distortion before the microphone stage, then there is not much chance of making up for it later on in the chain.

Difference between the Ear and the Microphone.

The architect, in designing a hall, has fortunately some advantages which help to minimise these difficulties. The two ears, with the aid of the eyes, can, by a certain amount of selection and concentration, adjust themselves to give satisfactory hearing in halls which give very considerable distortion to sounds proceeding from the platform or stage to any part of the auditorium. The binaural effect assists greatly in this respect. He can design reflecting surfaces on the walls and ceiling which, relying on this elastic property of the ears, will actually help in the total effect. The ears, in fact, will take what they want, reject—up to a degree—what they don't want, and pass on the "purified" result to the brain. Expressed in another way, they have a conveniently variable polar diagram.

The broadcasting engineer has to make things right for the microphone, which, being a mechanical instrument without the power of selection or a conscience, simply takes what is given to it and passes it on without improving it, probably spoils it just a little, however perfect an instrument it may be.

An example of this difference between the ear and the microphone is afforded by the case of two people conversing in one room, with a piano being played in the next room. The piano would not normally interfere seriously with the conversation. Now put a microphone in the position of one of the talkers, and we get the case of someone giving a talk in one studio with a piano being played in the next one. Put this "on the air," and you can be sure of many letters arriving at Savoy Hill and complaining of an annoying piano background to the talk.

The inexperienced broadcast engineer attempts to cure all these troubles at one fell swoop. He converts the studio into a padded cell (not all artists deserve this) by excessive draping and blanketing, and to a certain extent, scientifically at any rate, he succeeds. For the draping means a big absorption of sound, consequently very little reflection, the echo effect is practically killed, the standing wave effect is considerably reduced, and with these first two objections almost removed the third, the differential reflection effect, does not matter so much. Artistically, as we shall see later on, he has failed.

A More Detailed Consideration.

Let us consider these three difficulties that I have mentioned in further detail.

The echo effect, in a room, means the prolongation of sound after a given impulse, due to reflection many times over of the sound waves that come originally from the source. A listener hears, or a microphone picks up, first the original sound direct, then the successive reflections of that sound from the walls. The effect can be analysed into two types: first, echo pure and simple, meaning just a single reflection from one wall only, giving a duplicating effect—the original sound followed, after a brief time interval, by a replica, usually diminished in strength. If a second reflecting wall exists this might result in a succession of such echoes. An interesting example can be observed under the dome of Covent Garden Theatre when the dance floor is laid. You only have to stand in the centre and shout "Ha!" and the roof will laugh back at you, "Ha, ha, ha, ha, . . ." dying away after some twelve or fifteen times.

The second type of echo effect, which is the most common, is called reverberation, consisting of a gradual dying away of sound after a given impulse, without any marked echo peaks.

Sabine, in making his experiments in halls, always measured the time of reverberation, or time of dying away of sound, and was able to connect this time period by a

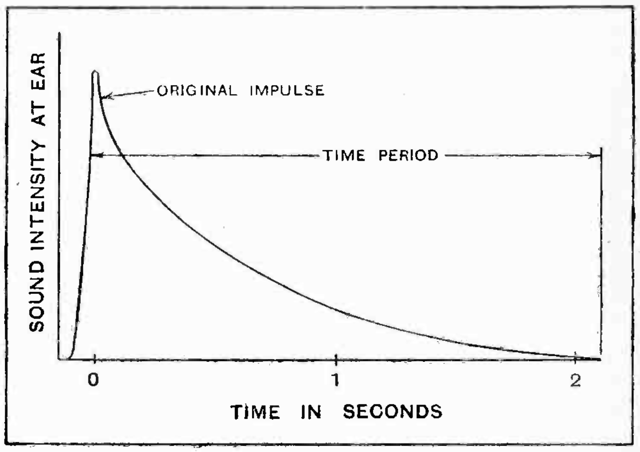


Fig. 3.—Example of reverberation.

simple formula with the amount of absorption provided by the materials on the walls, floor and ceiling.

This period is a definite property of a room, which can be altered by varying the amount of absorbing material. Sabine, in his practical way, brought into a room various numbers of cushions, and after measuring the corresponding times of reverberation by ear and with a stop-watch,

A Tour Round Savoy Hill.—
established a formula which is remarkable for the accurate results it can give by calculation alone for the reverberation period of any room or hall. His results have been extraordinarily useful for architectural work. But as far as broadcasting is concerned they have only been useful as a first approximation. Recent work carried out by the author has shown that it is just as important, possibly more so, to get an idea as to how sound dies away as to measure how long it takes to die away.

Now, with respect to the second difficulty to which I have referred, the standing wave effect, it is easy to see that for a source radiating sound of constant frequency in a room, an interference pattern is set up by the various reflections at the walls, resulting in a maximum of sound being heard at some points and a minimum at others. Most broadcast listeners are familiar with this effect in their own homes when listening to the tuning note reproduced on a loud-speaker. Moving about the room the intensity varies continuously between a maximum and zero,

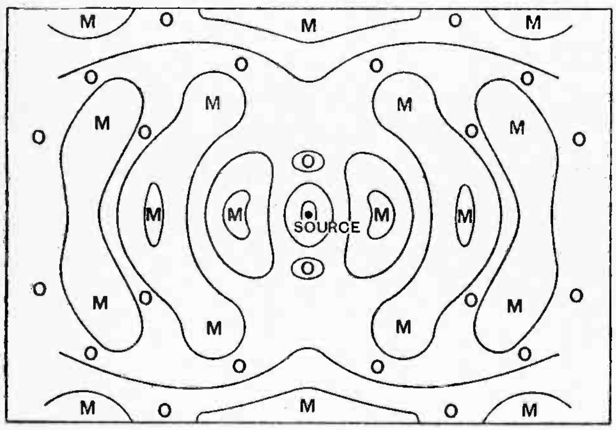


Fig. 4.—Contour lines showing the distribution of sound intensity at the head level in a room with barrel-shaped ceiling and source of sound at centre. M = maxima; O = minima. (From "Sabine's Collected Papers.")

the effect being more marked if one ear is closed; and for a given position of the loud-speaker the room can be mapped out into areas of maximum and minimum intensity.

Consequently, it follows that listening in one position in a room to a source emitting sound at varying frequencies, some frequencies will not be heard at all, others will be heard loudly. And it follows from this that a microphone in a given position in a room may miss many of the frequencies sung by a singer before it.

The presence of draping on the walls naturally reduces the proportion of reflected sound to direct sound, and so reduces that standing wave effect. But it has been found in carrying out delicate microphone experiments that it is practically impossible to find a material or arrangement of materials for draping that will render the effect by any means negligible. In practice in the studio, the engineer has to choose his microphone positions very carefully to get over the difficulty.

Now, as regards the third point: the question of differential reflection, the effects of which have hardly as yet been fully realised, at any rate in broadcasting work, the chief difficulty has been that most of the drapings and interior furnishings of studios, especially those most heavily draped, give a much greater reflection of the low tones than the high tones. From this point of view the perfect studio would have walls giving equal reflection for all frequencies. This result can be achieved in two ways. Either a succession of layers of different materials is chosen, which give an overall equal result for the whole range of frequencies; or different materials are used on various parts of the walls which give an average equal result. The latter method is feasible, because the sound in a room of moderate size undergoes such a very large number of reflections that the average for all the various materials can be taken.

As an example of the latter, the walls could be covered with a certain proportion of drapery and with a certain proportion of woodwork; the former giving low tone reflection, the latter high tone reflection. (See Figs. 5 and 6.)

If the proportions are properly worked out, the effective result should be approximately equal reflection and consequently equal absorption for all frequencies. This would mean also an equal time of reverberation for all frequencies

The practical outcome of all this can be summarised as follows:—

(1) In general, materials giving greatest absorption will do so unequally as regards frequency, and it is practically impossible to find an arrangement that will completely deaden a room and eliminate standing wave effect.

(2) If the idea of a completely dead room is abandoned, then an arrangement of materials can be found that will make the room equally reverberant for all frequencies. A certain amount of standing wave effect will then be present.

Practical Considerations.

The importance of these points in the practical design of studios will now be considered.

As mentioned before, the acoustic requirements of broadcasting must be considered from three points of view: those of the listener, of the artist, and of the microphone and subsidiary apparatus.

In taking the point of view of the listener one must realise an extremely important fact that is usually referred to popularly only in very vague terms. This is that for each type of transmission the amount of reverberation to give the most pleasing result must be of a definite value. One often hears it pronounced that the tone of such-and-such a transmission was extremely fine. This means, as far as the acoustic point of view is concerned (apart from the artistic), that the period of reverberation and its nature were just correct for that particular transmission. There is no doubt that to give the best result to the listener these values must be correctly rendered if possible for each type of performance. He may not be conscious of the reason for the effect, but he will respond to it musically, with enthusiasm, if it is just right. In some cases he will even appreciate a type of performance that would otherwise be distasteful to him.

For instance, a big orchestra should be transmitted with a considerable amount of reverberation—say, from 2 to 4 seconds. An octet sounds best if the room has a

A Tour Round Savoy Hill.—

period of about $1\frac{1}{2}$ seconds; while solo singers would be satisfactorily rendered in a room with a period of about 1 second; and ordinary dramatic work or speech with a period of about $\frac{3}{4}$ second. In any case experience has shown that there is no practical use for the heavily damped studio which has a period of less than half a second.

Practically this variation can be obtained by suiting a studio or hall to the particular type under consideration.

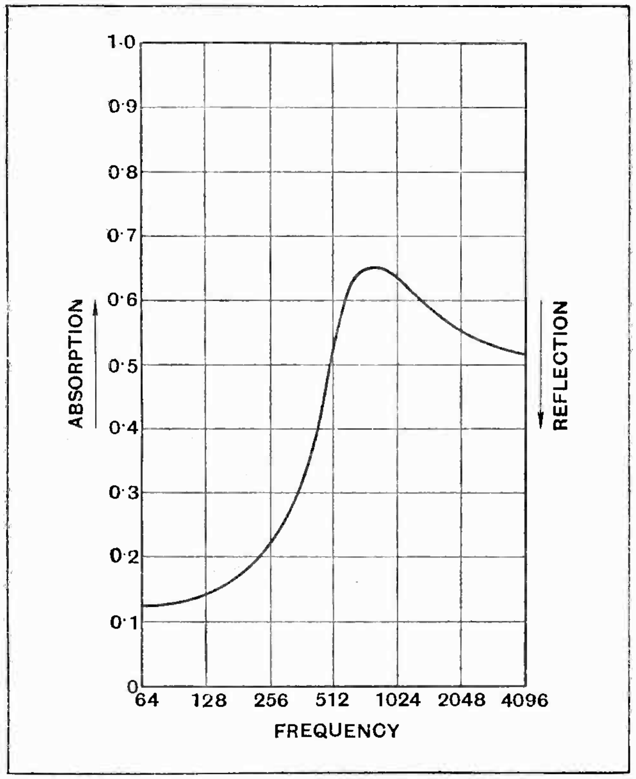


Fig. 5.—Absorbing power of felt for various frequencies. The higher tones are absorbed and the lower tones reflected.

by careful microphone placing, or by other methods to be described later on.

Unfortunately a difficulty arises here on account of the great variability in listeners' sets. It is a curious fact that the more frequency distortion there is in a set the greater is the apparent echo effect in the reproduction. This fact can be immediately realised by placing two loud-speakers of two different types, say a horn and a cone, side by side. The one with the flattest frequency characteristic will sound much less confused or echoey than the other. Similarly an ordinary head telephone receiver will give, on account of its peaky frequency characteristic, a much more echoey result than a good cone loud-speaker. This fact was pointed out and analysed by Capt. Round,[1] who showed that the reproduction of an impulse as a similar impulse depended on equal amplification of all the frequencies into which the impulse is analysed. If this condition is not satisfied the final combination of frequencies is reproduced in the form of an impulse with a definite tail; in other words, with the appearance of echo effect. There is thus naturally a considerable difficulty experienced in trying to estimate which is the most desirable effect to be given in the transmission. If a criterion of the best receiver and loud-speaker is taken, then the result will naturally be too confused for the less satisfactory set as used by the average listener. A compromise must naturally be effected.

Now taking the point of view of the artist, the deadened room has usually a most depressing effect on the singer or instrumentalist.

The bathroom effect is well known, and similarly the artist prefers to have as much a feeling of freeness in a studio as it is possible to get. This is for two reasons. A much better performance can be given by the singer or player if he can hear himself, which he can only do properly if the sound is reflected back to him; also, much less effort is required if the room is undamped than if it is damped, because in the former case the reflections assist and build up the total volume; in the latter case the energy is all absorbed away by the draping materials. It is like the difference between running in a bathing costume and running in a diving suit. I have heard strong opinions expressed on this point by many artists.

Another way of putting it has been expressed by one writer, who states that when, say, a violinist is giving a recital in a suitable hall, his instrument is not merely the violin itself but the violin and hall combined.

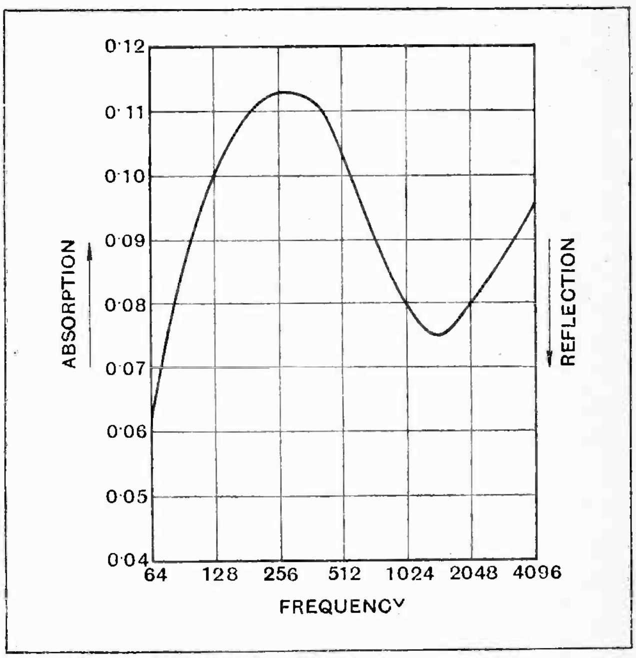


Fig. 6.—Absorbing power of wool sheathing 2 cm. thick. The lower tones are absorbed most, the higher tones being reflected.

It is therefore necessary, in order to get the best performance from artists in the studio, to avoid the depressing feeling imposed by a heavily draped room, and to give them as much as possible an impression of freeness and response in their surroundings.

Now taking the point of view of the microphone, it has been seen that the reduction of draping leads to an increase in standing wave effect. This result is usually

[1] *Year Book of Wireless Telegraphy and Telephony*, 1925, p. 826.

A Tour Round Savoy Hill.—

counterbalanced by a greater ease in control when echo effect is present. This is on account of the fact that a transmission in a deadened room without reflections may be very peaky for some reason or other. The peak values registered in the amplifiers may be high, and the mean value comparatively low. If echo is introduced, that is, if reflected sounds are added to the original, the peaks even out, and the mean value has a greater ratio to the peak values, resulting in greater modulation in the transmitter without blasting. A harsh voice, electrically peaky, may be smoothened by adding echo. Similarly, violin tone, scrapy as it leaves the violin, is greatly improved and enriched with the addition of echo of the right type. The later effect can be easily observed by the ear.

(To be continued.)

TRANSMITTERS' NOTES AND QUERIES

International Amateur Prefixes.

With reference to the prefixes proposed by the I.A.R.U. in Hartford, Conn., which we published on page 56 of our issue for January 12th, we have received the following letter from the G.P.O. :—

"Sir,—The Postmaster - General's attention has been drawn to an article in *The Wireless World* of January 12th concerning amateur international prefixes, the footnote to which conveys the impression that the British Post Office approves of the prefixes proposed.

"I am, therefore, to explain that the prefixes to be used in cases of international wireless communication have already been allocated by agreement between the various Governments concerned; and amateur experimenters in this country who are authorised to conduct experiments with countries outside Great Britain and Northern Ireland should use the authorised prefixes when conducting such experiments, and not those specified in your issue of January 12th.

"As the footnote referred to may give rise to misapprehension on the part of amateur experimenters in this country, the Postmaster-General would be glad if you would be so good as to take such steps as may be considered necessary to remove any element of doubt.

"I am, Sir,
"Your obedient Servant,
"(Signed) F. W. Phillips.

"General Post Office,
"London, E.C.1.
"January 28th, 1927."

We are sorry if our remarks on the proposed prefixes have been interpreted to mean that they have received the approval of the G.P.O. Our own views are that they are in themselves inapplicable to European needs, where the prefixes are in many cases firmly established, either officially or semi-officially, but that any really considered and authorised arrangement for definitely establishing amateur international prefixes on a proper and systematic basis is highly desirable.

o o o o

We have received a considerable number of letters on the subject of the new International Prefixes proposed by the I.A.R.U., of Hartford, Conn. Most of our correspondents consider them inapplicable to European requirements. One in particular points out that the letter "E," which is purposely omitted from amateur call-signs in Great Britain, would be very unsuitable if used as a prefix as it is so easily misread.

o o o o

General Notes.

Mr. F. N. Baskerville states that he has received confirmation from C 4DQ of the signals he heard at Hale, Cheshire, on November 28th, 1926. The Canadian station is owned and operated by Mr. A. J. Ober at Vulcan, Alberta, a district which is generally very difficult to hear in Europe. C 4DQ states that he was using 300 volts battery supply and a small semi-vertical aerial, the wavelength being 37.5 metres. It is interesting to note that Mr. and Mrs. Ober both operate the station, taking turns at the key.

o o o o

Mr. J. Clarricoats (G 6CL), 10, Friern Barnet Road, N.11, was in communication with R1ÜA in Nijni Novgorod, at 2315 G.M.T. on Monday, January 17th. He was then using an input of 3.2 watts and his signals were reported R 2-3, steady but weak. The following day he established communication with U 1BKE at Lynn, Mass., and later on with U 2CTN at Richmond Hill, New York. The power used was 4.5 watts derived from an ordinary H.T. battery.

o o o o

Mr. F. R. Neill (GI 5NJ), Chesterfield, Whitchurch, Co. Antrim, tells us that on Sunday, January 23rd, he got into touch with A 7CW at about 1915 G.M.T. The report on the strength and steadiness of his Morse signals was so encouraging that he decided to try telephony. After speaking for some minutes he asked 7CW to repeat what he had said. The Australian at once replied, giving nearly the whole of the message, a few words only having been lost through fading, and the speech generally was reported very clear and of excellent quality. A 7CW then spoke in return and his speech came through quite clearly on 2 valves. Mr. Neill was using an input of 85 watts to a DET 1 valve, modulating by the grid control method and using a separate receiving valve as a modulator. The wavelength was approximately 32.6 metres.

Mr. C. W. Randall (JM 3AB), Amber Rubber Estate, Senai, Johore, Malaya, tells us that he is transmitting on 44.5 metres, and hopes soon to be also on 23 metres. He is anxious to get into touch with British amateurs, and is always on the look-out for them, especially on Sundays, from 1500 to 2000 G.M.T.

o o o o

Oundle School Scientific Society (G 2CH) is transmitting regularly on Sundays at 11.15 a.m. and 2.0 p.m. The music recital from the Great Hall, Oundle School, is also transmitted at 6.15 p.m. The Society will welcome reports, which should be sent to K. R. Brecknell (2AHH), Sidney House, Oundle. The wavelength is 153 metres, and the input 50 watts. The aerial is a 70ft. × 6ft. T, and the counterpoise a 6-wire fan. The transmitter consists of a Hartley circuit oscillator modulated through the usual choke circuit to about 60 per cent.

o o o o

Low-power transmission seems to be rapidly growing in favour. Mr. A. M. Houston-Fergus (G 2ZC and TBA), La Cotte, La Moye, Jersey, finds that he gets better results on 45 metres since he gave up using his 5 h.p. motor and obtains his input from a 220-volt accumulator, with which he gets pure D.C. and no noise in working. Since he decreased his power he has succeeded in communicating with Northern Ireland and Sweden, which previously had been blind spots for him.

o o o o

New Call-signs Allotted and Stations Identified.

2 AAS W. Carter, Milton House, Great Yarmouth. This call-sign was formerly owned by R. M. Dougan, Clapham Common.

2 AZD (ex 6LX) W. G. Fudger, Brora, Priors Wood Road, near Godalming.

G 2MN (Portable), E. V. R. Martin, Groombridge, Northwood Avenue, Chaddesden, Derby. Transmits on 23 and 45 metres.

G 2NL F. J. Hughes, Ashdene, Wells Road, Bath. (It is regretted that in the R.S.G.B. Log Book the name of the City was inadvertently omitted from this address).

G 6HU E. P. T. Miles, 7, Eynella Road, East Dulwich, S.E.22. Transmits on 150-200 metres. This call-sign was formerly that of Mr. G. Rutherford, Dulwich, S.E.24.

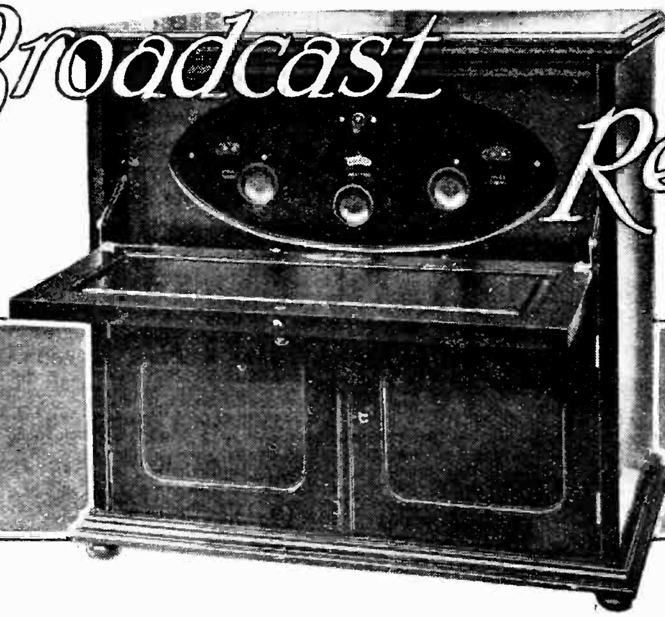
G 6XP L. C. Snowden, "Hillfield," Weybridge, Surrey. Transmits on 8, 23, 45 and 90 metres.

GI 6JA (ex 2BTT). A. Jameson, 60, Clifton Road, Bangor, Co. Down, Ulster. Transmits on 23, 45, 90 and 150-200 metres.

DNSC Royal Danish Dockyard, Copenhagen.

K 4PL (ex K LLO). C. W. Jenssen, Martins Allee 47, Bremen-Horn, Germany.

Broadcast Receivers



THE GAMBRELL CABINET THREE

A Wireless Set with the Upkeep Costs of a Gramophone.

APART from the vast army of constructors and experimenters whose interests are chiefly centred in the technique of broadcast reception, there is an ever-increasing number of listeners who look to the B.B.C. for their main source of musical entertainment. They find in the wireless set a medium which gives them music under ideal conditions without any of the numerous discomforts of the concert hall; there are no disagreeable echo effects; no one coughs at the wrong moment; if anyone is trying to beat time with a programme or chattering during the performance the fact is not noticed, though they may be next-door neighbours; neither is the spell of a perfect performance broken by applause which commences half-way through the last bar.

The amazing growth of the gramophone industry is a further proof of the existence of this class of listener and is a striking refutation of Sir Thomas Beecham's sweeping criticism of mechanically reproduced music. It may not be the real thing, but it resembles it so closely that anyone with any imagination at all can derive full satisfaction from a modern wireless receiver or gramophone.

Reliability of Broadcast Receivers.

Assuming satisfactory programmes, there seems little to choose from the musical point of view between the wireless set and the gramophone until one considers the question of reliability and cost of maintenance. Hitherto the wireless set has been at a distinct disadvantage due primarily to the uncertain behaviour of high-tension batteries and the necessity of periodically recharging the filament battery. Improvements in valve manufacture and the advent of the high-tension accumulator have done much to mitigate the charge of unreliability, but nothing to relieve the cost of maintenance Wireless receivers will not seriously compete with the gramophone until the necessity of maintaining batteries is done away with. In the present state of our knowledge, a supply of current at two distinct voltages is essential for satisfactory loud-speaker reception, and if batteries must be eliminated the only alternative source is the electric supply mains. The time is not far hence when batteries will be used only in country districts and in other circumstances where electric supply mains are not available.

Messrs. Gambrell Bros., Ltd., may be regarded as pioneers in the development of receivers working from the electric supply mains, and great credit is due to them for persevering with a problem beset with many difficulties. A satisfactory solution has been reached and a series of receivers suitable for A.C. or D.C. mains has been put on the market. These receivers are self-contained, are connected to the nearest electric light socket by a length of flex and a plug adaptor and are controlled by a single switch. They go one better than the gramophone; they do not want winding up!

Features of the A.C. Model.

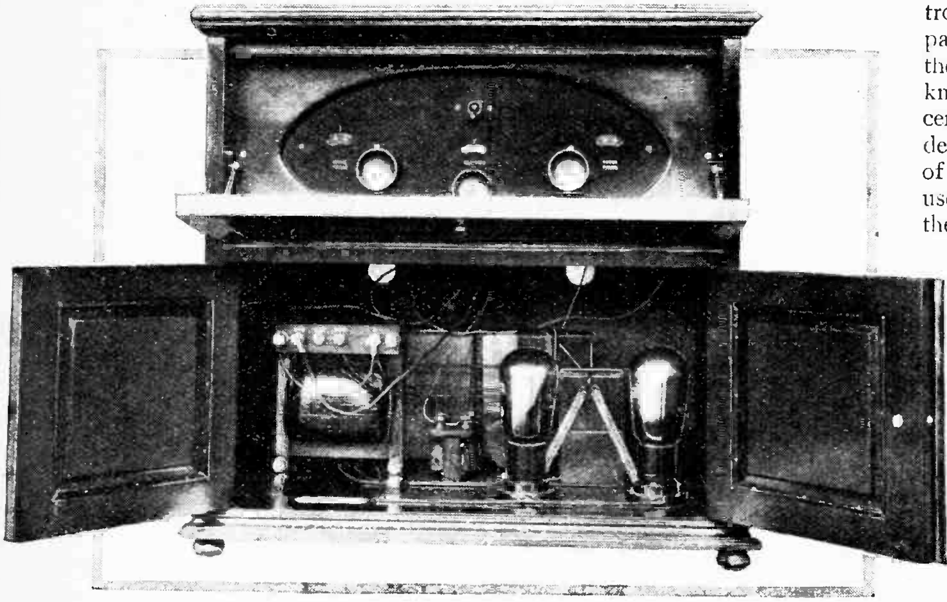
The receiver under review in this article is the Gambrell Cabinet-Three for use with A.C. mains. It comprises a detector valve preceded by a stage of H.F. amplification and followed by an L.F. (power) output valve. The "wireless" components are assembled in the upper half of the cabinet, the lower half being set aside for transformers, smoothing chokes, condensers, etc., associated with the power supply. At the back of the cabinet there are terminals for the aerial, earth and loud-speaker connections and also the flexible leads and plug adaptor for connection to the supply mains.

The plan view of the "wireless" compartment of the instrument shows the layout of components. On the left-hand side is seen the plug-in coil tuning the aerial circuit in conjunction with the large air dielectric condenser on

Broadcast Receivers.—
the left-hand side of the panel. A small fixed condenser is connected in series with the aerial lead-in so that the receiver may be readily adaptable to aerials of different capacity.

L.F. transformer and the loud-speaker terminals. The tuning controls are particularly neatly arranged in an oval setting at the front of the cabinet. The graduations of the tuning dials are visible through small windows adjacent to each tuning knob.

The three principal tuning controls occupy the lower part of the panel, the left-hand knob tuning the aerial circuit, the right-hand knob the anode circuit, and the centre knob the neutralising condenser. Variation of the capacity of the neutralising condenser is used as a reaction control. Above the reaction control is a single tumbler switch connected in the primary winding circuit of the power transformer which puts the set in and out of operation.



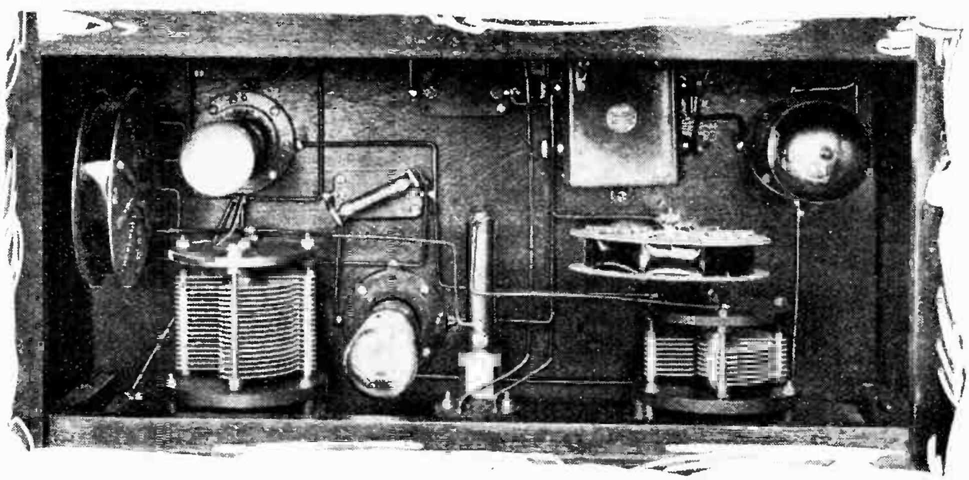
Interior of power supply compartment showing power transformer, rectifying valves, smoothing chokes and condensers and, at the back, the potentiometer winding.

Power Supply.

Turning now to the "power" section of the instrument the interior of which with the front doors open is shown in one of the photographs, it will be seen that rectified current is obtained through the medium of a step-down transformer and two rectifying valves. A very good feature of the transformer construction is the provision of tappings on the primary winding for supply mains of various voltages from 200 to 240 volts. Transformers for other supply voltages are available when required. There are two secondary windings, each with centre tappings, one providing the filament current for the two rectifying valves and the other the H.T. and L.T. current for the receiving circuit. The output from the latter winding is applied to the two Mullard D.U.5 rectifying valves which are arranged for full-wave rectification. The output from these valves, after passing through a smooth-

Neutralised tuned-anode coupling is used between the high-frequency valve and the detector. The tuned-anode coil is tapped at its centre for the + H.T. connection and the neutralising condenser is connected between the upper end of the tuned circuit and the grid of the H.F. valve. The centre tapping of the coil is brought out to a terminal in the centre of one of the fibre discs forming the sides of the coil. Connection to this terminal is made through a slotted brass strip, and some little care is necessary when changing coils to make sure that proper connection is made. We must assume that frequent changes of the wavelength range of the receiver will not be necessary otherwise a simpler arrangement of tuning coils should have been adopted having regard to the type of listener to whom the receiver is intended to appeal.

The remainder of the circuit calls for little further comment. Transformer coupling is employed between the detector and output valve, and the loud-speaker is connected directly in the anode circuit of the latter valve. By-pass condensers are shunted across the primary winding of the



Plan view of components in the "wireless" compartment

Broadcast Receivers.—

ing circuit consisting of the usual choke and condenser, is applied to the ends of a wire-wound potentiometer resistance from which is drawn the filament current supply and the H.T. supply to the receiving valves. A common H.T. voltage is used for the H.F. and power valves, and a separate tapping of lower value for the detector. The detector valve H.T. supply contains a separate smoothing choke and condenser.

The use of a single source of current for both the H.T. and the L.T. supply has been made possible by the use of valves of the 0.06 type, the filaments of which are connected in series. The valves chosen are the B.T.H. B5 for the H.F. and detector, and B.T.H. B6 for the output valve.

The provision of grid bias without special grid bias batteries presents no difficulty, since a sufficient fall of potential is available along the filament circuit. In practice this system has proved entirely satisfactory, and, due to the fact that the filament current as well as the H.T. current is smoothed, no mains noises are experienced through variation of the grid bias potential.

Performance.

In our practical test the set was installed where the supply was 240 volts, 50 cycles, and the only adjustment to the set required was to connect the flexible lead to the tapping of the transformer primary in the base marked 240 volts.

Quite frankly we were agreeably surprised at the efficiency of the mains supply unit. A cone loud-speaker was used with the set, and if any trace of mains hum was there, one had to listen very carefully before it could be detected. As soon as broadcasting came on one could not detect that the set was not working from local batteries. The test was carried out in London some three miles from 2LO, and, with an average aerial, the strength of London with the reaction control turned to zero was ample for home use in a large room.

Very little change in strength was noticed when the Daventry coils were changed for the short-wave coils and the set retuned, still with the reaction control at zero. Paris could also be tuned in with slight use of reaction until one obtained quite fair strength in the loud-speaker, but unfortunately we found it difficult to bring Paris up to this strength without a slight background of Daventry.

There is room in the design of the H.F. stage of the receiver for additional selectivity, and we are inclined to think that in this respect the standard of the receiver does not come up to the high standard of the remainder of the set, but we must remember that the purpose of the set is to give good quality and strength on the local station and Daventry, and we do not think that the manufacturers had in mind to make the set specially applicable for other alternative programmes; in every respect they have aimed at simplicity of operation.

For the sake of convenience, though we realise that it would have added to the cost of the instrument, we would have liked some alternative to the rather awkward arrangement of having to interchange two coils for the long or short waves. If the coils had been duplicated in the set and a switch provided to change over the coils for the alternative wavelengths we think the set would prove even more popular.

The address of the manufacturers is: Messrs. Gambrell Bros., Ltd., 76, Victoria Street, London, S.W.1, and the price of the Cabinet-Three A.C. model is £33, inclusive of Marconi royalty, valves and coils. The equivalent D.C. model is priced at £24 7s. 6d.

NEWS FROM THE CLUBS.

Progress in A.C. Voltage Measurement.

Mr. E. Butterworth, B.Sc., M.Sc. (Tech.), on Friday, January 21st, gave the members of the Radio Experimental Society of Manchester the results of his research work on the Bolometer Bridge, under the title of "A Development in the Technique of Alternating Current Voltage Measurement." He showed how sensitive the low-resistance Bolometer Bridge could be made under suitable conditions, its sensitivity being of the order of micro-milliamps. He further elaborated a method of depending on the use of this bridge for the measurement of capacity and A.C. resistance, which may be applied to the investigation of the dielectric properties of substances, including electrolytes. He also showed the application of the method to Electro-conductivity Titrations.

The next member to describe the results of his research work, under the "Individual Research Scheme," will be the Secretary, who will give a talk on crystals in general, and will demonstrate oscillating crystals.

The Society has vacancies for a few new members interested in experimental work and research.

Hon. Secretary: Mr. J. Levy, 19, Lansdowne Road, West Didsbury, Manchester.

H.F. v. L.F.

At the last meeting of the Ryde, I.W., Radio Society a lively debate was held on the subject of high frequency versus low frequency amplification. Mr. E. W. Pollard, B.Sc., the president, opened the debate in favour of high frequency, while Mr. John P. Turtle (hon. sec.) championed low frequency. A general discussion centred on the question of which type of amplification should receive greater attention in wireless receivers.

The society meets every Tuesday evening at the Royal Eagle Hotel, Ryde, and full particulars of the programme for the next two months can be obtained from the hon. secretary, Mr. John P. Turtle, at that address.

oooo

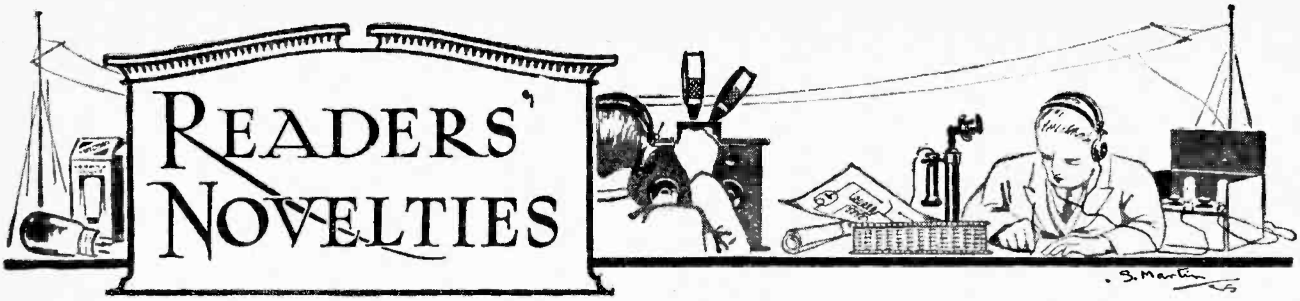
Active Year at Southend.

The chairman's report at the annual general meeting of the Southend and District Radio Society, held on January 28th, showed that 1926, the seventh year of the society's existence, had been a period of exceptional activity.

Thirteen indoor meetings were held, and on March 12th, 1926, a public lecture was given at the St. George's Hall. Three field days were also held.

In April of last year the society proferred assistance to the Victoria Hospital in connection with the replacement of the wireless equipment which was found to be in a bad state of repair. On examination it was found that the old installation had to be scrapped. An appeal for funds was launched, and altogether a sum of £101 was collected, with the result that to-day every bed in the hospital is complete with a pair of 'phones (65 in all). Each of the three children's wards and the sitting rooms of the matron, surgeons, sisters, nurses, and servants contained a loud-speaker. The set was designed and constructed by Mr. Revell and Mr. Burrows (chairman). The third annual radio exhibition, held on January 8th last, has already formed the subject of a report in *The Wireless World*. Its success was undoubted.

The Mayor of Southend, Councillor W. J. Hockley, has been elected president. The hon. secretary is Mr. Fred Waller, Eastwood House, Rochford, Essex.

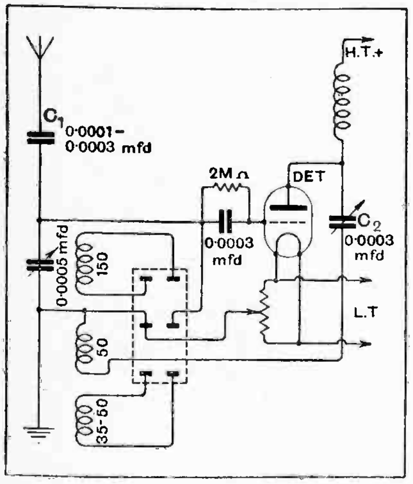


A Section Devoted to New Ideas and Practical Devices.

REINARTZ CIRCUIT.

The circuit diagram shows a method of changing over from short to long waves by means of a single switch without the necessity of removing or changing coils.

A three-coil holder with variable coupling carries the three coils, the No. 50 coil being fitted in the central position with the long- and short-wave grid coils on either side. The coupling between the reaction coil and each of the grid coils, once set, needs no further attention, fine adjustments or reaction being made by means of the reaction condenser.—R. H. N. D.



Switching from long to short waves in a Reinartz receiver.

oooo

WIRING HINT.

A third "hand" is often desirable when making awkward wiring joints in the interior of a receiver cabinet.

This will be provided if a rubber band is slipped round the handles of a pair of pliers, which will then form an adjustable clamp by means of which the ends of the wire may be held together to form the joint.—F. A. H.

VALVES FOR IDEAS.

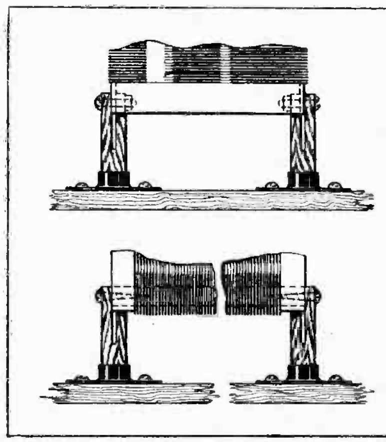
Readers are invited to submit brief details, with rough sketches, where necessary, of devices of experimental interest for inclusion in this section. A dull emitter receiving valve will be despatched to every reader whose idea is accepted for publication.

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

COIL SUPPORTS.

Empty photographic film spools make excellent supports for cylindrical coils of the type used in the "Everyman's Four" receiver. All-metal spools should not be used, but several makes are available with wooden centres and metal end caps. The end caps are drilled to take small wood screws for securing to the baseboard of the set.

The diagram shows two methods of utilising the spools, one for vertical coils and the other for horizontal coils. In the latter case, one side of the spool is cut down to form a step and fixing screws are driven into the ends of a narrow strip of wood carefully cut to length and fitted inside the coil former.—E. C. B.

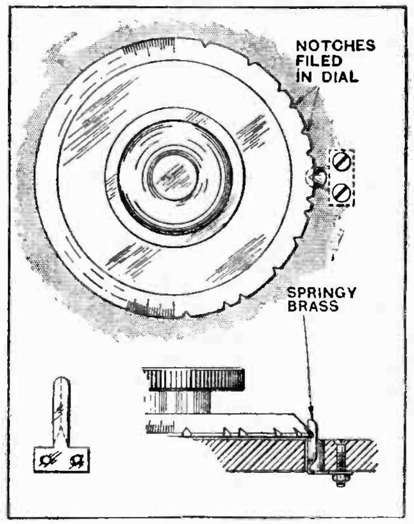


Coil supports constructed from empty film spools

oooo

CONDENSER SETTINGS.

When a receiving circuit has been permanently installed, and changes in the tuning constants of the various circuits are not likely to take place, the quick-setting device shown in the diagram will be found useful in finding broadcast stations which are received at good strength on the loud-speaker.



Quick-setting device for condenser dials.

A V-shaped pawl of springy brass is fitted to the panel near the edge of the dial, so that it projects slightly through the hole in the panel. Notches are then filed in the edge of the tuning dial opposite to the engraved scale, great care being taken in marking the position in the notch before removing the dial for filing.

When setting the condensers, all dials are turned to zero and then moved past the same number of notches in each case. In this way a station may be tuned in even in the dark.—J. M.

LOUD-SPEAKER CONSTRUCTION.

An Experimental Moving-coil Loud-speaker of Simple Design.

By G. W. SUTTON, B.Sc.

THE sources of distortion in modern loud-speakers may be conveniently classified as (*a*) those arising in the electrical and magnetic portions, and (*b*) those inherent in the mechanical construction. Theory indicates that moving-iron types, which include the attracted diaphragm, the reed, and the balanced armature, are all liable to sources of distortion under heading (*a*), which may be serious on loud signals. The moving-coil type, on the other hand, is free from these.

Sources of Loud-speaker Distortion.

It may be noted that the reaction of the current in the moving coil on the magnetic circuit, lack of uniformity of the field in which the coil moves, and change with frequency of the inductance and effective resistance of the coil may result in distortion.

That the first of these is negligible in the present instrument is apparent when it is noted that the exciting ampere-turns number 700, whereas the ampere-turns due to the moving-coil are not likely to exceed 4 or 5. Moreover, they act in a direction approximately at right angles.

It is only a question of careful construction to avoid the second.

So far as the third affects the relative phases of the harmonics in a complicated sound it is of no importance whatever, since the ear is known to respond to the various frequencies individually and irrespectively of their phase relationships. Its effect on the relative magnitudes of the harmonics is very small and can be safely neglected.

The instrument described below was constructed with the object of determining the importance aurally, if possible, of the sources mentioned above under heading (*a*).

In carrying out experiments from time to time with large diaphragms attached to moving-iron instruments, the writer had frequently been unable to decide whether an undesirable quality in the reproduction was due to the diaphragm or to the electrical and magnetic portion of the movement. With the moving-coil system, it is apparent that any noticeable distortion can arise only in the mechanical construction of the vibrating elements, and it was hoped to use this instrument as a standard of reproduction.

In attempting to deal with the problem of distortion in this way, however, it must be borne in mind that, since the electrical and the various mechanical portions are all coupled, an effect arising in one may modify considerably the properties of the others. A good example of this is afforded by a certain well-known horn-type loud-speaker. The vibrating reed of this instrument has a prominent resonant frequency; that is, when the horn is removed, the amplitude of the vibration set up per milliampere of current in the coils is much greater at this particular frequency than at neighbouring ones. The ratio is, in fact, of the order of two or three to one. This is very readily detected by the ear if the instrument is connected to an oscillator, the frequency of which can be continuously varied while its output remains approximately constant. It may also be demonstrated by measuring the effective resistance of its electrical circuit over a range of frequencies. The effective resistance is, of course, the quantity, which, if multiplied by the square of the current flowing in the circuit, gives the power input. This power is largely dissipated in losses of various kinds, but includes the acoustic output. Since the acoustic output is so much larger in the neighbourhood of a resonant point, the effective resistance also shows a sharp rise at that frequency.

In Fig. 1 is reproduced the effective-resistance/frequency characteristic (*a*), without horn, of the instrument mentioned above. It reveals the existence of a sharp resonance point at 690 cycles and a more heavily damped one at 2,030 cycles. There is some indication of one at 1,500 cycles. The latter two are doubtless produced by the third and second harmonic modes of vibration of the reed to which the diaphragm is attached, and are not exact multiples of the fundamental When the horn is replaced, curve (*b*) is obtained. It is seen that its effect is to smother the prominent resonance points. The resultant is still very uneven, though not sufficiently so to produce really noticeable distortion in reproduction.

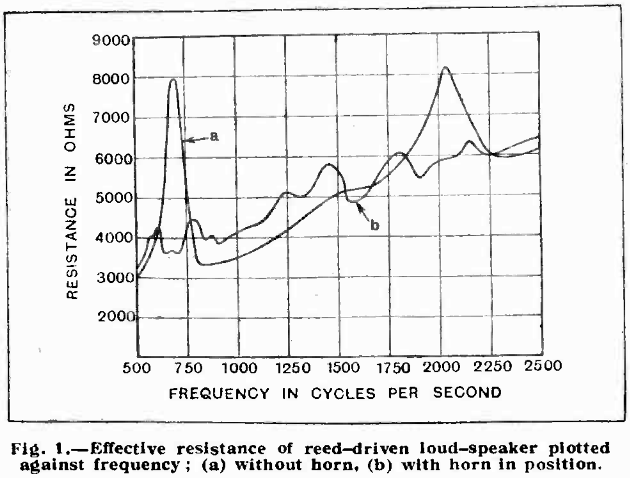


Fig. 1.—Effective resistance of reed-driven loud-speaker plotted against frequency; (a) without horn, (b) with horn in position.

Theory of Magnetic Systems.

It may be as well to recapitulate here the indications of theory in regard to the faithfulness of reproduction of moving-iron instruments.

The operating force is provided by changes in the magnetic field between two parallel iron surfaces. The length of the field is short compared with its area of cross-section, so that the flux-density is fairly uniform. If the value of the latter, when the diaphragm is at rest, is B lines per square centimetre, the force of attraction between the surfaces is approximately equivalent to a weight of $B^2a/8{,}000\pi$ grammes, "a" being the area of the polar surface. If we take B

Loud-speaker Construction.—

to be 2,000 and "a" to be 0.5 square centimetres, the force is equivalent to 80 grammes, or about 3 ounces. This steady pull has to be counteracted by rigidity in the reed or diaphragm, which entails a comparatively high natural frequency (of the order of 600 or 800 cycles per second). The consequent tendency is towards comparatively poor response to the lower frequencies.

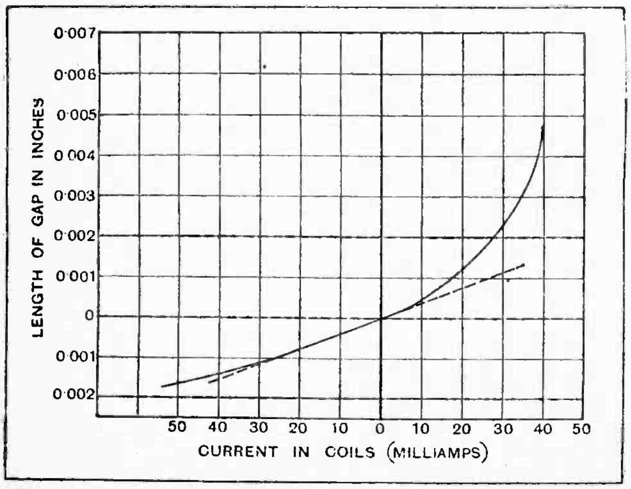


Fig. 2.—Curve showing displacement of reed with operating current. The mean air gap is 0.007 inch and the horizontal dotted lines represent the practical limits of movement for a loud signal.

When an impulse of current, i, flows in the winding of the instrument, this may be considered to alter the value of B by an amount $\pm b$, usually much smaller than B. For instance, 1 milliampere flowing in 5,000 turns, would produce a value of, very approximately, 50 lines per square centimetre. The force of attraction is then modified to $(B \pm b)^2 a/8{,}000\pi$, which, multiplied out and neglecting the constant is $(B^2 \pm 2Bb + b^2)$. Of these terms, B^2 may be regarded as representing a steady pull, with no effect on reproduction. $2Bb$ is the desired operating force, and is proportional to i. The last term is an additional unwanted force which must cause distortion since it is proportional to i^2. If, for instance, the current is one corresponding to a pure note of any particular frequency, so that it may be represented by the equation $i = i_0 \sin \omega t$, the b^2 term becomes $i^2_0/2(1 - \cos 2\omega t)$. It produces an additional steady pull together with one varying at double the original frequency and therefore corresponding to a note an octave higher than the original.

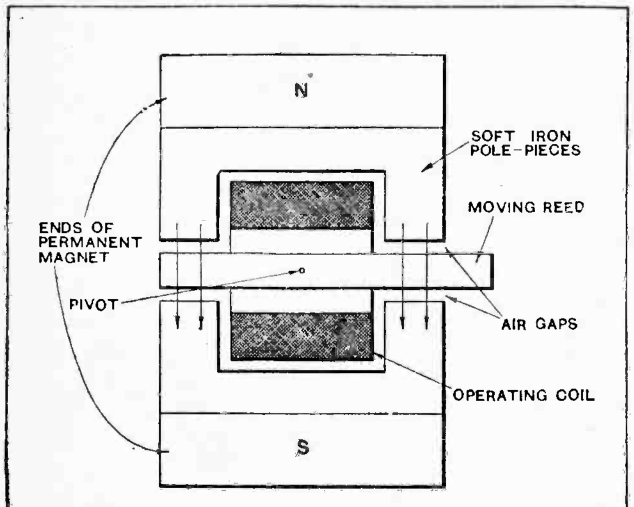


Fig. 3.—Section of balanced armature movement.

Importance of a Strong Permanent Field.

The importance of having a large value of B is apparent, since it directly increases the magnitude of the $2Bb$ term, and renders the b^2 term relatively unimportant in the ratio $2{,}000^2 : 50^2$ or $1{,}600 : 1$. It is interesting to note that without the polarising flux, as Ba is called, the output from a telephone receiver of the moving-iron type would be automatically raised an octave above the input.

In addition to the above there are two sources of distortion which may be of much greater importance practically. The first is that b may not be strictly proportional to i owing to hysteresis and eddy-current effects in the iron, and the second that B is not strictly constant,

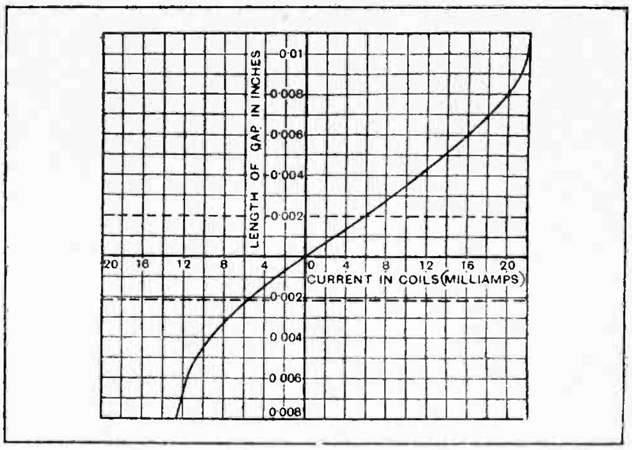


Fig. 4.—Displacement–current characteristic of balanced armature movement. Again the approximate limits for a loud signal are indicated by the horizontal lines.

but varies with the position of the armature relatively to the poles. The practical importance of the former is very difficult to assess. The general tendency will be towards the elimination of the higher frequencies, though this may be minimised by the use of annealed, laminated soft iron pole-pieces.

With regard to the second point, Dr. Mallett has shown that if this change of B with position were proportional to the displacement, no distortion would result. The relationship is, however, not linear. It is doubtful if sufficient attention is paid to the fact that B is not constant, but varies with the position of the reed or diaphragm relatively to the poles. When the diaphragm moves from the mean position towards the poles, B is automatically increased, whereas when it moves away it is decreased. In the case of headphones and of loud-speakers intended only for small output of sound, it is not a point of any consequence. But in these days of

Loud-speaker Construction.—
excellent transmission, almost faultless amplifiers, and economical power valves, no reproduction can be considered satisfactory which does not approach the intensity of the original sound. In order to achieve this the amplitude of the vibrations of the diaphragm must be such that

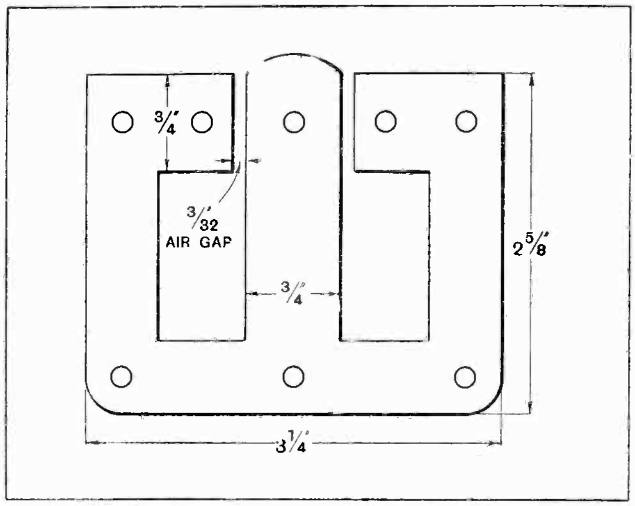


Fig. 5.—Dimensions of stampings used in the field magnet of the moving-coil loud-speaker.

on the lower notes it is an appreciable fraction of the length of the air-gap.

This point is illustrated in Fig. 2, where the displacement/operating-current curve for a well-known moving-iron instrument is shown. The tangent to this curve at the origin gives the relationship which would exist if B were independent of the position of the diaphragm.

The Balanced Armature Movement.

The effect will be complicated under working conditions by the fact that when the diaphragm moves, B does not immediately adjust itself to its new value. (The curve shown was obtained on D.C.) At the higher frequencies it therefore tends to remain more nearly constant and to lead to less distortion. It is at the lower frequencies that the effect is of importance, however, for the reason just given.

The case of the balanced armature type of movement is somewhat different from that discussed above, and it will be seen that it is more suitable for powerful speakers from some aspects. This instrument is a development of the P.O. neutral-tongue relay, and is illustrated in Fig. 3.

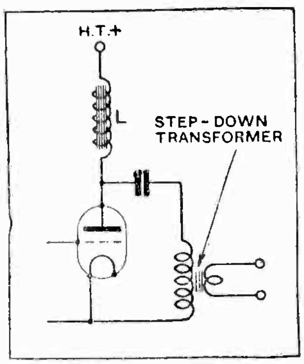


Fig. 6.—This circuit, in which it was proposed to use L both as exciting winding and feed choke with an anode current of 0.015 amp., proved unsuccessful on account of the excessive voltage drop.

In this the flux from the main poles divides into two portions, one passing through each end of the moving reed. When correctly adjusted the two small air-gaps in each path are of equal length, and so the forces of attraction on the ends of the reed balance one another out. When a current passes through the exciting winding, however, the flux in the gap on the upper face of one end and the lower face of the other is increased, while that in the other gaps is correspondingly decreased. The balance is therefore disturbed, and the forces become $2(B+b)^2$ and $2(B-b)^2$; giving a resultant force $2(B+b)^2 - 2(B-b)^2$ or $8Bb$, tending to turn it about the pivot. This instrument is therefore free from the distortion arising from the b^2 term, but is still liable to those due to change of B with position, and hysteresis and eddy-currents. The curve in Fig. 4 for the balanced armature is seen to be approximately symmetrical. This curve was obtained from an experimental instrument before sufficient attention had been paid to the necessity for accurately centring the moving reed. Consequently, the position of rest is not at the centre of the displacement curve, and a greater amplitude is possible in one direction than the other while remaining on the straight part of the curve.

Turning now to the moving-coil instrument, it is as well to mention its big drawback at the outset. This is its

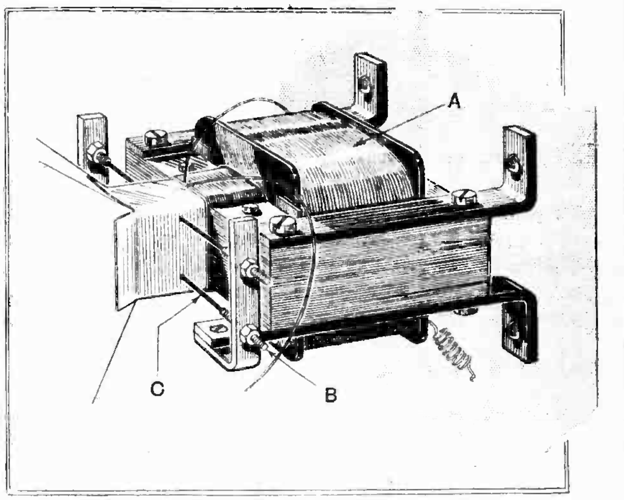


Fig. 7.—Details of the moving coil system. A, field magnet winding; B, adjusting screws for string tension; C, horizontal supporting strings.

comparative inefficiency. In order to accommodate the coil in the air-gap the latter must be increased in length beyond what is usual in the moving-iron type. This leads to a decrease of flux-density which can only be made good by a large increase in the magnetising force. Permanent magnets are out of the question unless of ample size and carefully constructed. The simpler solution, usually adopted, is to employ an electro-magnet system with its attendant battery. Even then the sensitivity does not compare favourably with a similarly constructed moving-iron speaker

Advantages of the Moving Coil System.

To sum up: there are certain sources of distortion in the electromagnetic portion of all moving-iron loud-speakers which are probably negligible when only a small sound output is required, but which may become important when more realistic volume is demanded. These sources

Loud-speaker Construction.—

are absent in the case of the moving-coil instrument, even when working at the largest volumes. If, therefore, such a movement is fitted with the simplest form of diaphragm it is probable that as close an approach to an ideal instrument will be obtained as is at present possible, at least as far as the electromagnetic type is concerned. A considerable increase in power will be needed to operate it, however.

The construction involved need not be complicated. In the present case, Stalloy stampings of the shape and dimensions given in Fig. 5 were used as the magnetic circuit. A coil of 520 turns of No. 22 S.W.G. D.C.C. wire was wound on a built-up $\frac{1}{32}$in. leatheroid bobbin, held during winding in a wooden former and subsequently waxed solid and removed. This provides the exciting winding. It was hoped, at first, to employ the circuit shown in Fig. 6, for the sake of economy. The voltage drop in a suitable winding was found to be prohibitive, however. The coil described above is designed to operate from a 6-volt accumulator, and having a resistance of 4.4 ohms, provides 700 ampere-turns. It would prove economical to anyone connected to D.C. electric light mains to alter the number of turns and gauge of wire and supply the coil through a lamp.

Winding the Moving Coil.

The stampings were slipped into this coil one at a time, 55 being used altogether. They were then clamped between iron straps, as indicated in Fig. 7, and the polar faces carefully smoothed over with a fine file.

The air-gap is, of course, rectangular in shape, which necessitates a rectangular moving-coil, the making of which was the only troublesome part of the work. Five coils were made before a satisfactory one resulted. If the following procedure is adopted, however, little real difficulty will be encountered.

A rectangular block of wood is split for half its length with a tenon-saw. A strip of heavyweight drawing paper of good quality is wrapped around this and glued along the overlapping faces. Thin wedges are then driven into the saw-cut till the paper is drawn as tight as its strength will allow. The coil, consisting of about 140 turns of No. 36 S.W.G. D.S.C. wire in two layers, is wound on tightly and given several coats of pure shellac varnish. After each it is thoroughly baked for some hours. On removing the wedges from the saw-cut the coil can be slipped off and will be found to be quite rigid and of a satisfactory shape. It will be seen from the dimensions given, however, that the least buckling would render it useless.

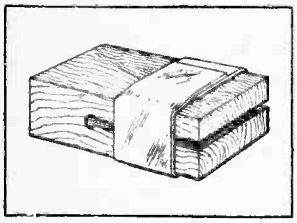


Fig. 8.—Former for winding moving coil.

The coil thus made was glued to a paper cone shaped as a square pyramid and mounted in the gap on two horizontal strings. Any good quality heavy thread or thin string is suitable for the purpose, and if a little glue is worked into the four holes where it passes through the paper former a secure suspension results. The ends of the string are attached to short lengths of threaded brass rod, which pass through holes in vertical brass strips (see Fig. 7). The position of the coil and the tightness of the strings are readily adjusted by nuts running on the short rods. The principal natural frequency of the suspended system is in the neighbourhood of 30 cycles, and it is almost critically damped.

The horizontal width of the coil had been so gauged that one or other of the outer surfaces touched an outer pole-face before either of the inner surfaces could come in contact with the inner surfaces of the gap. This made it easy to adjust the coil so that it moved freely in the gap.

As the resistance of this coil is only 9 ohms and its inductance about 2 millihenries, a step-down transformer is needed. It was decided to design this so that the impedance of the transformer, with the coil connected to its secondary, should "match" the differential resistance

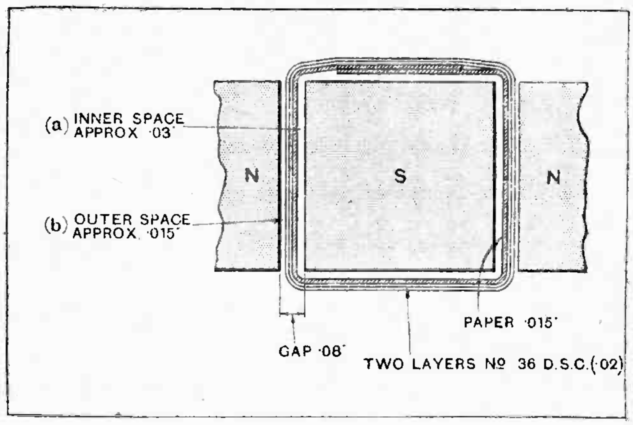
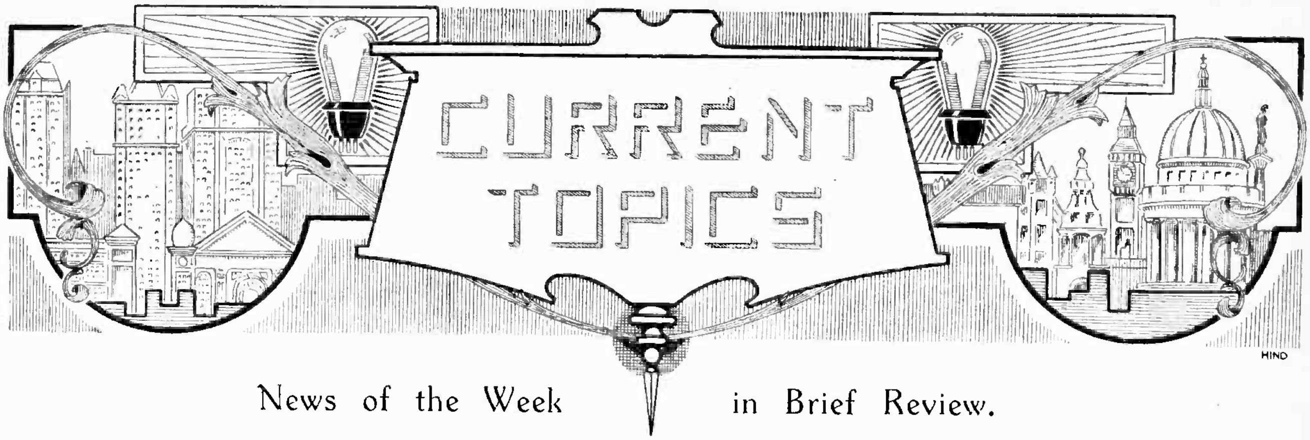


Fig. 9.—Clearances between moving coil and magnet poles; (a) is made greater than (b) to reduce risk of touching pole face, the outer space being easily adjustable by inspection.

of a suitable power valve at 100 cycles. There is then some falling off at the higher frequencies, but this is not as serious as the corresponding effect on the lowest frequencies if a higher figure is selected. Taking the resistance of the power valve to be 3,000 ohms, and the impedance of the coil as 10 ohms, then the step-down ratio should be $(3,000/10)^{1/2}$, or about 17 to 1. Some transformer stampings happened to be available, and it was found that with these and about 1,700 turns on the primary the maximum voltage likely to be used only called for a flux-density of about 2,000 lines per square centimetre. One hundred turns of No. 26 S.W.G. wire formed the secondary, which was wound in one "slab" and sandwiched between two 850-turn coils of No. 36 wire forming the primary.

In order to make the cone as rigid as possible, the free edges were folded back on themselves and held in position by small strips gummed into the corners. It was endeavoured to prevent interference between the waves of sound radiated from the front of the cone and the corresponding ones from the back by enclosing the completed instrument in a wooden box. This was lined throughout with cotton-wool, with the idea of absorbing the unwanted radiation from the rear surface.



News of the Week in Brief Review.

PERSIAN WIRELESS.

A general wireless service has just been established at Teheran for both foreign and local traffic.

oooo

BELGIAN BROADCASTING STATION CLOSES DOWN.

It is reported that on Wednesday last the Antwerp station (Radio-Zoologie) closed down, owing to lack of funds. Let us hope that the trouble is only temporary.

oooo

I.E.E. ANNUAL DINNER.

H.R.H. the Prince of Wales has graciously consented to preside at the annual dinner to-morrow (Thursday) of the Institution of Electrical Engineers at the Hotel Cecil, Strand.

oooo

WIRELESS FOR HOSPITALS.

We regret to have to record the death, which occurred on January 31st, of Mr. J. Hugh Jones, a director of *The Daily News*. It was Mr. Hugh Jones who was mainly instrumental in organising the "Wireless for Hospitals" Fund.

oooo

NEW ZEALAND TACKLES OSCILLATION PROBLEM.

Regulations forbidding the use of direct reaction coupling to the aerial in broadcast receivers have been issued by the New Zealand Post and Telegraph Department. Exceptions will be made in regard to sets of specially approved design.

oooo

D.F. VAN AT WINDSOR.

In consequence of complaints of interference made by wireless listeners resident in Windsor and the adjacent district, Post Office engineering officers have recently been engaged in locating the sets responsible for spoiling broadcast programmes in this part of the country.

The specially designed D.F. van, which has been used elsewhere with excellent results, was sent to deal with the Windsor complaints. Bearings were taken by means of a frame aerial, and the engineers in charge of the van were able to locate several of the offending stations. An inspection of the suspected sets followed, and in each instance it was found that reaction was being used. The owners of the sets professed to be ignorant of the trouble they were causing.

R.S.G.B. ANNUAL DINNER.

The annual dinner of the Radio Society of Great Britain will take place on Friday next, February 11th, at 7.15 p.m. for 7.45 p.m., in the Richelieu Room. Hotel Cecil, Strand. Tickets are 12s. 6d. each, and it is important that applications, accompanied by remittance, should be sent in immediately to the Society's offices, 53, Victoria Street, London, S.W.1.

oooo

AMATEUR CALLS THE ANTARCTIC.

Mr. C. W. Goyder (G 2SZ), operator of the well-known amateur station at Mill Hill, was in two-way communication with the Norwegian whaler *Sir James Clark* on Sunday, January 30th, when the vessel was close to the Ross Barrier and some 250 miles within the Arctic circle. G 2SZ worked on 32.2 metres, and the whaler on 33.5.

oooo

EXPERIMENTAL BROADCASTS IN MANCHESTER.

Mr. J. E. Kemp, of the Manchester Radio Scientific Society, has opened a research station (2HD) from which he and members of the Society broadcast musical programmes on 440 metres on Sundays. The transmissions are experimental.

As we go to press we learn that the Society has received a letter from the Postmaster-General intimating that if the information which has reached him is correct, there had been a serious breach of the conditions on which an amateur wireless transmitting licence is held.

ONE OF THE NIGHT BRIGADE.—Mr. Herbert Jones, a Liverpool listener, who recently picked up a transmission from Winnipeg broadcasting station of the Canadian National Railways. CNRW operates on a low power with a wave-length of 384·4 metres

oooo

MODERNISING THE MERSEY.

With a view to modernising the system of marking Mersey Harbour, the Mersey Docks and Harbour Board proposes to obtain the sanction of the P.M.G. for the installation of a wireless beacon.

oooo

A BROADCAST BALLOT.

In an endeavour to gauge public requirements in the matter of broadcast programmes, our contemporary, the *Daily Mail*, has launched a ballot to determine the most popular type of programme. Prizes of £500, £100, and £50 are offered to competitors who successfully forecast the result.

oooo

THE "EVERYMAN'S FOUR."

Readers of the "Everyman's Four" booklet, which has just been issued by the publishers of *The Wireless World*, price 1s. 2d., post free, are asked to note that Table IV. on p. 19 relates to the characteristics of the D.E.5B valve, and not the D.E.5. as stated.

oooo

THE RADIO ASSOCIATION.

The Radio Association will hold its annual meeting at the Hotel Cecil, Strand, on Thursday, February 17th, at 3.30 p.m. Commander the Hon. J. M. Kenworthy, M.P., will deliver the presidential address.

The meeting will be followed by a lecture at 4.45 p.m. on "Broadcasting and Television" by Professor Fournier D'Albe, D.Sc. This lecture will be open to the public.

oooo

THE WIRELESS WORLD DIARY.

Readers who have not yet obtained their copies of *The Wireless World Diary* for 1927 may be interested to learn that a few copies are still available. This handy little book is not merely a diary; it contains a fund of just that kind of information which every wireless amateur wishes to have at his finger-tips.

The principal sections include a list of amateur call signs in Great Britain and Ireland, explanations of all the standard receiver circuits, with twenty-nine diagrams, and a comprehensive table of valve data. The diary portion is in a convenient form, each week of the year being allotted two pages. Numerous other features combine to make the diary an extremely valuable pocket-book for ready reference.

The book can be obtained from all booksellers, or direct from the publishers, Iliffe and Sons Ltd., Dorset House, Tudor Street, E.C.4, price 1s. 1½d. post free (cloth), or 2s. 8d. post free (leather, with pockets, etc.).

Book Review.

TELEVISION.
By Alfred Dinsdale, A.M.I.R.E.
Sir Isaac Pitman & Sons, Ltd.
62 pp. Price 2s. net.

Although the title suggests a general treatment of moving-picture transmission the book is devoted essentially to details of the system developed by Mr. John L. Baird. The first chapter wildly speculates on the progress of invention and prepares the non-technical reader for the statements which are to follow in the hope that television may appear to be almost commonplace and merely a long-awaited step in the process of scientific evolution. In referring to the Baird system it is given as a statement of fact that television over short distances outside the laboratory has been accomplished, and it is to be presumed that the author has satisfied himself on the correctness of his statement.

The subject is treated in a non-technical manner or, in the words of the author, "We propose to deal in detail and in a popular manner with the world's latest and most startling discovery—Television—following through the earliest attempts made by various investigators right up to the final attainment of the much-coveted goal by John L. Baird."

The attempts of Szczepanik, Rosing and Mihaly are dismissed in a short chapter occupying a little more than two pages. Considerably more space is, however, devoted to a biography of Mr. Baird. An explanation of his system is given in pictorial diagrams in which it is gratifying to find that reference is made to synchronisation, the principal difficulty in any system of television and one which is, incidentally, completely overlooked in the text. The use of synchronous A.C. motors is suggested for the purpose of holding the sending and receiving sets in step while both the picture transmitter and the synchronising signals are applied to wireless transmitting and receiving apparatus. Such a method of synchronisation is impracticable, and to anyone with a knowledge of the close degree of synchronisation required or acquainted with the difficulties of superimposing the synchronising signals on a wireless transmission, the system without some explanation as to how it is accomplished is unconvincing. The achievement of television really has nothing to do with wireless, though there are frequent references to wireless systems of television. To convince the reader as to the success of the Baird system mention is made of a demonstration given to members of the Royal Institution, though there are no details as to the distance over which television was accomplished in this instance.

Among the problems confronting any inventor of a system of television are those of synchronisation and the devising of a suitable light sensitive cell. Neither of these points is explained in the book, and without more technical information one can regard Mr. Dinsdale's book only in the light of propaganda.

A LUCKY PRIZE WINNER. A cheque for twenty-five guineas being handed to the dealer who won the second prize in the C.A.V. high tension accumulator competition. On his right is Miss Ruth Fazen, the first prize winner. The story is t ld below.

TRADE NOTES.

The "Silent Sixty."

An interesting little ceremony was performed at the Acton works of Messrs. C. A. Vandervell & Co., Ltd., on Friday, January 28th, when Miss Ruth Fazen, of Deodon Road, Putney, was presented by Mr. R. W. Cox with a cheque for 75 guineas, this being the first prize in connection with the Company's recent competition organised for the purpose of obtaining a suitable name for the new C.A.V. 60-volt H.T. accumulator. Miss Fazen suggested the "Silent Sixty," a name which immediately commended itself as an eminently suitable designation.

In accordance with the conditions of the competition, Captain Brechenshaw, of Morlands Motors, Ltd., Sheen Lane Garage, East Sheen, S.W.14, the dealer who supplied the accumulator to the first prize winner, received a cheque for 25 guineas.

oooo

Offer to Blind Listeners.

In connection with the sale of "Hear-Easy" rubber headphone pads, Messrs. Leslie Dixon & Co. (Electradix Radios) are offering one pair free to any *blind* broadcast listener in return for 2d. in stamps to cover postage. Hospitals are offered one pair free for every pair ordered.

The list price of the "Hear-Easy" pads is 2s., but this has been reduced to the sale price of 6d. The pads are light and soft, and are designed to exclude all external noise.

oooo

Igranic Fancy Dress Carnival.

Over 500 guests attended the annual fancy dress carnival of the Igranic Electric Co., held at the Café Dansant, Bedford, on January 14th. The majority of those present were in fancy dress, the originality and variety of which made the task of the judges very difficult. Eighteen valuable prizes were presented by Mrs. A. H. Curtis, wife of the general manager.

FORTHCOMING EVENTS.

WEDNESDAY, FEBRUARY 9th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Demonstration of the Marconiphone "Straight Eight."

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Lecture: "The History and Development of Short Waves," by Mr. G. W. Wigglesworth.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Lecture: "Two Valves and a Crystal," by Mr. S. Cursitor, O.B.E.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Lecture: "The Neutrodyne," by Mr. R. F. G. Holness.

THURSDAY, FEBRUARY 10th.

Institution of Electrical Engineers.—Annual dinner. Stretford and District Radio Society. At the Café Imperial. Lecture by Messrs. The General Electric Co., Ltd.

Preston and District Radio Research Society.—Lecture and demonstration by Messrs. Ferranti.

FRIDAY, FEBRUARY 11th.

Sheffield and District Wireless Society.—At the Dept. of Applied Science, St. George's Square. The Month's Wireless News.

Leeds Radio Society.—Open Night.

MONDAY, FEBRUARY 14th.

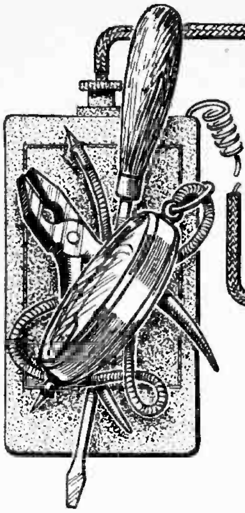
Croydon Wireless and Physical Society.—At 128a, George Street. Lantern Lecture: "The Manufacture of a Valve from Raw Materials," by Mr. C. Hector, of Thermionics, Ltd.

Hackney and District Radio Society.—At 8 p.m. At 18-24, Lower Clapton Road, E.5. Lecture: "Fault Finding," by Mr. G. V. Colle.

Northampton and District Amateur Radio Society.—At 8 p.m. At the Cosmo Café. Lantern Lecture: "The Tungar Rectifier," by Mr. A. P. Hill, M.Eng. (of the B.T.-H. Co.).

TUESDAY, FEBRUARY 15th.

Lewisham and Bellingham Radio Society.—Short Wave Competition.



PRACTICAL HINTS & TIPS

A Section Mainly for the New Reader.

MAKING THE MOST OF A VOLTMETER.

The necessity for a reliable voltmeter with suitable ranges for reading the voltages of L.T., H.T., and grid bias batteries, has frequently been urged in these notes. It has also been shown that moving-coil instruments, apart from performing the functions for which they are primarily intended, may also be made to serve as anode milliammeters or as distortion indicators, when connected in the plate circuit of the output valve.

A voltmeter may also be made to act as a form of indicating galvanometer; for this purpose it should preferably be mounted in a box or on a board, with terminals or sockets connected as shown in Fig. 1. Sockets are certainly more convenient, as they permit of rapid and easy changing of leads; two of these should be prepared, and they may be fitted with suitable plugs at one end and with the so-called pin terminals at the other. A 4½-volt flash-lamp battery forms a part of the testing equipment, and is wired between the instrument terminals and the "test" sockets as shown.

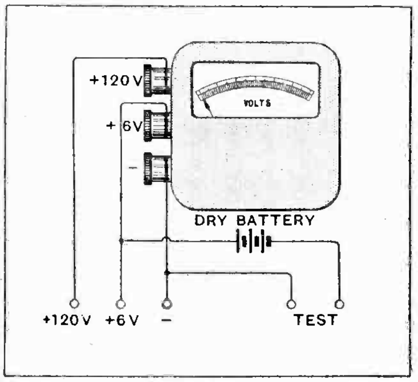


Fig. 1.—A two-range voltmeter mounted for insulation and continuity tests.

To use the instrument for measuring voltages, the appropriate sockets marked –, +6, and +120 (or whatever the ranges covered may be) are connected across the battery in the usual way. For testing continuity and insulation, the leads are transferred to the sockets marked "Test," and the ends are applied across the part of the circuit or the component under suspicion. A full deflection (*i.e.*, the same as is obtainable when the testing leads are connected together) will indicate that the external circuit has a resistance which is negligible in comparison with that of the meter itself.

If no deflection whatever is obtained, it may be assumed that the insulation resistance is fairly high, although for a good test of this kind it is desirable that the voltage applied should be very much greater than that mentioned. For this purpose two extra terminals may be fitted, so that a high-tension battery of 100 volts or so may be inserted in series with the flashlamp battery. The value of the test will depend on the sensitivity of the meter (and therefore on its resistance). An instrument of the highest possible resistance is, generally speaking, the most suitable for wireless purposes, although it should be added that a high-resistance meter must be used only with great care in the anode circuit of a power valve for indicating overloading, as the voltage dropped across it may easily be excessive. There is no reason, however, why a non-inductive wire-wound resistance should not be connected in shunt when it is used for this purpose; by adopting this plan the effective resistance can always be reduced to some 200 ohms. Allowing an anode current of 10 milliamps, the voltage dropped will then be only 2, as against 10 when an unshunted 1,000-ohm meter is inserted in series. The coils of some instruments have resistances several times greater than this.

All these remarks apply, of course, to moving-coil voltmeters; the cheaper moving-iron pattern has a limited field of usefulness, and, due to its comparatively low resistance, its use may be misleading and harmful, particularly when testing the H.T. battery.

oooo

A SOLDERING HINT.

When a small soldering iron is not available, connections may easily be made in inaccessible positions by adopting the plan indicated in Fig. 2. The connecting wire should be placed in position, and a trace of flux

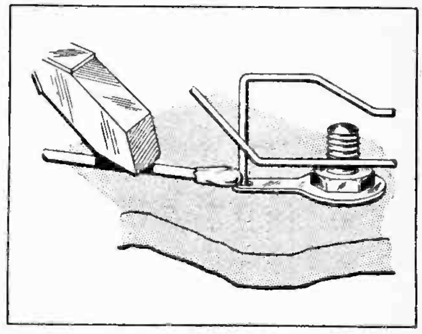


Fig. 2.—Soldering a connection in an inaccessible position.

applied to the junction. The end of a short length of thin copper or brass rod is now coated thickly with solder, and is pressed on to the joint; the heated soldering iron is applied to a point on this rod as near as possible to the work. After a few moments, sufficient heat will be conducted through the metal to cause the solder to run.

A piece of thick wire of, say, No. 16 gauge, or heavier, will serve in place of the rod for light work.

oooo

H.F. TRANSFORMERS.

Although the modern high-efficiency transformers, described in connection with the "Everyman Three," the "Everyman Four," and several other recent *Wireless World* receivers, give the highest amplification when used with the particular types of valves recommended, it must not be thought that they are definitely unsuitable for coupling together valves of lower efficiency. Indeed, the contrary is the case; it is probably correct to say that these transformers give better results than other conventional couplings with any type of valve having an impedance value up to 50,000 ohms, or even slightly more. For valves of very high impedance an extra turn or two should be added to both the primary and neutralising windings.

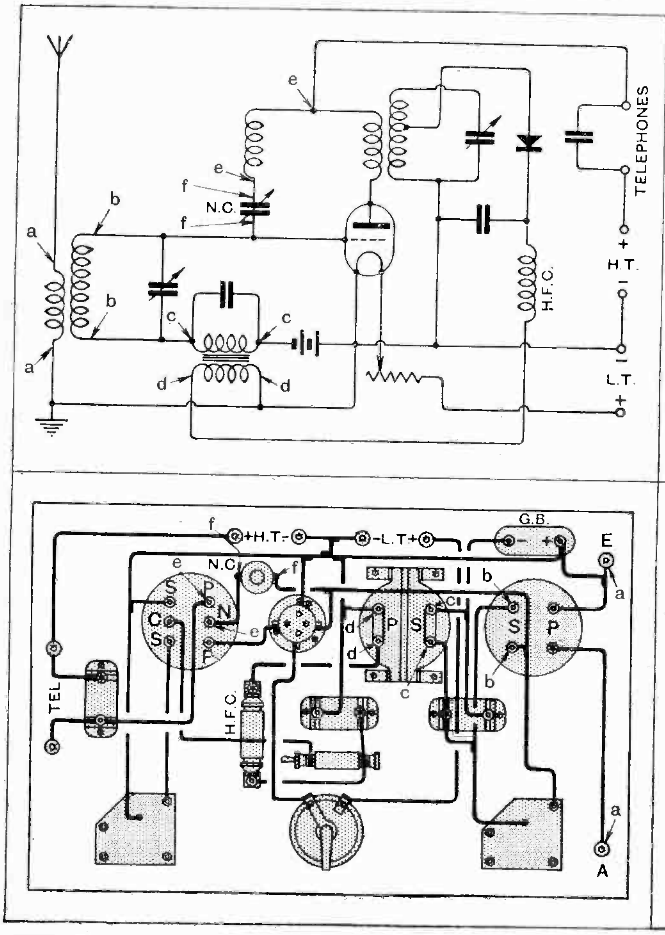
Designs for transformers suitable for valves of low impedance have already been given (see *The Wireless World* for June 30th, 1926); their chief difference lies in the smaller number of primary and neutralising turns.

DISSECTED DIAGRAMS.

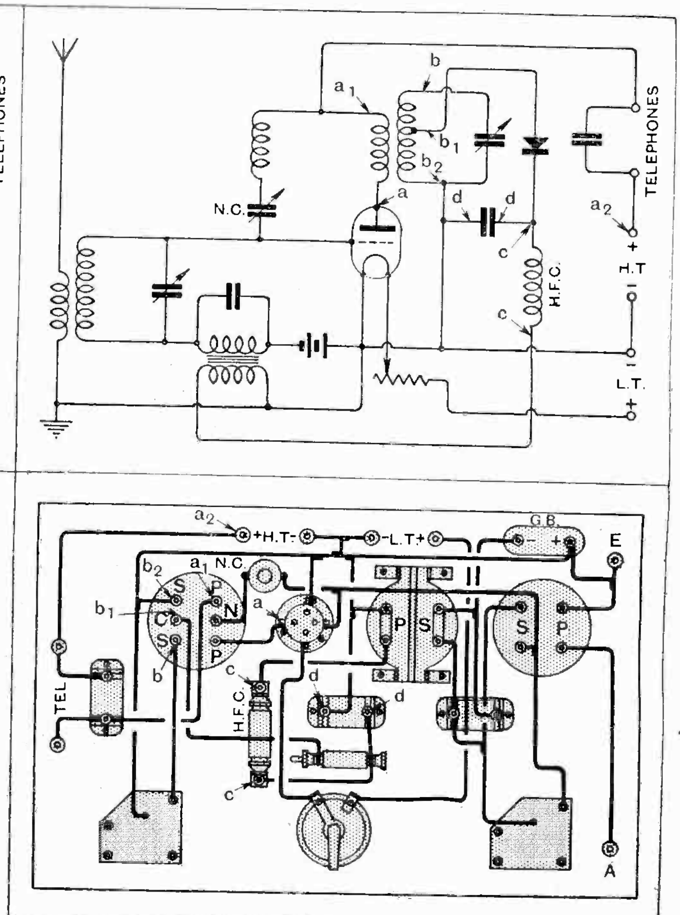
Point=to=point Tests in Theory and Practice.

No. 59.—A Single-valve Reflex Receiver.

The present series of diagrams is intended to show simple methods of locating faults in typical wireless receivers. Failing a sensitive galvanometer, it is suggested that a pair of telephones with a small dry battery should be used as an indicating device. These tests will show not only actual faults, but will reveal the small leakages which are so often responsible for poor reception and flat tuning. Batteries should be disconnected before testing.



Continuity in the primary and secondary windings of the aerial coupling transformer is shown between *a–a* and *b–b*. The tuning condenser should be disconnected and tested separately for a short-circuit. The primary and secondary windings of the L.F. transformer are tested across *d–d* and *c–c*. Continuity in the neutralising winding is shown between *e* and *e*, while the balancing condenser is tested across *f–f*.



The continuity of the primary winding is shown between *a* and a_1, and of the anode circuit as a whole between *a* and a_2 (with phone terminals short-circuited). The secondary winding is tested between *b* and b_2, and the connection for the crystal tapping between b_1 and either *b* or b_2. Continuity in the choke is shown across *c* and *c*, and the insulation of the by-pass condenser between *d* and *d*.

Measurements on RADIO-FREQUENCY AMPLIFIERS.

II.—Voltage Amplification.

By R. L. SMITH-ROSE, Ph.D., D.Sc., A.M.I.E.E., and H. A. THOMAS, M.Sc.

IN the previous article [1] the main properties of radio-frequency valve amplifiers were discussed, and a brief review was given of the more important methods which have been devised for the measurement of voltage amplification. It is now proposed to describe in some detail experimental arrangements which have been recently developed for accurate measurement work in connection with high-frequency amplifiers. It has already been pointed out that any method which is based upon the comparison of signal intensity in telephone receivers is subject to limitations, and for accurate measurement work some form of indicating instrument is to be preferred. Unfortunately, the current which passes through a pair of telephone receivers for an average signal intensity is only of the order of a few microamperes, and such instruments as the reflecting thermo-galvanometer and the electrostatic voltmeter can only be used for comparatively loud signals. Indirect methods of measuring the feeble output currents required for ordinary signal intensities, such as the valve or crystal rectifier and "slide-back" method, give rather doubtful accuracy, and they introduce not only shunting loads, but also large capacities to earth as a result of the batteries associated with such measuring circuits.

By means of a suitable instrument we can measure one of two quantities: the root-mean-square value of the output current, or the value of the fundamental component of the complex wave forming this current. Most methods of measurement give the R.M.S. value, but this gives only an approximate value of the output unless an accurate knowledge of the wave-form of the current is also obtained. If the fundamental component of the output is measured, however, we can obtain the true amplification of the original wave due to the system, the harmonics produced being considered merely as the result of secondary effects which can be studied separately. With this object in view the method for measuring the output current in the work now being described employs a vibration galvanometer in connection with a current transformer.

Principles of Method Adopted.

For the purpose of obtaining small known E.M.F.s at radio frequencies a step-down current transformer[2] is used in conjunction with a calibrated potentiometer connected across the secondary winding. This potentiometer is of quite low resistance, and the arrangement is thus free from the errors caused by the unavoidable self-capacity when simple potentiometers are used at radio frequencies. The current in the primary winding of the transformer is measured by means of a thermojunction and galvanometer, and the E.M.F. applied to the resistance forming the potentiometer can then be readily calculated. In this manner E.M.F. ratios of 1 : 10^5 can be obtained, and it is towards the smaller values of applied E.M.F. that there is any falling-off in the accuracy of measurement. Since, for the measurement of high-frequency amplifiers, an audio-frequency output is required in order to operate the galvanometer, the oscillations obtained from the radio-frequency source are modulated at an audible frequency by means of an aperiodic coupling in series with the anode circuit. This arrangement can be understood from the diagram of connections shown in Fig. 1. In carrying out measurements the aperiodic modulating coil is always adjusted to give complete, or 100 per cent. modulation. The method of determining this condition makes use of a local tuned crystal receiving circuit coupled to the radio oscillator. When the source is over-modulated, *i.e.*, when the amplitude of the audio-frequency component exceeds that of the radio-frequency oscillation, a second harmonic is easily detectable in the rectified current in the telephones, and the adjustment at which this harmonic just vanishes gives the completely modulated condition. Any other degree of modulation can be adopted by actual measurements with an electrostatic voltmeter.

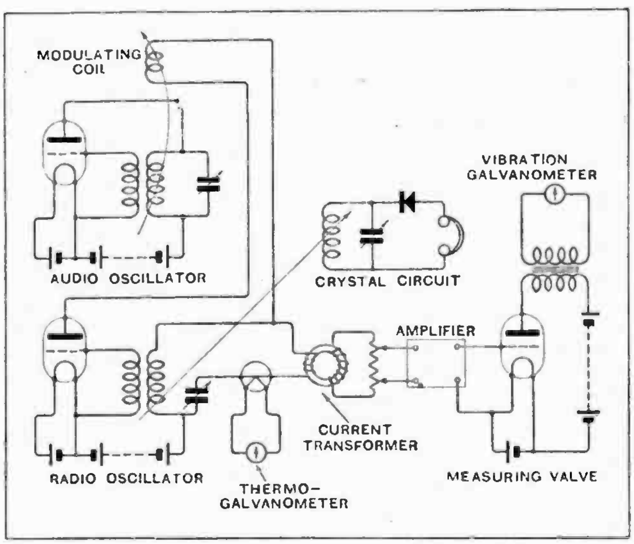


Fig. 1.—Circuit diagram indicating the principle of the method adopted to measure voltage amplification.

The vibration galvanometer, together with the transformer connected to it, can be calibrated directly from the audio-frequency source. This calibration is not required for the determination of high-frequency voltage

[1] *The Wireless World*, Feb. 2nd, 1927.

[2] See D. W. Dye: "Producing Small Voltages at Radio Frequencies," Journal I.E.E., Vol. 63, p. 597, 1925.

Measurements on Radio-frequency Amplifiers.—

amplification at any constant modulation, and is actually only necessary for the absolute determination of the rectifier characteristic. In making the amplification measurement a known value of the modulated radio - frequency E.M.F. is applied to the input terminals of the amplifier, and the measuring valve with its attached vibration galvanometer is connected to the rectifying valve. After recording the deflection of the galvanometer, the input E.M.F. is transferred to the grid-filament circuit of the rectifier, and the E.M.F. is increased until the same deflection is produced on the galvanometer. It is then evident that the ratio of the two E.M.F.s gives the voltage amplification required, and the operation can be repeated for the individual stage if desired. Since the actual value of the applied E.M.F. is known throughout the measurement, the alternating current conditions under which each valve, including the rectifier, is working can be easily ascertained.

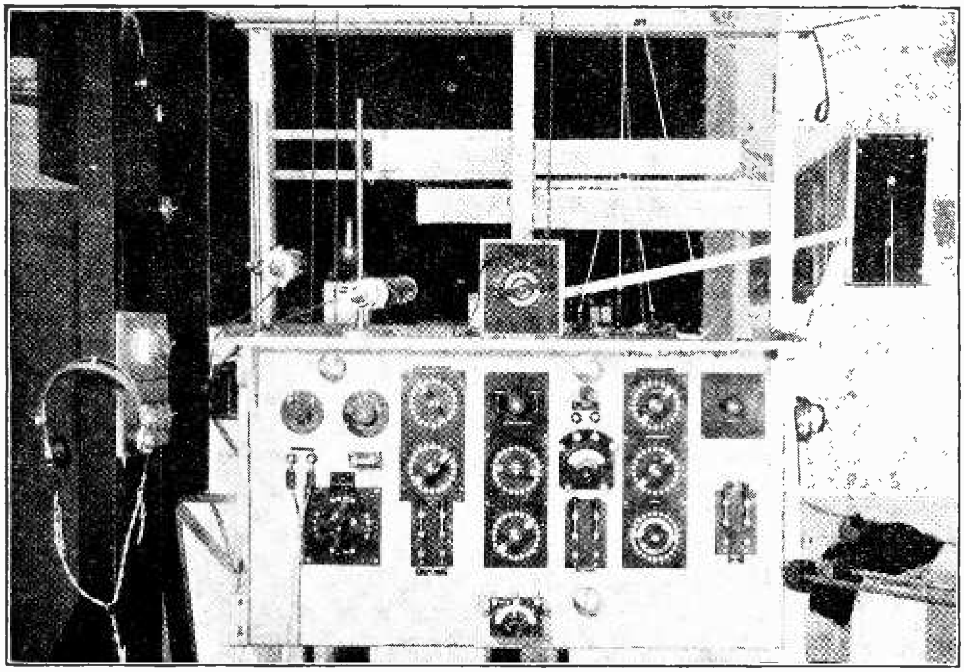


Fig. 3.—Front of measuring panel represented diagrammatically in Fig. 2.

For the determination of the amplification factor of the low-frequency stages, an E.M.F. from the audio source is applied direct to the grid and filament of the first audio-frequency stage by means of a potentiometer, and the output is measured as before. The procedure is then similar to that described above.

Practical Arrangement of Measuring Apparatus.

In practice it is found that the current-sensitivity of the vibration galvanometer varies considerably, and it was therefore necessary to set up a complete switching arrangement by means of which the galvanometer could be calibrated with the audio-frequency and a vacuo-thermo-junction, which in turn could be calibrated by direct current. These calibrations are carried out immediately after making measurements on an amplifier; so that in this manner both the input and

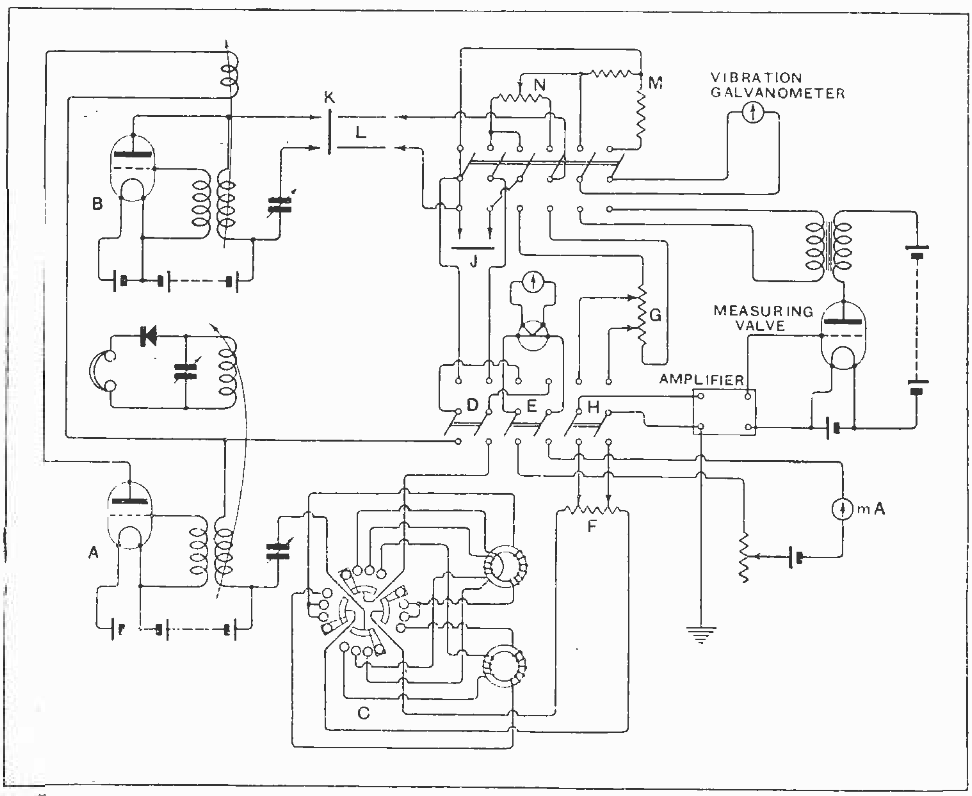


Fig. 2.—Complete connections of the apparatus showing switching arrangements for making the various calibrations required.

Measurements on Radio-frequency Amplifiers.—
output to the amplifier under test can be referred directly to a reliable direct-current instrument, and the accuracy of the whole measurement is considerably enhanced.

Switching Arrangements.

The above switching arrangements and the diagram of connections of the complete measuring panel are shown in Fig. 2. The radio- and audio-frequency oscillators are shown at A and B respectively, with the modulating coil and crystal detector circuit. Three ranges are provided on the high-frequency current transformer and controlled by a switch C. The thermojunction and galvanometer can be inserted into either the radio or audio source by means of switch D, and can be calibrated with the aid of switch E and the milliammeter. Either the radio potentiometer F or the audio potentiometer G can be connected to the amplifier through switch H. When the three double-pole interlocked switches are in the lower position the galvanometer is connected in the output circuit, whereas in the upper position it is connected to the audio source for calibration. Switch J is also interlocked with the above and is closed for calibration. Switch K closes the tuned circuit of the audio-frequency oscillator for modulation purposes, while L permits the source to be used for application to the amplifier and for calibration of the galvanometer. The standard shunts employed are shown at M, and the potentiometer N is used for calibration. Front and back views of the measuring panel embodying the features described above are shown in the photographs, Figs. 3 and 4. With such a compact arrangement of the controls for carrying out the various calibrations required, measurements can be quickly made of both the high-frequency and low-frequency portions of any amplification system.

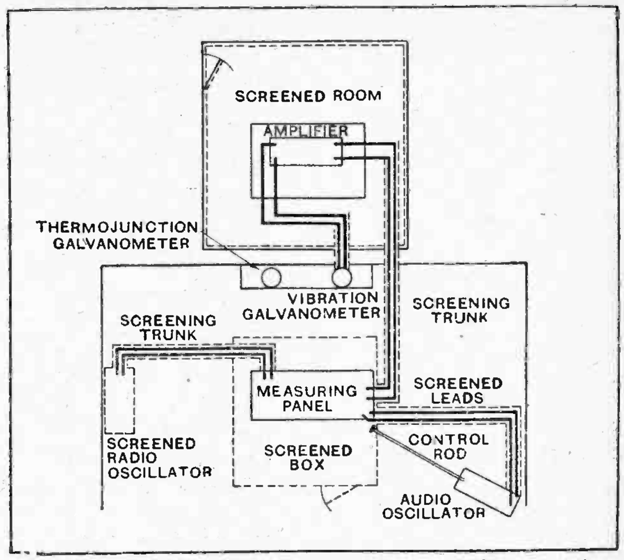


Fig. 5.—General layout of the apparatus showing screening methods adopted.

One of the most serious practical difficulties encountered when the highest accuracy is sought is that which arises from the direct induction of oscillatory E.M.F. from the source into the amplifier. With extremely sensitive amplifiers this induction may be very serious, even though the source and amplifier may be separated by a considerable distance. In the case under consideration this difficulty has been overcome by elaborate and

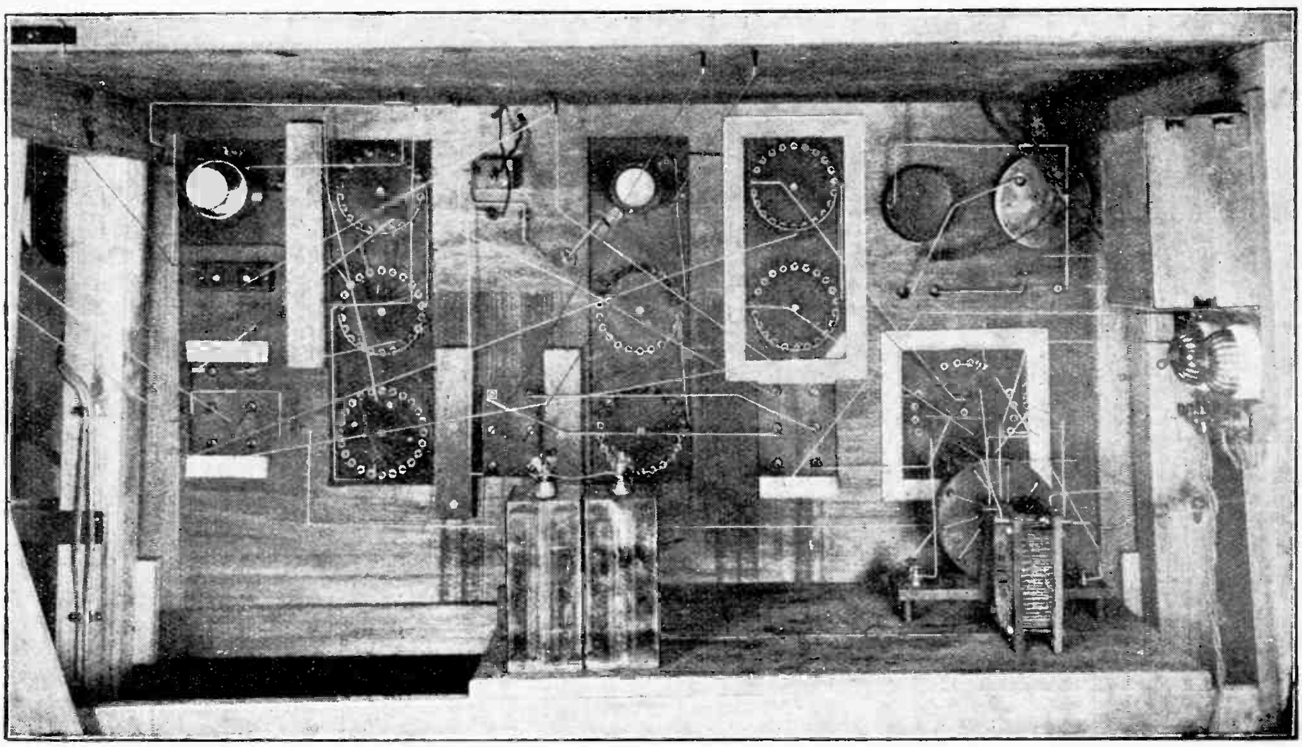


Fig. 4.—Rear view of measuring panel.

Measurements on Radio-frequency Amplifiers.—carefully designed screening arrangements. The principles of screening both electric and magnetic fields are now well understood, and they have been described in former articles in this journal[3] by one of the present writers.

The general layout of the screens adopted for the amplification measurements forming the subject of these articles is shown in Fig. 5. The measuring panel shown in Figs. 3 and 4 is completely enclosed in a metal cage formed of ½in. mesh galvanised iron wire netting, supported on a wooden framework. All joints in the screen are carefully soldered, and the door, for the admission of the operator, is provided with copper spring contacts. The amplifier under test is placed in a room which is screened in a similar manner. Fig. 6 is a photograph of a portion of the room, showing the door with its copper spring contacts and an amplifier which is being tested. The leads into this room are enclosed in a metal-lined trunk, which can be seen on the left of the photograph. The radio-frequency oscillator, as seen from the photograph in Fig. 7, is completely screened in a metal-lined box, with a bolted-on lid, through which the control handles are brought out. The output leads from this oscillator to the measuring panel are contained in another screening trunk. These trunks are made of wood, lined with tinned-iron sheet, and have cross-sectional dimensions of about twelve by eight inches; thus, while adequate screening is provided, the enclosed leads can be well separated to reduce to a minimum the shunt capacity effect which would otherwise be serious at radio frequencies.

[3] *The Wireless World*, November 18th, 1925, p. 694, and January 13th, 1926, p. 61.

Owing to the lower frequency, the necessity for screening the audio oscillator is not so great, but the leads to the measuring panel are suitably screened. A photograph of this oscillator is given in Fig. 8, and shows the special switch and variable condenser control rod, operated from within the cage containing the measuring panel.

Specimen Results Obtained with Various Types of Amplifier.

To illustrate the results obtained with measuring apparatus of the above type, it will be useful to describe some measurements which have been made on various standard types of amplifier, as part of a complete investigation of the principles of amplification.

(*a*) *Resistance-capacity Coupling.*—The circuit arrangement of a single stage of resistance-capacity coupling is represented in Fig. 9. The assumed non-inductive resistance R in the anode circuit of the first valve possesses, with the accompanying wiring, a certain self-capacity which is represented by the condenser C_1. When the valve is in operation, the alternating potential difference across the resistance R is transferred to the grid-filament circuit of the second valve by means of the condenser C_2. Now, at low frequencies the reactance of C_1 will be very high, and therefore the resistance R will comprise the whole of the external impedance in the anode circuit of valve No. 1. In a similar manner, however, the condenser C_2 will offer a high reactance, and will thus impede the transfer of alternating potential difference to valve No. 2. Unless, therefore, the capacity of the condenser C_2 is made specially large for audio-frequency work, the amplification obtained at low frequencies will be moderately small. The first effect of increasing the frequency will be the reduction of the reactance of the condenser C_2, with a consequent rise in the amplification obtained. This state of affairs will continue until a maximum amplification is obtained, when the shunting effect of the condenser C_1 becomes appreciable. At still higher frequencies the external impedance of the anode circuit of valve No. 1 decreases, which results in a falling off of amplification.

A typical measured amplification curve for a six-stage resistance-capacity coupled amplifier is shown in Fig. 10. It will be seen that the maximum amplification is obtained for a wavelength of about 2,500 metres, and while the falling off in

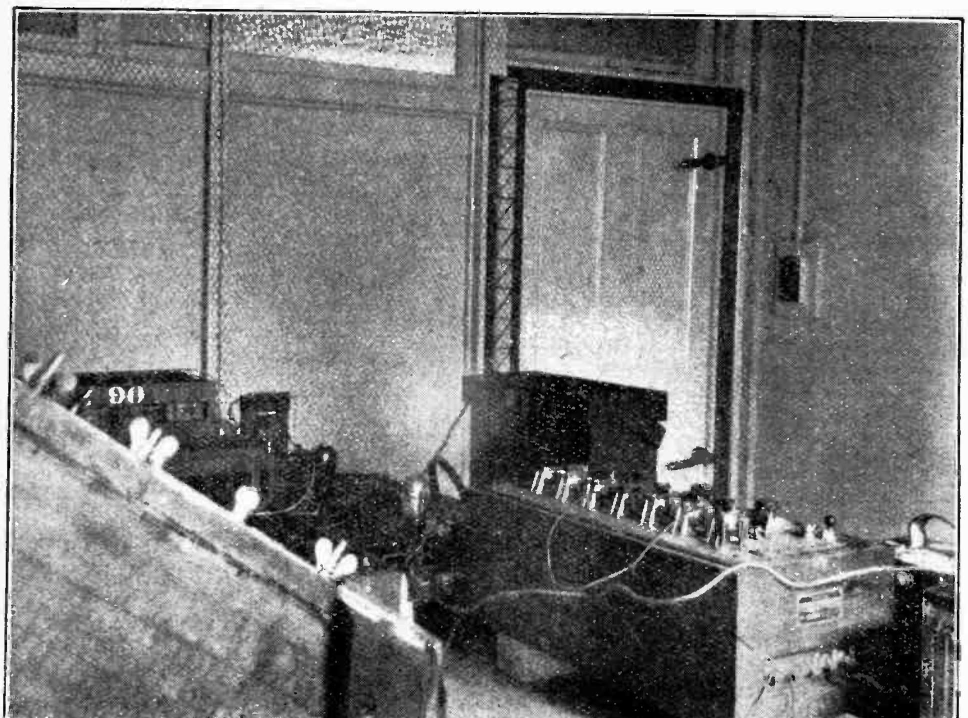


Fig. 6.—A corner of the screened room containing the amplifier under test. The end of the screened trunk through which leads are brought into the room occupies the bottom left hand corner of the picture.

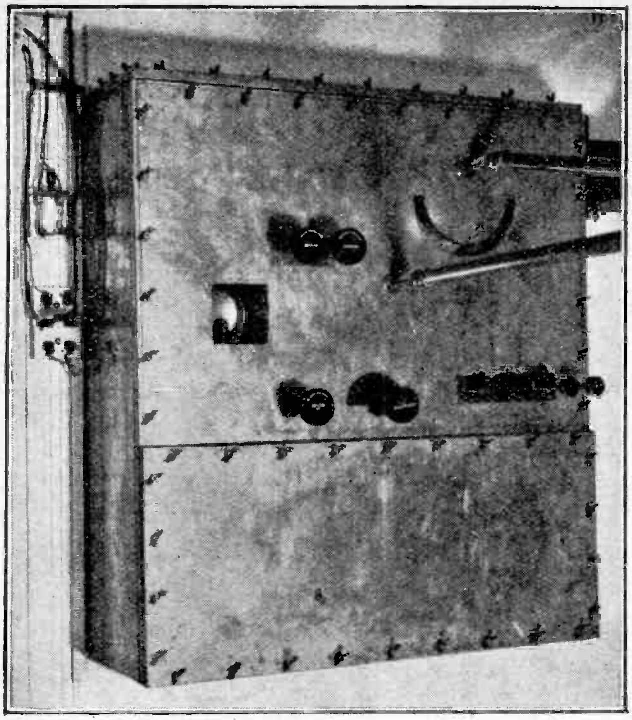


Fig. 7.—Screened radio-frequency oscillator. The filament ammeter is observed through a wire gauze window.

amplification is very rapid at shorter wavelengths, it is much less serious for the longer wavelengths. The maximum voltage amplification of 1,160 corresponds to approximately 3.2 per stage, while it is seen that over the wavelength range of 1,200 to 20,000 metres, the overall amplification is in excess of 800.

Resistance Coupling on Long Waves.

From these results it will be appreciated that the important characteristic of resistance-capacity coupled amplifiers is that, although the voltage amplification per stage is small, not often exceeding one-half of the voltage factor of the valve, yet it is not critically dependent upon the wavelength or frequency over quite a large range. This property makes these amplifiers invaluable for long-wave receivers which have to operate over large ranges of wavelength.

(*b*) *Transformer-coupling*.—A typical circuit arrangement for the usual form of transformer-coupled amplifier is shown in Fig. 11, in which it is seen that a tuned circuit is connected to the anode of the first valve. Such a circuit will offer a very high impedance at its natural frequency, and a comparatively low impedance at other frequencies. It is therefore evident that the amplification obtained with such a type of coupling in the anode circuit will vary with frequency, and if the tuned circuit be made of low resistance a very sharp amplification response can be obtained in the neighbourhood of the natural frequency. The anode circuit at resonance behaves exactly like a resistance coupling in which the resistance corresponds to the impedance of the tuned circuit. One advantage possessed by the latter is that there is no appreciable drop in high-tension voltage due to the flow of the steady anode current through the resistance. The alternating potential differences across the anode circuit can be transferred to the succeeding valve by a condenser and grid-leak as in the previous case (Fig. 9), comprising the well-known tuned-anode coupling; or, as represented in Fig. 11, a tuned transformer coupling may be employed.

"Aperiodic" H.F. Transformers.

When it is desired to use a transformer-coupled amplifier to operate effectively over a range of wavelengths, it is necessary to adopt some means of avoiding the sharp resonant effect possessed by the tuned winding as described above. Such amplifiers are usually required at the lower or medium wavelength, when, as already shown in Fig. 10, the resistance-capacity type of coupling

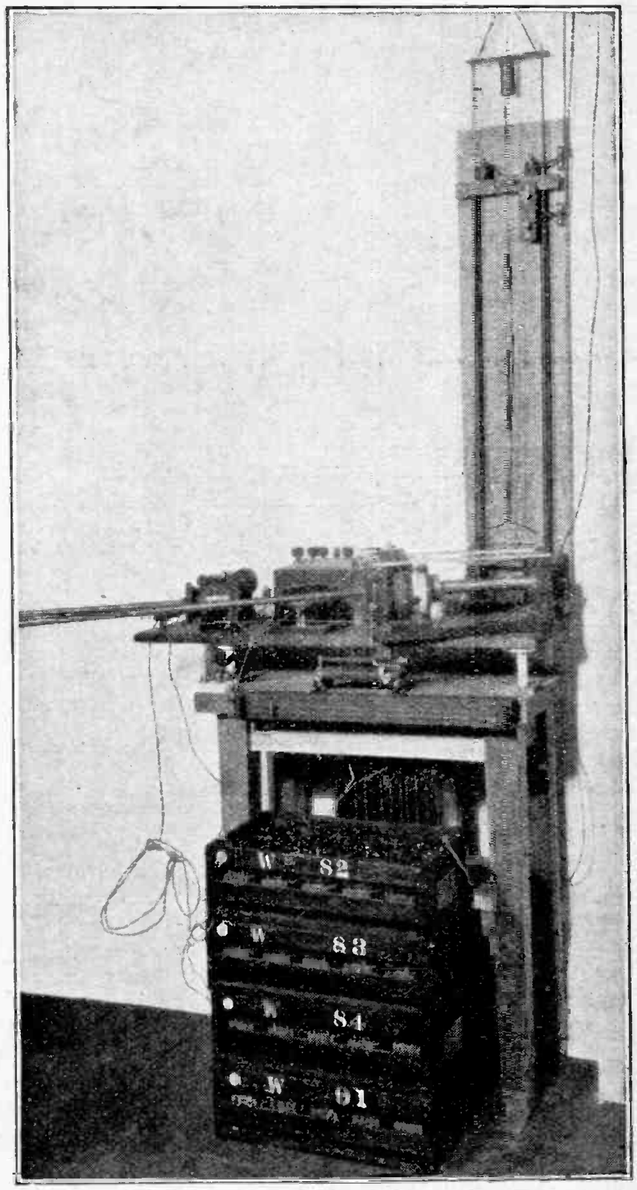


Fig. 8.—Audio-frequency oscillator showing remote control rods and (at back) the double-pole long-break switch.

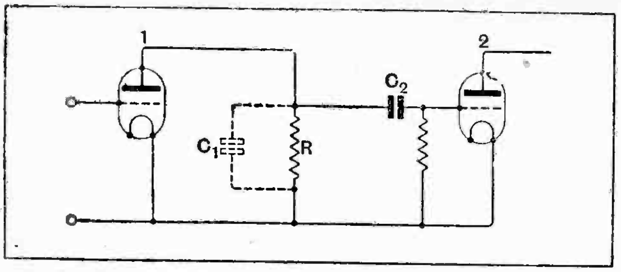


Fig. 9.—Circuit arrangement of a single-stage resistance-capacity coupled amplifier.

decreases rapidly in efficiency. One method of flattening the response curve of an amplifier is to use high-resistance windings for the transformers, and to combine the transformer or inductive coupling with that of the capacity type, as shown inset in Fig. 12. The presence of the capacity coupling retards the falling off in amplification which otherwise occurs at the shorter wavelengths. The results of the measurement of an amplifier employing six stages of such a type of coupling are given in the curve in Fig. 12. It will be seen that the combined amplifier gives a fairly well-defined peak of voltage amplification at a wavelength of about 300 metres, while the smaller humps are probably due to the resonance of individual transformers which, it is to be observed, are tuned by

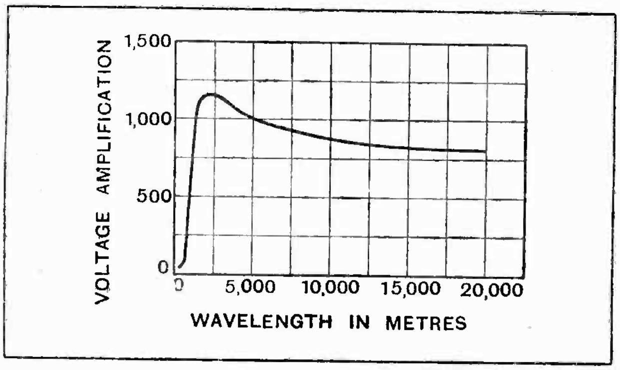


Fig. 10.—Measured voltage amplification curve of a six-stage resistance-coupled amplifier.

their natural self-capacity only. In spite of these peaks, however, the amplifier gives the very good voltage amplification factor of more than 1,000 over the wavelength range of 250 to 750 metres.

Extending the Wavelength Range.

Another method of obtaining good amplification over a range of wavelengths is to use transformers, the natural frequencies of which are distributed over the range. A measured curve for an amplifier of this type, comprising three transformer-coupled stages, with the transformers tuned solely by the self-capacity, is shown in Fig. 13. By measuring the individual stages separately, the various peaks in the curve could be allocated to the various transformers. In this manner it was found that the whole system had a natural frequency corresponding to about 5,000 metres. The first transformer was tuned to about 2,150 metres, and since oscillations corresponding to this wavelength were amplified by two succeeding stages, a very sharp peak of high value is obtained at this point. The second transformer was tuned to 800 metres, and oscillations of this wavelength were amplified by one stage; while the last transformer was tuned to 1,500 metres and was not followed by any high-frequency amplifying valves. By separately tuning these individual transformers, it would, of course, be possible to obtain increased amplification over a smaller range of wavelengths.

The curves shown in Fig. 14 are interesting in showing the different results that may be obtained from two apparently identical amplifiers. In this case the high-frequency portion of the amplifiers comprised three transformer-coupled stages, and these were manufactured in a similar manner to the same specification. The results of the measurement of the overall voltage amplification are given in the two curves in Fig. 14. It will be seen

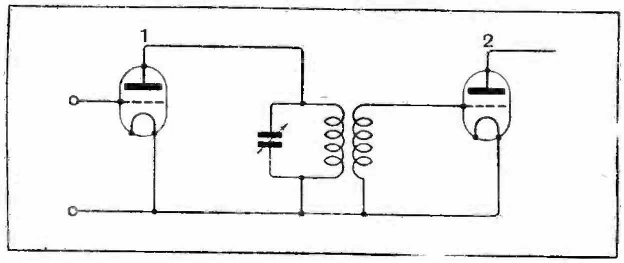


Fig. 11.—Typical connections of single-stage of transformer-coupled amplifier.

that, while the shapes of the curves are very similar, amplifier A is about five times as sensitive as amplifier B at the same wavelength. Such results tend to show that our present knowledge of the design of such amplifiers to give a specified performance is very limited.

One great advantage of employing tuned circuits in the coupling components of an amplifier is that the selectivity of the system is increased, and so the desired signals are amplified to a much greater extent than either any unwanted, interfering signals, or any atmospheric disturbances. With the resistance-capacity coupled amplifier, on the other hand, the selectivity must depend upon the external input and output circuits, but as against

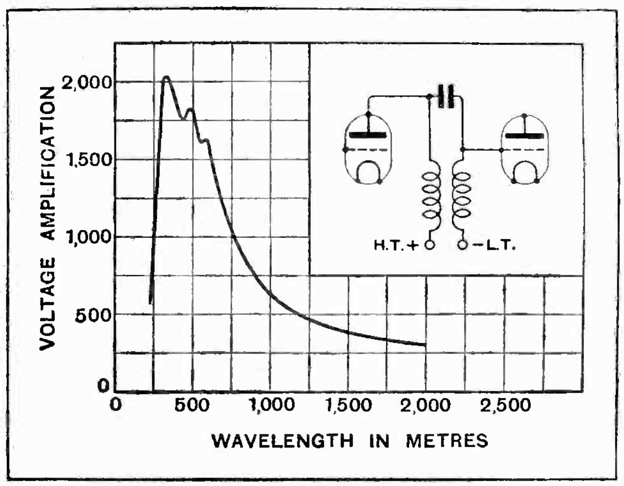


Fig. 12.—Six-stage "aperiodic" transformer-coupled amplifier.

Measurements on Radio-frequency Amplifiers.—this it has the advantage of giving very good amplification over a large range of wavelengths.

Conclusion.

In this article it has been shown that the modern radio-frequency amplifiers of the "semi-aperiodic" type, using from three to six valves, can give a voltage amplification of from 1,000 to 3,000 at certain definite wavelengths, while an amplification of the order of 800 to 1,000 can be obtained over a large range of wavelengths. These figures have been obtained from actual measurements on amplifiers not provided with any external retroaction arrangements, and under conditions of perfect stability. In considering the above figures, it should be remembered that the power amplification is proportional to the square of the voltage or amplitude amplification. It is thus seen that high-frequency amplifiers can be made to give a power amplification of the order of one million times. From this aspect one can appreciate the great utility of the high-frequency amplifying stages of a receiver in magnifying up the extremely minute power induced in a receiving aerial by the wireless waves from a distant transmitting station until it provides the larger, though still small, power required to reproduce sounds from the telephone receivers. Since a sensitive telephone receiver will operate comfortably on a fraction of a micro-watt the power required in the aerial need only be a small part of one micro-micro-watt.

While the measurements so far described have been confined to wavelengths between 300 and 20,000 metres, a discussion will be given in a succeeding article of the application of these results to amplification at shorter wavelengths. The next article will deal with the effect of the amplifier as an effective load applied to the input receiving circuit.

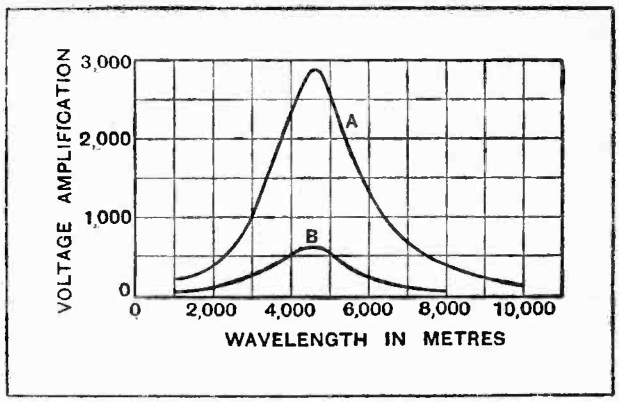


Fig. 14.—Curves for two apparently identical amplifiers employing three transformer-coupled stages.

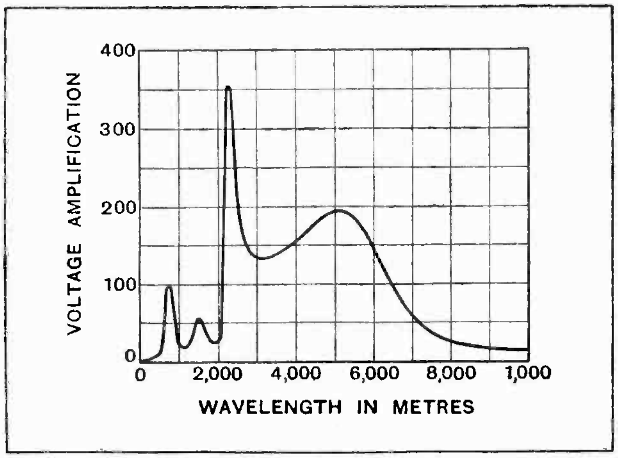


Fig. 13.—Three-stage transformer coupled amplifier; transformers tuned by their self-capacity only.

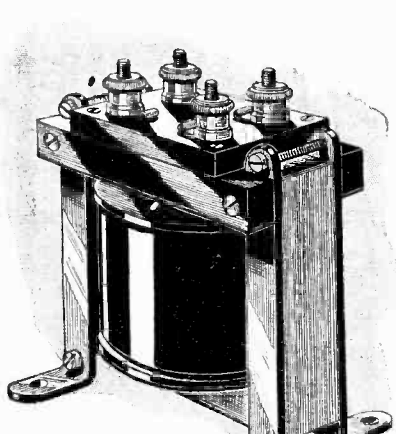
TRANSFORMERS FOR THE NEW A.C. VALVE.

THE heater fitted to the new K.L.1. valve in the Marconi and Osram series requires a current of 2 amperes at a potential of 3.5 volts for raising the temperature of the cathode. The valve which is intended to obviate the use of an accumulator for filament heating is operated from alternating current supply through a step-down transformer. Since the introduction of this valve several instrument manufacturers have set about the production of suitable transformers for supplying the heater current.

The R.I. Transformer.

There is not likely to be any great demand for a transformer for supplying heater current to a single valve, and Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, London, W.C.1, have therefore designed a model suitable for operating one to four valves.

It has an overall height of 5in., and covers a baseboard space of 3in. by 4in. The winding is carried on a spool about 3in. in diameter by 2¼in. in length, the sectional area of the core being a little more than 1 sq. in. Iron clamps pulled up tightly between brass bolts hold the stamping securely together, and when in use the core has no tendency to buzz. In fact, there is not the slightest sound emitted from the transformer when on full load, showing that there is neither vibration of the stampings or windings. The terminals, which are nickelled, are carried on an engraved ebonite panel.



The R.I heater transformer suitable for operating four valves.

The specimen transformer tested was intended for a 200 to 220 volt 50 cycle supply. As already stated, the heater current required by each valve is 2 amperes at 3.5 volts, and to test the utility of the transformer, therefore, the output terminals were shunted with resistances equal to the heater resistance, and also of half, third and quarter this value, representing the load of one, two, three and four valves. On a one-valve load the potential was found to be 3.8 volts with a current of 2.2 amperes. A two-valve load gave a voltage of 3.6 with a current 4 15 amperes. The three-valve load gave 3.5 volts with 6 amperes, and the four-valve load 3.4 volts with a current of 8 amperes. For a change in load between 2.2 and 8 amperes the voltage only dropped by 0.4 volt, showing the transformer to be suitable for operating equally satisfactory one to four valves.

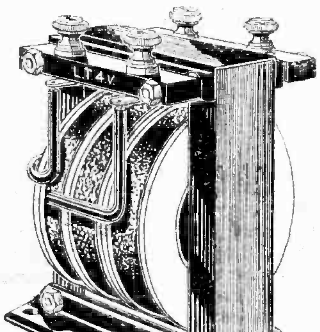
In order to test the transformer on a prolonged load the primary voltage was increased to 240, and a four-valve load on the secondary then gave 3.45 volts at 8.45 amperes. Left on load for two hours the core and winding remained perfectly cold to the hand.

The Marconiphone Transformer.

The windings of the Marconiphone transformer are arranged in three sections, the two series connected primaries being side by side. The overall height is 4in., the transformer covering a base area of 3in. by 3½in.

Pieces of angle iron clamp the stampings rigidly together at the base, forming a foot, while bolts passing through the stampings at the top support the terminal strips. Both stampings and windings are held tightly in position, avoiding mechanical buzz when the transformer is in circuit with the supply.

Designed for a 220 volt 50 cycle supply, the transformer on test gave 4.3 volts at 2.4 amperes on a single valve load, 4.15 volts at 4.6 amperes on the two-valve load, 3.9 volts at 6.8 amperes on three-valve load, and 3.7 volts at 9.2 amperes on the four-valve load. It is obvious, therefore, that the manufacturers intend that rheostats should be connected in the leads to the heaters, an arrangement



The Marconiphone transformer gives a higher voltage output than is required by the valves so that regulation may be provided by means of series connected rheostats.

which would seem to be desirable, as a valve functioning as a detector can be run with a different heater current than one working as an L.F. amplifier.

Assuming the use of controlling rheostats the particular model examined is suitable for use on 200 to 240 volt 50 cycle supply. Tested with 240 volts across the primary a potential of 4.1 volts was developed on a 10 ampere load. When left in circuit with a 10 ampere load for two hours no rise in temperature was noticeable. This transformer is capable of heating the cathodes of four valves, though the use of regulating resistances is, of course, recommended.

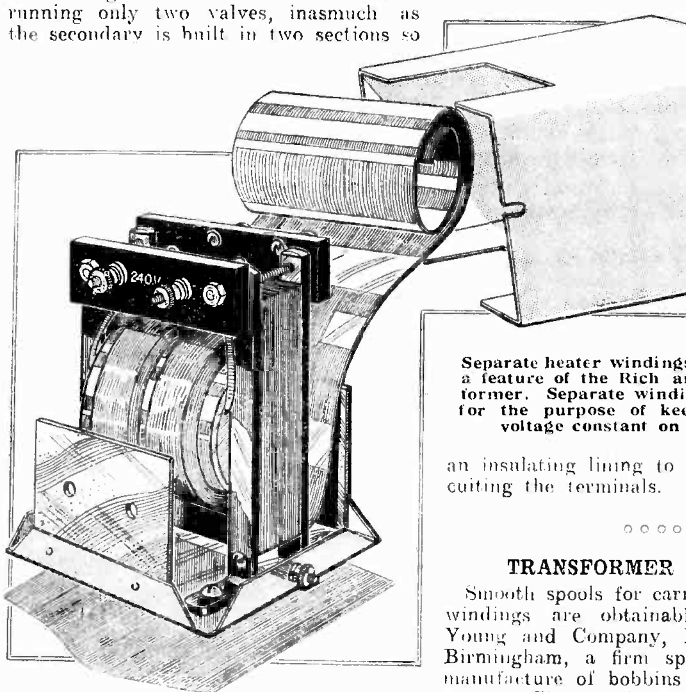
Rich and Bundy Transformer.

The manufacturers of this transformer, Rich and Bundy, 13, New Road, Ponders End, Middlesex, obviously had in mind the making of a transformer suitable for running only two valves, inasmuch as the secondary is built in two sections so that each heater can be fed from a separate secondary. The dimensions of the transformer are such, however, that each of the two sections are together capable of running two valves while still maintaining a good working potential. On a two-valve load each winding gave 3.5 volts at 4 amperes, which is the exact rated requirements of the valves.

The overall height of the transformer is about 5¼in., and it is enclosed under a cover 5½in. by 3¾in. by 3¼in. The primary winding is carried on a Paxolin spool, and is covered with a 2in. Paxolin tube upon which are wound the two output windings. The heater windings are exceptionally well insulated from the primary, so that the heated cathode of the valve is well insulated from earth, and consequently many novel circuit arrangements can be employed, both with regard to the position of connecting the H.T. battery as well as an interstage or reaction coupling. The provision also of separate heater windings for the several valves of a receiver is equivalent to the use of separate filament heating batteries in the several amplifying stages, and here again novelty may be introduced as to the circuit arrangement.

Although the terminals are at the top of the transformer, which in the ordinary way would elevate the wiring of the set, Paxolin card supports are provided near the bottom of the case so that the leads are actually brought out at a convenient height of about 1in. from the baseboard.

The case which is intended for screening completely encloses the transformer, and incidentally guards against the danger of shocks by protecting the high voltage terminals which are connected to the A.C. mains. It is provided with



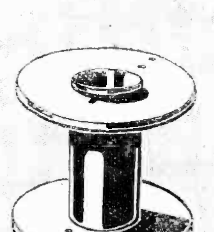
Separate heater windings for each valve is a feature of the Rich and Bundy transformer. Separate windings are provided for the purpose of keeping the output voltage constant on varying load.

an insulating lining to prevent short-circuiting the terminals.

○ ○ ○ ○

TRANSFORMER BOBBINS.

Smooth spools for carrying transformer windings are obtainable from A. M. Young and Company, Bordesley Street, Birmingham, a firm specialising in the manufacture of bobbins for various purposes. The specimens examined were



Specimen transformer bobbin suitable for intervalve transformer construction.

made from good grade black fibre, the end cheeks being securely held in position without the aid of an adhesive, a matter of importance when a spool is to be used to carry fine wire which might readily corrode. Apart from their use for the construction of intervalve transformers these spools are particularly suited for making up small power transformers, and can also be supplied in quantity made in other insulating materials according to requirements.

BROADCAST BREVITIES

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Europe's Long Waves—Midnight Tests—New Regional Scheme? —"Artistic Environment"— Talks Galore.

Long-wave Experiments in Europe.

Some lively nocturnal experiments are likely to take place very shortly involving all the European stations which work on wavelengths above 600 metres. The tests, which were planned by the Bureau International de Radiophonie at its last meeting in Brussels, will represent an attempt to formulate a scheme for the long wavelength stations similar to the famous Geneva plan for the medium and short wave stations.

The experiments will be conducted after normal broadcasting hours, and I learn that they will be directed by Captain P. P. Eckersley.

○ ○ ○ ○

Aim of the Tests.

The stations will begin by simultaneous transmissions on their ordinary wavelengths, and the object of the tests will be to overcome mutual interference step by step by "juggling" with the wavelengths until order is built out of the present chaos. Russia will, of course, be included in the experiments for the special reason that the Russian stations offer the biggest problem of all. The number of high power stations now working in Russia on wavelengths over 1,000 metres is rather surprising.

○ ○ ○ ○

The Russian Medley.

Nijni Novgorod works on 1,050 metres, West-Ustchuk on 1,010, Moscow (Popoff) on the same wavelength, and Leningrad on 1,100. A new station at Moscow on 12 kilowatts is to work on 1,040 metres. The Russian authorities also contemplate the erection of a station at Novo Sibersk with a power of 25 kilowatts, while another station on the same power is already in operation at Kamschatka. Other stations are projected for Leningrad (10 kW.), Ekaterinoslav and Petrosawodsk.

These, however, represent only a fraction of the number of stations Russia will eventually possess if the Soviet authorities can carry out their present scheme of providing the country with 50 stations within the next two years.

○ ○ ○ ○

The Washington Conference.

The Bureau International will therefore have to tread warily, especially in view of the international radio conference to be held in Washington next autumn, which may upset any plans made in haste.

Daventry and the Regional Scheme.

At the moment of writing I learn that "Daventry Junior" is awaiting the delivery of its generator. When this indispensable component turns up there should be little delay in beginning the experimental transmissions.

While the station will carry out its tests on a power between 15 and 20 kilowatts, it does not necessarily follow that the power ultimately adopted by the regional stations will be restricted to these limits.

A New Plan?

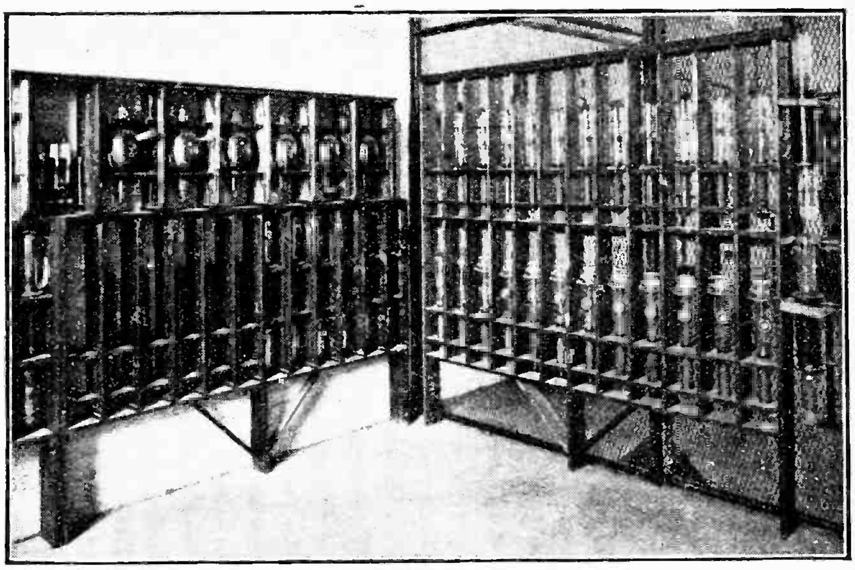
In this connection a story reaches me that a more ambitious scheme has recently been formulated providing for the erection of several stations in Great Britain with a power as high as 50 kilowatts. This would indicate that the B.B.C. is taking up the challenge thrown out by certain of the Continental broadcasting interests who have apparently given up thinking in terms of less than 25 kilowatts.

If the British regional stations each employed a power of 50 kilowatts they would, I gather, be limited to four in number, but their range would be such as to give every crystal user at least two programmes, and each station would transmit on two wavelengths. The possibility of erecting a short-wave station for broadcasting to the Dominions is also being mentioned.

○ ○ ○ ○

2LO's New Studio.

We shall probably have to wait another week before we can appraise the quality of transmission from Savoy Hill's new "super" studio. Certain indoor tests have already been conducted through the control room, the results being reproduced



READY FOR ACCIDENTS This is not a new design of transmitting panel. The photograph was taken at Daventry, and shows an interesting collection of spare valves for use in emergencies.

on loud-speakers and headphones in different parts of the building. At the moment of writing experiments are being carried out with variations in the lighting scheme, as the authorities consider that no pains should be spared to secure the most artistic effects possible.

○○○○

The "Artistic Environment."

So much attention is paid to microphone environment that one occasionally wonders whether the thing is overdone. The outstanding examples of imaginative resource in this direction was the Zenith studio in Chicago, where the broadcast artistes found themselves in a kind of Persian garden (which included a fountain and a balcony) and were submitted to an aura of coloured lights varying in shade according to the nature of the broadcast.

If the B.B.C. resort to these subterfuges, I have no doubt that additional verve would be imparted to a talk on, say, "Beetroot" if the speaker were enveloped in a flood of fiery crimson; while a dramatic and timely ending could be secured by the sudden substitution of dead black.

But the whole question is very complex. Environment is not everything. The best things are sometimes said from the soap-box.

○○○○

Item.

"10 p.m. Schluss der Emission."

No; not a description of a B.B.C. talk. It merely signifies closing time at Zurich.

○○○○

The Loneliest B.B.C. Station.

Which is the loneliest B.B.C. station? One or other of the relays is the first answer that occurs to one. Actually the palm goes to 5XX.

The engineers (there are eight of them) who watch over the transmitter of the highest-powered and hardest-worked broadcasting station in the British Isles spend their days (and nights) in one of the most isolated spots in central England. They work in two daily shifts, and their "day" extends from about 9.30 in the morning until 12 o'clock at night.

But they will not die of *ennui* in their spare time, for I hear that that little unused studio at Daventry makes an excellent billiard room!

○○○○

A Genuine Idea.

What about a "running commentary" on a match for a hundred up in the Daventry studio?

The description could be given by the losing player, though in that case it might have to pass through a special filter.

○○○○

Wireless Organisations Advisory Committee.

At a meeting of the Wireless Organisations Advisory Committee, held at Savoy Hill on January 31st, it was agreed that the members should prepare analytical reports based on the views of listeners regarding the composition of broadcast programmes. These are to be submitted to a special meeting of the committee, which will take place on Monday next, February 14th. The committee unanimously agreed that the only means of ensuring a broadcasting service which was satisfactory to all listeners was that provided by an alternative programme scheme.

Capt. Eckersley attended and gave technical evidence upon the progress of the B.B.C.'s future plans with regard to alternative programmes. Further discussion on alternative programmes was deferred until next Monday's meeting, when members of the committee will have had time to consider the evidence heard.

The committee intend to meet on the last Monday in every month.

○○○○

The Weekly Average.

There is generally a savage satisfaction to be gained from digging out "averages" which go to show that things are not what they seem.

FUTURE FEATURES.

Sunday, February 13th.

LONDON.—Light Orchestral Concert.
MANCHESTER.—Masterpieces of Wagner.

Monday, February 14th.

LONDON.—"Paul Jones," a comic opera in three acts.
BIRMINGHAM.—Radio Fantasy—"Old Memories."
CARDIFF.—Welsh Celebration of St. Valentine's Day.
NEWCASTLE.—Traditional Music, Song and Story.
ABERDEEN.—Concert by the Insch Choral Union.

Tuesday, February 15th.

LONDON.—"The Fog," a short play by Martin Hussingtree.
GLASGOW.—Rutherglen Programme.
BELFAST.—"By Virtue of a Broadcast," by Frank H. Shaw.

Wednesday, February 16th.

LONDON.—Programme by the Chief Engineer.
MANCHESTER.—Popular Suites and Ballets.
BELFAST.—"Saint-Saëns," by the Station Orchestra.

Thursday, February 17th.

LONDON.—B.B.C. National Concert relayed from Royal Albert Hall.
GLASGOW.—Edward German Anniversary Programme.

Friday, February 18th.

BIRMINGHAM.—W. W. Allen in character studies from the works of Charles Dickens.
BOURNEMOUTH.—"The Two Bobs" (entertainers).

Saturday, February 19th.

LONDON.—Community Singing from the Royal Albert Hall.
CARDIFF.—"The Rest House," a Radio Satire by Andrew Harding.
MANCHESTER.—"Vaudeville."

An interesting list has been prepare[d] at Savoy Hill showing the average number of hours worked weekly by th[e] twenty-one stations in this country. Daventry surpasses all others with [a] weekly average of 81 hours, while London with 65½ hours, is closely followed b[y] Cardiff, with 62¾ hours. Strangel[y] enough, Nottingham comes next with 6[?] hours, and another relay, Plymouth, i[s] only half an hour behind.

Of the main stations, Birmingham come[s] last with a weekly average of 54 hour[s] 41 minutes, though the lowest of th[e] bunch, *i.e.*, 51 hours 10 minutes, is Edinburgh's. But "Auld Reekie" believes i[n] quality, not quantity.

○○○○

Problem.

Why are those who are dissatisfied wit[h] the B.B.C. programmes the quickest t[o] complain when transmission is poor?

○○○○

Talks Galore.

In a week or two Paris will have th[e] first "wireless university" in Europe. The idea has already materialised i[n] America, but one doubts whether France has not gone "one better." For *l'Université et l'Education Nationale*, as it i[s] to be called, has secured the active co-operation of the Paris Chamber of Commerce, the School of Anthropology, the Maritime and Colonial League, the Central Union of Decorative Arts, and other commercial and educational associations.

The headquarters of the new venture will be the Eiffel Tower station. The lessons will begin each evening at 6 o'clock, and at each session ten specialists will lecture on subjects of general interest in accordance with a carefully prepared curriculum.

○○○○

Broadcasting England v. Ireland Rugger.

A running commentary on the England v. Ireland Rugby match at Twickenham on February 12th will be broadcast from 2LO and 5XX.

○○○○

Mr. Lloyd George to Broadcast.

Mr. Lloyd George's speech at the dinner of the Women's Advertising Club of London, to be held at the Piccadilly Hotel on February 14th, will be relayed to 2LO and 5XX.

○○○○

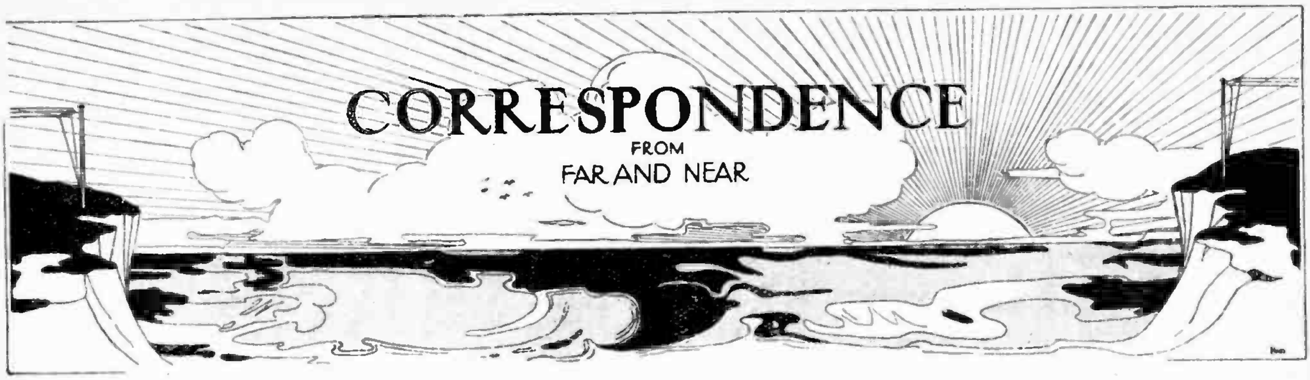
School Broadcast To-night.

Part of the choir of Mansfield Road L.C.C. Boys School, N.W., are to broadcast several songs this evening (Wednesday).

○○○○

Comic Opera.

"Paul Jones," a comic opera in three acts, will be broadcast on February 14th from 2LO and other stations. The author is H. B. Farnie, and the composer, Robert Planquette, also composed such well-known operas as "Les Cloches de Corneville," "Rip Van Winkle," "Nell Gwynne," and "The Old Guard."



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.

ARRANGEMENT OF PROGRAMMES.

Sir,—I heartily agree with your programme suggestion. I feel sure that a continuous programme for each section of listeners as you suggest would meet with the approval of all wireless listeners. Also, I think that the evening programme would be much more enjoyed if it was continuous from, say, 8 p.m. to 10 p.m., instead of breaking it into pieces as at present.

Many listeners have expressed their opinions to me that the best times were when the first news bulletin was broadcast at 7 p.m. and the second at 10 p.m. I have previously written to the B.B.C. concerning this, and they replied that the present times were arrived at only after very careful consideration, and they thought that the new times did meet with the approval of the majority of listeners. So I would like to hear what readers of *The Wireless World* think. I myself would much prefer last year's programme times and arrangements, but I am only one amongst so many.

London, E.14. A. T. REYNOLDS.
January 27, 1927.

Sir,—I have for some time studied the programme of the B.B.C. by the aid of the old schoolday method of pencilling against each item heard the letters VG, G, F, B, these indicating the varied degrees of satisfaction derived. Latterly I have added a more recent three-letter abbreviation, as the plain "B" hardly meets some exceptional cases. This, I find, gives me a clear and general view of my own ideas of the fare that is meted out, and also affords some degree of pleasure.

Those possessed of multi-valve sets are fortunately able to vary their programmes at will by switching over to another station or the Continent; the latter will always afford an abundance of musical items, from heavy opera to jazz.

There are, however, the thousands of listeners with crystal sets who are bound to their local station, and these deserve consideration. They comprise every class of the community—the hard-working toilers of the land, many situated in the remote countryside; the factory workers in their prim homes in congested centres; the workers in shops and behind counters; clerks, office workers; and last, but not least, the business man. What do all these multitudes want? They want to get away from work, worry, care, and everything else that damps their spirits and fags their brain, and lose thought of business worries and cares in light pleasure; be that the theatre, the music hall, the pictures or wireless. The latter could be the most popular seeing it is at their own fireside.

I would not say the B.B.C. programmes are, in the main, bad. I would rather say they are too good. They break in suddenly on our musical items with talks brim-full of brain protoids, culture, and good advice; all good in its way and in the proper place, but that place is not the evening programme. And, if we must have talks, let them be at least by chosen speakers who can articulate clearly and correctly—a virtue *not* universal with broadcast speakers. Some talks are made enjoyable by the speaker, and we may miss much good to mind, body, or soul, by having to switch off unintelligible talk.

Here is a digression. Concerning our spiritual fathers who are wont to address us on Sunday evenings, much could be said. Sufficient is this. There is a want of short, clear, simple, concise addresses as man to man without the chanted drawl; there are some of our intoning clergy who can no more get away from that doleful drawl than our girls can get away from the Charleston.

Now, any simple idiot can find fault—that doesn't require brain effort; but while it is impossible to please everyone, there is a means of knowing what is wanted generally. A doctor may be confronted with a difficult case, but by feeling the patient's pulse some indication is given of a line of treatment which may possibly lead to success. Let the B.B.C. take a post-card census from listeners, giving three heads—music, talks, news, and under these heads itemise the classes, grades or types of each and let the listeners voting place these in numbered position as they appeal to each individual. This would be feeling the listeners' mental pulse.

The B.B.C. as a wireless physician may be good, the B.B.C. as amusement caterers would be better.

Aberdeen H. McKENZIE.
January 28th, 1927.

MODERN AMPLIFIER PERFORMANCE.

Sir,—I was very glad to see Mr. Kingsbury's letter in your current issue, as it should be apparent to anyone conversant with the technicalities of alternating current circuits that the valve makers in developing power valves of low differential resistance (impedance) are working on entirely wrong lines.

The function of the so-called power valve is to reproduce in the anode circuit a fluctuating current of the same wave form as the fluctuating grid E.M.F. This can only be obtained when the time constant, L/R, of the anode circuit is small, or in other words the reactive E.M.F. in the loud-speaker must be swamped by making the resistance of the circuit many times the reactive impedance of the loud-speaker.

Mr. Keiller kindly tells us that the reactive impedance of a 2,000-ohm Primax loud-speaker is about 20,000 at 800 periods. This is anything but small, and if anything like true tone is to be obtained at higher periodicities a valve with a differential resistance of several times 20,000 is indicated as desirable.

In short, the differential resistance of the power valve should always be as high as one can afford, bearing in mind that a high resistance brings in its train a high cost for H.T. battery.

So much for theory. In practice I have found that using a 2,000-ohm Primax loud-speaker, changing from a valve of

32,000 ohms to one of 15,000 ohms, has resulted in a decidedly perceptible loss of tone on the two upper octaves of the piano, no change being perceptible on Big Ben, which is, of course, a very low note.

There is one more aspect of the case which, however, should be mentioned. When a loud-speaker is fed through a considerable length of flex the capacity of the leads shunts some portion of the current from the loud-speaker on the higher frequencies. The remedy would be to use a loud-speaker wound to a lower resistance and consequently having a lower reactive impedance and employing a power valve of *proportionally* lower differential resistance.

Of course, in practice an imperfection in one part of a system may be partially compensated by an imperfection in another part, but if progress is to be made the only sound way to go to work is to try to get as near perfection as one's pocket can afford in every part of the whole system.

Westminster, S.W.1 LANCELOT W. WILD.
January 26th, 1927.

Sir,—I have observed in your issue of January 26th the letters of Messrs. C. M. Keiller and D. Kingsbury on the above subject.

First, in connection with the letter from Mr. Keiller. This gentleman has been led astray, I think, by imagining that the impedance of a loud-speaker is of the nature of a simple inductance. This is by no means correct, as the electrical equivalent of a loud-speaker is an extremely complicated circuit, depending not only on the inductance of the windings, but on the design of the magnetic circuit, the self-capacity, and the reaction of the diaphragm. The net result, as regards the Kone loud-speaker, is to give an impedance varying from about 3,000 to about 8,000 ohms over its working range of frequencies. It is definitely recommended by the Standard Telephones and Cables Co., who are the patentees of this type of speaker and have studied it extensively, that the valve or valves used with it should have a total anode A.C. resistance of the order of 3,000 ohms.

After considerable investigation on various loud-speakers to be used with our own LL525 valve (which has an anode A.C. resistance of the order of 3,000 ohms), we found quite definitely that even with our own horn loud-speaker better overall results were obtained by having a winding of lower impedance than the "2,000-ohm" winding previously used, and we have accordingly reduced this to approximately the same impedance as that of the Kone. From the point of view of complete absence of frequency effects, it is doubtless best to use the lowest valve resistance and the highest loud-speaker resistance possible. But in view of the fact that the loud-speaker is a power-operated device, this would result in serious loss of strength, and we have adopted our new winding as being the best compromise.

With regard to the letter of Mr. Kingsbury, I am afraid I cannot accept his blunt statement that "one of the requirements of this type of loud-speaker, in order that it may produce constant sound output at varying frequencies, is constant driving force, *i.e.*, current." It is an unfortunate fact that no existing loud-speaker acts as a power absorber, or rather transformer, of constant impedance and characteristics over the whole of its range. At the lower frequencies, where the impedance of the speaker tends to become smaller, an increase of current is advantageous, since, owing to the difficulty of imparting motion to air at low frequencies, loud-speaker efficiency is almost always smaller. It is much more accurate to state that the loud-speaker should have diminishing current at higher frequencies in order to obtain some approach to constant power output. As a general rule, it will be found most satisfactory in practice to keep the anode A.C. resistance of the amplifier last stage quite low, unless a transformer is used.

P. K. TURNER.
Blackheath, January 26th, 1927.

Sir,—I have read with interest the two letters in the correspondence columns of the January 26th issue of *The Wireless World* under the heading of "Modern Amplifier Performance," and would like to make a few remarks upon some of the points contained in them.

With regard to Mr. Keiller's letter, I am afraid this gentleman is confusing D.C. resistance with A.C. impedance. This mistake is probably due to the fact that most manufacturers only tell us the D.C. resistance of their loud-speakers, which tells us nothing at all about their abilities to reproduce various frequencies. It merely enables us to calculate the voltage drop across the instrument when inserted in the plate circuit of a valve. It is a great pity that loud-speaker characteristics are not more easily available, although if they were some firms would probably find their sales suffer a severe decrease.

Mr. Keiller is probably quite right in saying that the loud-speakers he mentions have an impedance of about 3,000 ohms at 100 cycles. What he does not realise, however, is that an instrument having a D.C. resistance of 750 ohms, such as he mentions, may also have an impedance of 3,000 ohms at 100 cycles. The D.C. resistance has little bearing on the question of uniform reproduction at various frequencies.

The object of making instruments of 750 ohms *resistance* is to prevent a large voltage drop occurring across them when used with low-impedance valves, which pass about 15 to 20 milliamps, but at the same time the A.C. impedance is high compared with that of the valve. Thus, although the D.C. resistance of such loud-speakers is fairly low, the impedances are still sufficiently high to reproduce the low notes without very much loss in amplification when used with low-impedance valves. By low loss in amplification I mean with a maximum decrease of 30 to 40 per cent. at 50 cycles, which decrease is not very noticeable by the average human ear at 50 cycles.

Mr. Symes' suggestions of a "swamp" resistance are certainly interesting. I do not know sufficient about the characteristics of the type of loud-speaker he mentions to give an opinion as to whether this arrangement would be suitable, but if such instruments do require a constant current feed, I presume a "swamp" resistance means putting a resistance in series with the loud-speaker of such value that the variations in loud-speaker impedance at various frequencies create hardly any difference in the total impedance of the output circuit of the amplifier.

Assuming that this is done, it seems to me that we have an alternator feeding a load of much lower impedance than itself, if we regard the loud-speaker as the load and the valve and "swamp" resistance together as comprising the alternator. Under such conditions voltage regulation will surely be very bad—that is, on loud notes, when the loud-speaker should be receiving greater current, a greater voltage drop will occur in the "alternator."

I am no authority on this point, but I will bear out my remarks by referring to a paper "KDKA" read before the American I.R.E by Messrs. Little and Davis, of the Westinghouse Electric and Manufacturing Co., in September, 1925, in New York. In describing the transmitting plant of this station the authors emphasise the importance of keeping the modulator impedance low compared with that of the oscillators, in order to keep distortion down to the minimum. They found that the distortion was roughly comparable to the voltage regulation on the generator (modulator), and by using an impedance of 400 ohms in the modulator and 3,000 ohms in the oscillator the distortion was brought down to 3 per cent. This case is exactly similar to a valve feeding a loud-speaker, and it therefore would seem that the loud-speaker impedance must be high compared with the valve impedance. I hope that we shall have some other opinions on the matter. It would seem that a low-impedance valve is necessary to bring out the bass notes, because when using an ordinary cone type of loud-speaker, which, although differing considerably from the free edge moving coil type in details, is somewhat similar in action, the bass notes are reduced very markedly when a low-impedance valve is replaced by one of medium impedance.

As regards economy, power output efficiency cannot be studied very much when first-class reproduction is sought. Also, a grid swing of up to 20 volts is required on the last grid to obtain comfortable strength in a medium-sized room when using a cone speaker, and an LL.525 valve with 150 volts will handle this, whereas an L.525 will not on the same anode voltage.

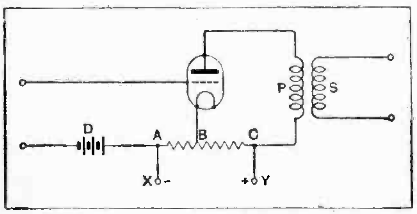
BERNARD J. AXTEN (G2VJ).
Wembley.
January 29th, 1927.

Brain Waves of the Wireless Engineer.

Mains Supply for Valve Circuits.
(No. 261,110.)

Application date: August 15th, 1925.

G. M. Wright describes in the above British patent a very interesting valve circuit deriving its power from electric light mains. The supply is so connected to the valve that any variation in supply due, perhaps, to insufficient smoothing causes a variation in grid potential which is counterbalanced by an equal and opposite potential variation in the anode circuit. The invention can be applied equally well to any type of intervalve coupling, but that shown in the illustration shows a transformer-coupled amplifier. Here the anode circuit of the valve V contains the primary winding P of the transformer PS. The high-tension supply derived from the mains either smoothed direct current or smoothed and rectified alternating current is shown at XY. This supply is shunted by a composite resistance ABC. The input circuit of the valve is not connected in the usual manner between the grid and filament, but between the grid and the negative high-tension terminal, *i.e.*, the end A of the resistance ABC, the filament connection being taken to a tapping point B on the resistance. Should now there be any variation in the high-tension supply voltage it will cause a drop of potential along the resistance ABC. Since the grid circuit contains a portion of the resistance AB a certain voltage will be introduced into the grid circuit. This voltage will in turn be introduced into the anode circuit, but will be increased in magnitude owing to the amplification factor of the valve. However, a larger portion of the resistance BC is in the anode circuit, and accordingly a greater voltage will be



Circuit for eliminating hum in receivers supplied from mains. (No. 261,110.)

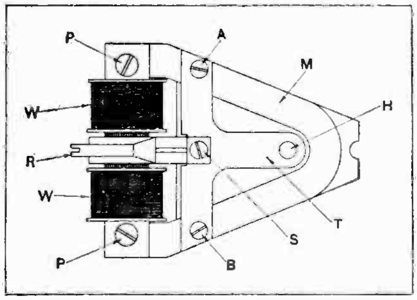
introduced into the anode circuit owing to the fall of potential along the portion AB. The voltage introduced into the anode circuit from the grid circuit will be in opposite phase relation to that introduced across the resistance BC, and if these two voltages are made equal their effect will be cancelled out. It will be readily seen that this condition is fulfilled when the larger portion of the resistance, *i.e.*, BC, is equal to the smaller portion AB multiplied by the amplification factor of the valve. The specifications show how the resistance should be connected and proportioned for various other forms of intervalve coupling.

oooo

Reed Mounting.
(No. 261,506.)

Application date: September 19th, 1925.

A mounting for a reed-driven type of loud-speaker or telephone receiver is described by S. G. Brown in the above



Loud-speaker movement with adjustable reed. (No. 261,506.)

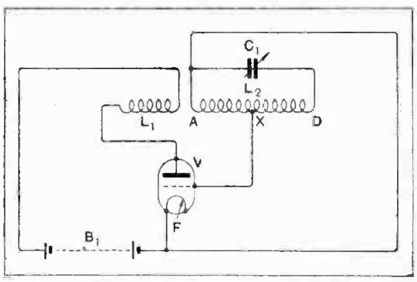
British patent. The invention will be clearly understood by reference to the accompanying illustration, in which it will be seen that the loud-speaker movement comprises a V shaped magnet M with laminated pole pieces P, which are screwed to the ends of the magnet in the normal manner, the two pole pieces carrying windings W, a small gap, of course, existing between them. The limbs of the V-shaped magnet support the two ends A and B of a T-shaped member T, the reed being fixed to the middle of the horizontal T-shaped member by a screw S. The other portion of the T-shaped member is provided with a hole H for adjusting purposes. A screw provided with a flanged portion bearing upon the surface of the T member works through the hole H, and, in addition, works against the pressure of a helical spring. Thus, as the screw portion is rotated it will work backwards and forwards through the hole H, the flanged portion thereby causing the T-shaped member to move slightly in the vertical plane, thereby imparting a similar motion to the reed. In this manner the distance of the reed from the pole pieces can be easily varied.

oooo

Wavemeter Circuit.
(No. 261,905.)

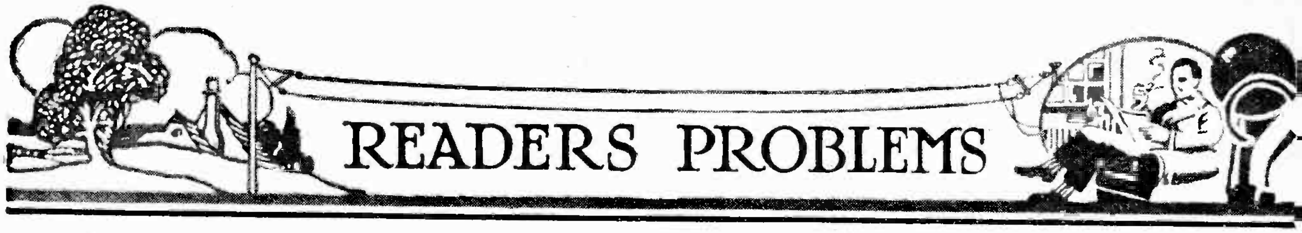
Application date: November 13th, 1925.

It is essential that the constants of a wavemeter should not change in use. Some slight difficulty has been experienced with valve wavemeters owing to the necessity of substituting a new valve when the original one with which the instrument was calibrated burns out. Varying inter-electrode capacities of the valves, for example, would seriously alter the maximum and minimum wavelength to which the wavemeter will tune, thereby introducing inaccuracies over the whole of the range. Lt.-Col. K. E. Edgeworth, D.S.O., M.C., describes in the above British patent a circuit which overcomes this difficulty. Here it will be seen that a valve V is provided with a reaction coil L_1 and a high-tension battery B_1. This is coupled in the normal manner to a grid circuit inductance L_2, tuned by a variable condenser C_2. One end A of the inductance L_2 is connected to the filament F of the valve, while instead of connecting the free end D directly to the grid of the valve the actual grid connection is taken to a tapping point X along the inductance L_2, so that only a portion of the turns of the inductance are actually in the grid circuit. Obviously, then, the valve capacity is only in shunt with a few of the turns instead of all the turns, as



Wavemeter circuit. (No. 261,905.)

would be the case with the normal arrangement. This means that any slight variation in valve capacity will not materially alter the wavelength of the circuit L_2 C_1, since the capacity variation is only in shunt with a few of the turns.



"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Advantages of Loose Coupling.

I am contemplating the construction of the "Wide Range Broadcast Receiver" described in THE WIRELESS WORLD *of January 19th and 26th, but as I live fairly close to Daventry I should appreciate details of the alterations necessary in order to loose-couple the aerial on the long waves. I have been told that loose coupling the aerial will increase the wavelength range of a set. Would you kindly explain this and also any other advantages of loose coupling?*

A. N. P.

The alteration required for loose coupling on the long waves is very slight, and the complete circuit is given below.

Here L_1 and L_2 are the grid and aerial coils as described, L_3 and L_4 are the long-wave coils, and L_5 the rejector coil. The coils L_3 and L_4 may be of the ordinary plug-in type such as Lewcos, L_4 being a No. 50 coil and L_3 a No. 250 coil, and the connections to an ordinary double-pole change-over switch as given. A Lissen push-pull reversing switch could be used on the receiver instead of the one described.

When using a loose-coupled aerial on the long waves, besides increased selectivity, there is the added advantage of increase of tuning range, since practically the only tuning capacity is provided by the main variable condenser. The ratio of maximum to minimum capacity across the grid coil (L_3+L_1) is thus very much larger than when the aerial is connected as well.

To make this clearer, suppose we take an example. Suppose the aerial capacity is 0.0003 mfd., the maximum capacity of the variable condenser is 0.0005 mfd., and its minimum capacity (including all stray wiring capacities) is 0.0001 mfd.

The minimum capacity with the aerial connected is thus (0.0001+0.0003) mfd. or 0.0004 mfd., while the maximum is (0.0005+0.0003) mfd. or 0.0008 mfd., *i.e.*, a 2 to 1 ratio.

If the aerial is loose-coupled correctly (*i.e.*, by a fairly small coil of fine wire as described for L_2 in the "Wide Range Receiver") we can assume practically *no* added capacity due to the aerial, and therefore the tuning capacity range is from 0.0001 mfd. to 0.0005 mfd., *i.e.*, a 5 to 1 ratio.

It is probably well known that the equation connecting wavelength with inductance and capacity for a tuning circuit is wavelength $\lambda = 1885\sqrt{LC}$ where L is inductance in microhenries and C is capacity in microfarads.

For a given coil, therefore, the wavelength depends on the square root of the capacity, so that the wavelength range depends on the square root of the capacity range.

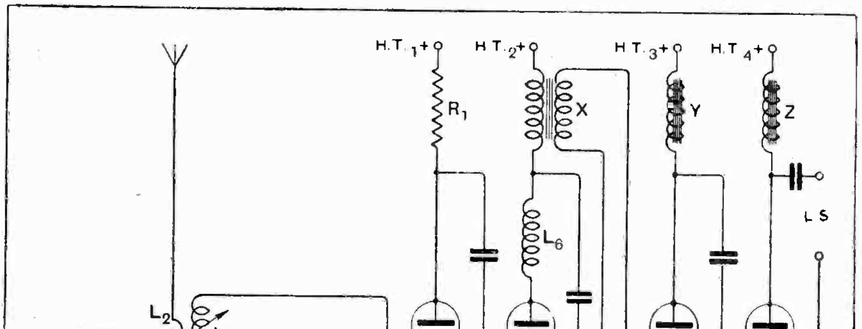
In the two cases under consideration therefore, the wavelength range with the aerial connected is $\sqrt{2}:1$, *i.e.*, about 1.4 to 1, while with the aerial loose-coupled the range is $\sqrt{5}:1$, *i.e.*, about 2.3 to 1.

Another decided advantage of the loose-coupled aerial arrangement is that in order to reach the same actual maximum wavelength, a larger grid coil is necessary, due to the reduction in total tuning capacity with removal of the aerial from the grid circuit.

Using an anode bend detector or an H.F. valve, which are both *voltage-operated* arrangements, the use of comparatively large tuning coils for the production of large voltages is desirable.

The selectivity of a loose-coupled arrangement is considerably better than that of a direct-coupled aerial, since the resistance of the tuning circuit is largely reduced by removal of the aerial.

oooo



The Wide Range Broadcast Receiver adapted for loose-coupled aerial on both long and short waves. A reaction condenser (*not shown*) should be connected between the plate of the second valve and the grid of the first valve.

Two Transformers *versus* Transformer and Choke.

I should like to know if it is possible to use two good transformers such as the Ferranti A.F.3 in place of the transformer and choke used in the "Wide Range Broadcast Receiver" recently described?

L. McK.

It is certainly possible to use two transformers as suggested provided that the last valve is of the super power type. The L.F. amplification using the arrangements described in the article is already enormous, and, of course, would be still greater when using two transformers. If you do not wish to be continually overloading the last valve, therefore, it will be necessary to increase the grid bias, and therefore the H.T. supply to this valve, and probably the best thing to do is to use a valve of very low amplification, and A.C. resistance such as the L.S.5A, which will safely stand large plate voltages of the order of 200 up to 400, and to use grid bias values accordingly.

It will almost certainly be necessary to use at least 200 volts on the plate of the last valve, since the L.F. amplification should be increased by nearly 200 per cent. by the use of an extra transformer.

The Wireless World
AND RADIO REVIEW
(14th Year of Publication)

No. 390. WEDNESDAY, FEBRUARY 16TH, 1927. Vol. XX. No. 7.

Assistant Editor: F. H. HAYNES. Editor: HUGH S. POCOCK. Assistant Editor: W. JAMES.

Editorial Offices: 139-40, FLEET STREET, LONDON, E.C.4 - - Editorial Telephone: City 4011 (3 lines).

Advertising and Publishing Offices: DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.

Telephone: City 2847 (13 lines). Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street. Telegrams: "Cyclist Coventry." Telephone: 5210 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street. Telegrams: "Autopress, Birmingham." Telephone: 2970 and 2971 Midland.

MANCHESTER: 199, Deansgate. Telegrams: "Iliffe, Manchester." Telephone: 8970 and 8971 City.

Subscription Rates: Home, 17s. 4d.; Canada, 17s. 4d.; other countries abroad, 19s. 6d. per annum.

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

A CAMPAIGN FOR QUALITY.

WRITING on the subject of quality in broadcast reception in our issue of December 8th last year, we expressed the view that the broadcasting authorities have a wonderful opportunity for assisting in educating the public up to a proper standard in broadcast reception. We recommended that instead of, or supplementary to, the present B.B.C. concerts, concert halls all over the country might be thrown open to the public as frequently as possible and the programmes of the local station reproduced with suitable apparatus and loud-speakers. Similarly, we expressed the opinion that the radio manufacturers collectively, through their Association, should also consider the advisability of undertaking demonstrations in the interests of their industry.

It would probably not be an exaggeration to compare the present position in broadcasting reception to the state of affairs which would exist if, with motor cars of the present standard of perfection, the roads over which they had to travel in this country were in such a condition that a large percentage of them were almost impassable except with the greatest discomfort to the traveller. In broadcasting we have reached a stage where the transmissions are approaching perfection, but we believe that only comparatively few of those who listen to the programmes have the advantage of apparatus so designed and operated that it does full justice to what is put out from the transmitting stations. To increase the popularity of broadcasting it is imperative that the public should be given the opportunity of hearing the best in reproduction in order that they may have a standard against which they can compare their private installations. The public must be educated to understand that great advances in receiving apparatus have been made during the past two years, and they should not be content to continue listening with a receiver of obsolete design or unsuitably operated, when, in all probability, that receiver can be brought up to modern standards of perfection with comparatively little additional expense. We believe that it would be well worth while for the radio manufacturers to undertake to inspect the demonstration sets in use by wireless retailers all over the country and to give help and advice so that these demonstration sets shall give the public a correct impression of the capabilities of broadcast reception to-day instead of, as we fear is the case in the majority of instances, creating an impression on the public calculated to turn them away from wireless rather than encourage them to accept it in their homes. We would urge the British Broadcasting Corporation to look upon this question as one of paramount importance, requiring their close and immediate consideration.

We believe that the proper course to adopt would be for the B.B.C. to call a Joint Committee of their engineers, and representatives of the Radio Industry and the technical wireless Press. We feel confident that such a joint effort would have far-reaching effects, and would have the support of the whole wireless Press.

CONTENTS.

A TOUR ROUND SAVOY HILL.

Part II.—Application of Acoustic Principles in the Development of Broadcasting Studios.

By A. G. D. WEST, M.A., B.Sc.

IN the first article, which dealt with the theory of sound in relation to broadcasting studios, it was demonstrated that it is desirable from the points of view of the listener (the most important), the artist, and the microphone, to introduce echo effects into studio transmission. The trend of progress in studio design is best illustrated in a description of the various studios that have been built for broadcasting purposes at Savoy Hill. The general development of the ideas involved has taken place in conjunction with work on a large number of outside halls which have been used from time to time for broadcast concerts. At the same time the converse problem of reducing the echo effect of halls too echoey for broadcasting, or of remedying halls with bad characteristics has been studied, but the discussion of these latter results is rather outside the scope of these articles.

The chief point in the development of studio technique is that it is desirable to transmit all kinds of programme material with the acoustic environment that is most suitable to it. For instance, chamber music should sound as if it were taking place in a room or small hall, and symphony orchestral music as if in a large hall.

There are three methods of obtaining these varying effects :—

(1) By the use of variable draping in the studio itself.

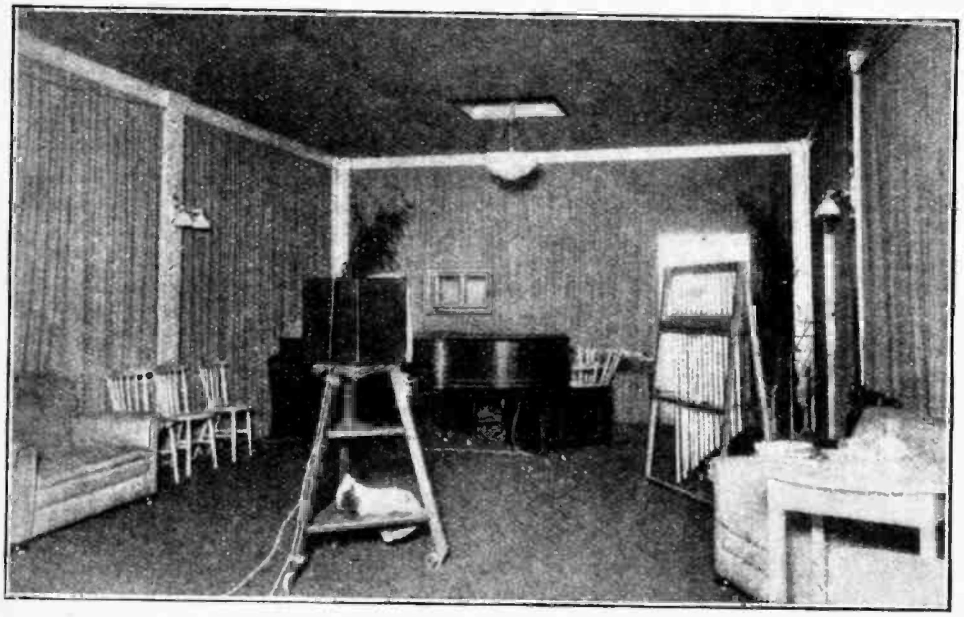
(2) By creating an echo with sounds coming direct from the source (the orchestra, etc.).

(3) By the use of artificial echo.

These methods will be considered in turn in relation to the studios in which they have been used.

The Original Studio.

The first studio to be built at Savoy Hill was opened in April, 1923—a memorable occasion. This particular studio, now called No. 3, is still in frequent use, in practically the same condition as when it was first put into commission nearly four years ago. In size, 37ft. × 18ft. × 11ft. high, it has its walls and ceiling covered with six layers of Hessian cloth, air spaced, and stretched on battens. The studio itself is consequently very soundproof, for it was built originally with this purpose that no sounds from outside should enter it, and very little sound pass out from inside. It is very useful for daytime transmissions, but its acoustic properties are far from satisfactory. The thoroughness of the draping gives a very large absorption, especially of the higher frequencies, resulting in an average period of reverberation less than a quarter of a second. Consequently, the visitor to the studio experiences on entering it a feeling of deadness and closeness which is very unnatural, and which has a depressing effect on artists. But this studio cannot be blamed for this reason, because it proved to be extremely useful, on account of the absence of marked standing-wave effect, for the development of a high-quality type of microphone which has been in constant use, and still is used in B.B.C. stations. The magnetophone as developed by Capt. Round went through practically all its experimental stages in this studio. Furthermore, for many months it remained the one and only studio in existence in London, and provided the majority of transmissions from that station. When it is dismantled it will not be without some feeling of regret on the part of those associated with the B.B.C. since its beginning.



The old studio at Savoy Hill (now No. 3) opened in April, 1923. The walls and ceiling are covered with six layers of Hessian cloth to exclude external sounds.

The need for further studio facilities necessitated taking over a large room on the first floor in the same building (the west side of the block). This became what is now known as Studio No. 1. Its dimensions are 44ft. × 26ft. × 18ft. high, and it had originally on its walls a layer of Hessian cloth covered by a layer of decorative drap-

A Tour Round Savoy Hill.—ing. The period in that condition was about 0.7 second, and the under cloth was later removed, giving a period of about 0.9 second. Finally, the decorative draping on the walls was mounted on rollers, so that any amount of it could be drawn aside, exposing the bare wall. With the walls fully bared, the period is increased to about 1.3 seconds, though it is seldom used in that condition for reasons to be explained. This studio has generally been considered one of the best studios that the B.B.C has built. It is capable of accommodating orchestras of all sizes, and is suitable for most types of performance. Acoustically, it is satisfactory, because of the very solid walls with which it is built, this solidity appearing to be essential, whatever the type of draping is that is placed on it. In spite of its size, this studio, as all normal-sized studios must do, suffers from what can be described as the "room effect," which is accentuated very considerably when the walls are bared. The effect is due to successive reflections from opposite walls, which tend to give a definite frequency value or combination of values to the room. The effect for the case where source and ear are on the line midway between two walls is shown in Fig. 7, with the condition that the walls are solid. The successive reflected impulses tend to follow each other after equal intervals of time. If the walls are lightly built, and are capable of acting like a diaphragm, it follows that under the action of sound waves they will do so, and will vibrate at their own frequency and thus tend to reinforce some reflections and reduce others. The effect will then be as shown in Fig. 8, and will be heard as a rattle between the two walls. If the walls are extremely light and respond markedly to certain definite frequencies, the result will be to give an accentuation of these frequencies to any sounds produced and heard between the walls. In the case of a room which can be considered as being enclosed by three pairs of walls, the various reflections following a given sound impulse may take the form of several simultaneous regular sequences, each with its own period, and producing in aggregate, the room effect. This effect, which may take the form of a "boom tone" or a "chink," depending respectively on a low- or high-frequency characteristic for the room, is easily recognisable by the ear, and is more accentuated for the microphone. If by any chance such a room effect has a period corresponding to a peak frequency in the microphone the effect is disastrous. Some of these difficulties were experienced in preparing the studios that were incorporated in the new building at the corner of the Savoy Hill block, opposite the Savoy Chapel. This corner was entirely rebuilt in 1925, and incorporated three new studios—two of these being small ones, and the third of medium size. The type of construction adopted in this building was very much lighter than that in the original building. Some of the interior walls were lightly built and resulted in the reduction of boom tones and rattle effects which were very difficult to remove from the transmission from those studios. No. 4 studio, which has dimensions 44ft. × 21ft. × 11ft. high, was the first to be built with variable drapings on the walls and on the ceiling. This draping is mounted on runners, and can be rapidly drawn aside if it is desired to vary the effect between consecutive

Studio No. 1, in which the draping can be drawn aside to expose the wall and vary the echo effect. This studio is suitable for orchestras of all sizes.

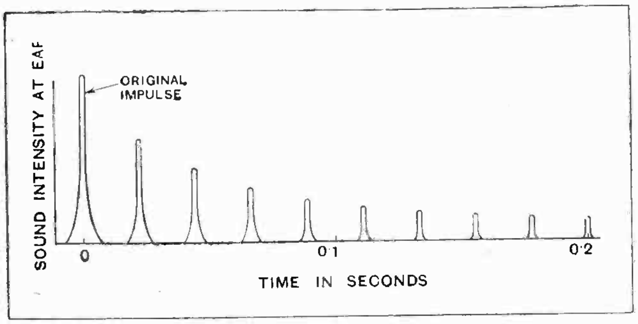


Fig. 7.—Sequence of echoes between two parallel solid walls known as the single frequency effect.

A Tour Round Savoy Hill.—

programmes or between the items of a programme. Such an arrangement proved useful at first for suiting the acoustic effect to the type of transmission, but in practice this particular studio, which is called No. 4, has been found to be of a useful size for programme items under the heading of Variety, and as these items are all of a similar nature it is not usually found necessary to make

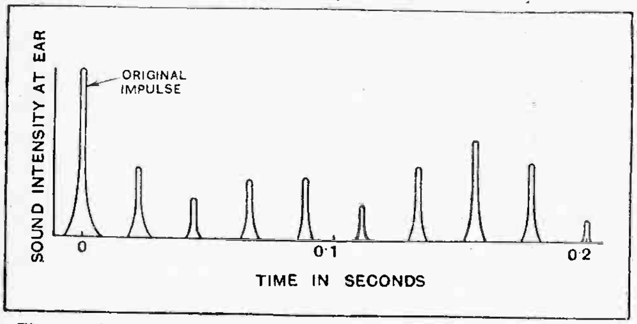


Fig. 8.—Sequence of echos between lightly built walls known as the rattle effect.

much alteration in the draping. Of the small studios, one (No. 5) has been in use continuously for the reading of News Bulletins and for Talks. It is permanently draped with a fairly thick casement cloth in accordance with the principle that very little echo is required for broadcasts of this nature. Actually, in practice this room exhibited a very strong boom effect, due to the lightness of construction of one of its walls. To reduce the reaction of this wall to the boom tones in speech, the whole of it has been covered with a layer of hair felt about 1in. in thickness, underneath the decorative draping, and this has had the result of reducing very considerably the defect in question.

The last studio to be opened in this building was one designed mainly for dramatic purposes. It consists primarily of three sections, each the size of a medium-sized room, next door to each other, with communicating doors. The central section has been designed primarily for speech purposes for the production of plays. The second section, in which the acoustic effect can be varied by means of variable draping from a dead effect to a fairly echoey effect, is used for the production of noises incidental to the plays. A third section, opening out from the speech studio, is employed for the addition of echo effect on the speech itself The electrical arrangements and the means for giving this variation effect will be described later, but it is important to note that with this combination of three sections it is possible, by means of the methods of control adopted, to give any variation of effect to the production of the speech and of the incidental noises independently. The arrangement, which is controllable in a simple manner, proves to be a very effective scheme for the production of broadcasting plays.

All the studios that have so far been described have been constructed with decoration schemes in accordance with the traditional methods of using folded or pleated draping on the walls and ceiling. In an attempt to avoid, if possible, this arrangement with its consequent rather depressing effect on artists, and its tendency to give low-toned reflection, the latest studios at Savoy Hill have been designed in an entirely new fashion which breaks away from the old tradition. First of all the deadening effect, which is necessary to a certain extent in all rooms used for broadcasting studios, has been obtained by the use of concealed material. Secondly, the interior decoration has been brightened up as much as possible so as to counteract by bright visual impression any deadening that may be noticed by aural impression. The required effect for each of the new studios was determined beforehand, the necessary absorption to be introduced calculated, and the design made out accordingly. The results have turned out extraordinarily well up to expectations, and have so far justified the use of the new method. The first one to be treated in this manner, called No. 6 studio, was to be used primarily as a Talks studio and for incidental piano transmissions. It was necessary to reduce the period of the room to about 0.8 of a second, to fit in with the architectural design of the studio, which was to have the appearance of an artistic and comfortable drawing room. As the walls had to have the appearance of plaster walls with wallpaper on top, the absorption was introduced in the form of a layer of hair felt over the greater part of the wall surface and covered with the necessary wallpaper to fit in with the design.

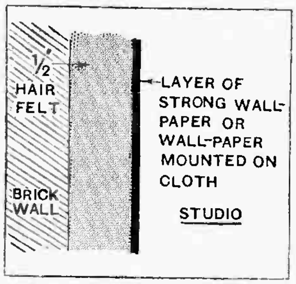


Fig. 9.—Type of covering used on parts of the walls in Studios No. 6 and 7. The felt provides the necessary absorption and a little low-toned reflection which is compensated partially by the high-toned reflection given by the paper surface.

Half the ceiling was treated in a similar manner, the other half being left bare to add a little reflection from above, so that the announcer or talker could hear himself a little, this adding a certain amount of freeness to the studio. It was estimated that this arrangement of walls would tend to give a low-toned reflection with a possible general low-toned effect to the whole studio, so this was compensated by the use of a certain amount of wood and of Celotex in building up the ventilation system of the studio, the surfaces of which would give a high-toned reflection to compensate for the effect of the felt. Actually, this compensation was overdone, as the paper used over the surface of the felt added a high-toned reflection to the low-tone reflection introduced by the felt. The result has been the presence in this studio of a fairly even reflection over all frequencies, with the addition of a certain high-pitched reflection, which is noticeable as a slight "chink" when talking in certain parts of the studio. This defect has been remedied by hanging pictures and tapestries on the walls in certain positions so as to reduce the backwards and forwards reflection effect between opposite walls, which tended to accentuate the "chink." The result now is a satisfactory studio, artistically pleasing to the eye, giving to the ear a feeling of freeness, and to the microphone an effect suitable for the types of broadcast taking place in that studio. The application of similar principles to the latest studio at Savoy Hill, No. 7, and the use of artificial echo effects will be described in the next article.

(To be continued.)

SPECIAL Demonstration RECEIVER

Constructional Specification of "The Wireless World" Long-range Set for High-quality Reproduction.

By F. H. HAYNES.

RECENT articles on the design of low-frequency amplifiers, together with the developments which have taken place in loud-speaker design and operation, have created a demand for a receiver in which every care has been taken to maintain the highest quality of reproduction. Many amateurs are no longer satisfied with the straightforward low-frequency amplifier usually incorporated in a broadcast receiver, and where, in the past, every endeavour has been devoted to improving the performance of the high-frequency stages, attention is now being turned to obtaining faithful amplification in the L.F. stages and realistic reproduction in the loud-speaker.

In so far as quality of reception is concerned, the set to be described was developed by Dr. N. W. McLachlan as part of the demonstration equipment for use in connection with his lectures in various provincial centres. To increase the utility of the receiver, a high-frequency amplifying stage has been added, making use of H.F. transformers developed by W. James which have attained considerable popularity as a result of the performance of the "Everyman's" series of receivers.

Hence in the low-frequency amplifier the features now required are:—

(1) Greater signal output for the operation of a loud-speaker of the coil-driven type and for producing, when required, a volume of sound comparable with that in the station studio—a necessary requirement for good quality.

(2) Careful avoidance of overloading by the use of suitable valves and high anode potentials.

(3) A last stage amplifier employing special valves working with high anode potential and suitable grid bias and giving a large fluctuating current output.

(4) The elimination of parasitic high-frequency oscillation in the L.F. stages.

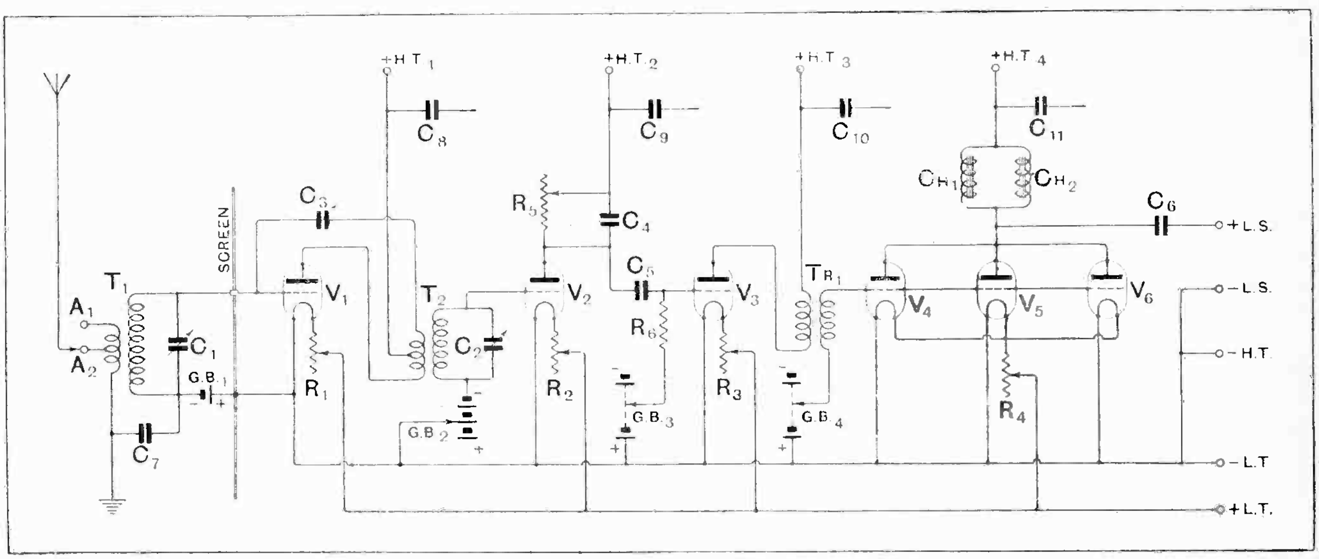


Fig. 1.—Four valve circuit embodying a stabilised H.F. amplifier, anode bend detector, and resistance and transformer coupled L.F. stages, for giving liberal volume with long range reception.

Special Demonstration Receiver.—

(5) The use of suitable condensers, transformers, and chokes in the L.F. stages designed to maintain, as far as possible, even amplification with particular attention to note frequencies as low as fifty cycles.

When a Baseboard Set is an Advantage.

There is little need to adopt an attractive design making use of an instrument panel and cabinet. For demonstration purposes the components and connections are available for inspection, while for public reception in a small hall the receiver does not require to be displayed. In the home the associated batteries, or battery substitute, precludes the installing of the set among surroundings where good appearance is of importance. A baseboard layout following, as far as possible, a disposition of the components as they appear in the theoretical circuit diagram, is essential for public demonstration work in order that the performance through the successive stages can be easily examined and faults quickly cleared.

All components which need to be constructed are described below in detail, the aim being to give the reader all the necessary information he requires for building the set.

Baseboard.—To accommodate the apparatus a baseboard measuring 48in. × 18in. × ⅝in. is required. Planed mahogany, oak, or American whitewood boards are used, and can usually be obtained exactly 9in. in width. If the edges are not true it is better to obtain 10in. boards. Owing to the weight of the apparatus and the fact that two boards are used, four cross battens 1in. × 2in. should be glued and screwed in position. Make sure that the wood is thoroughly dry before fitting the battens to avoid an opening occurring between the boards.

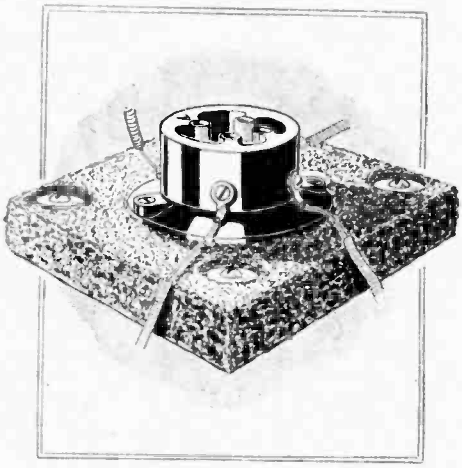


Fig. 3.—The valve holders are supported on "Sorbo" rubber pads to prevent the transference of vibration from the baseboard to valve. It may be found advisable also to completely cover the detector valve with a box packed with cotton wool.

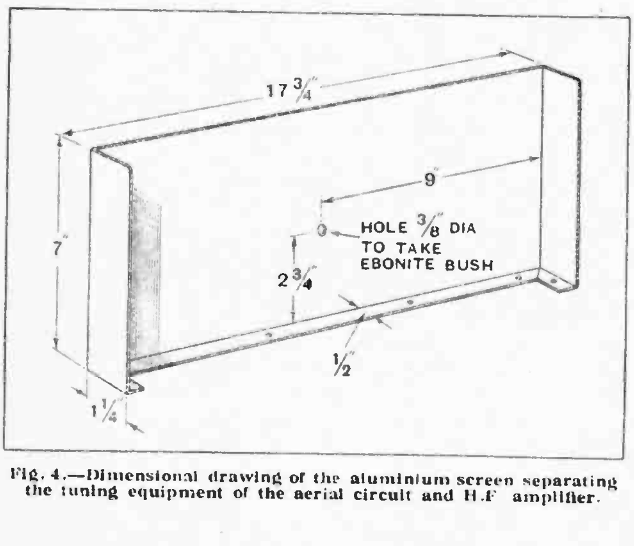


Fig. 4.—Dimensional drawing of the aluminium screen separating the tuning equipment of the aerial circuit and H.F amplifier.

The two centre battens should be drilled through across their width with six $\frac{3}{16}$in. holes one inch apart, and set out from the centre. These holes are for passing the

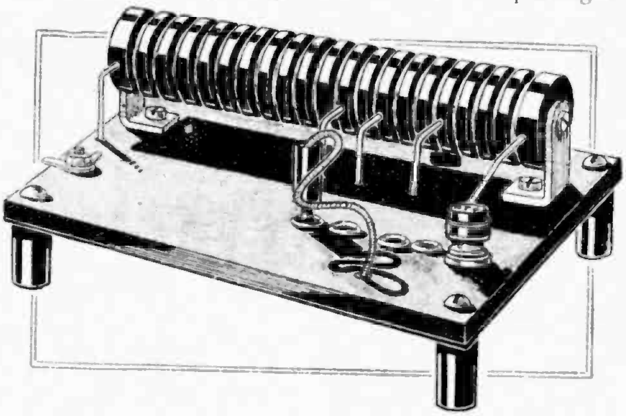


Fig. 2.—Constructional details for making up the tapped anode resistance.

connecting wires through in sleeving, and probably only two will be required in each batten, though it is not possible to exactly predetermine the route to be taken by the leads.

The baseboard should be polished or treated with shellac varnish, the underside also being varnished to prevent warping.

Terminal Strips.—Elevated ebonite strips are required to carry the earth and two aerial terminals, the two L.T. terminals, three H.T. terminals, the loud-speaker terminals, as well as single pillars for the H.T. terminals of the first and second valves, though, if the anode resistance is home-made, this latter terminal (H.T.2) can be carried on the ebonite platform which supports the resistance. The strips are made from ¼in. ebonite 1in. in width, two pieces 4½in. in length being required for carrying three terminals as well as two pieces 3in. in length supporting two terminals. All of the terminals are 1¼in. apart. A great deal of trouble will be saved as regards sawing and finishing edges by purchasing 18in. of 1in. ebonite strip already sawn to width. The terminal strips are elevated from the base by pieces of ½in. ebonite tube with ¼in. hole, each ¾in. in length. Round-headed, blued screws, 1½in. × No. 8, are used for securing the strips.

Aerial Tuning Transformer (T_1).—This is wound on a former 3in. in external diameter by 3½in. in length, and is secured to the baseboard by two ebonite pillars 1⅝in. in height. It is best to drill and tap the ends of the pillars to take 4 B.A. screws, though wooden supports can be adopted if fixing is found to be easier.

The secondary winding consists of seventy turns of No. 27/42 Litzendraht wire with silk-covered strands. Eight ebonite or wooden strips 1¼in. in length and ¼in. in thickness support the primary turns, which are put on in two sections of eight and then seven turns spaced-

Special Demonstration Receiver.—
wound and in the same direction as the secondary. The primary winding is No. 28 D.S.C., and it is arranged at the filament end of the secondary winding.

Aerial Tuning Condenser (C_1).—A platform 5in. × 5in. is made from ¼in. ebonite and supports this condenser, which should have a maximum value of between 0.00035 and 0.0005 mfd. Four pieces of ebonite tube, ½in. dia. × ¼in. hole, are used as spacers, and the platform is clamped into position with four 6in. lengths of 2 B.A. brass "studding."

The 1.5 volt grid cell, G.B.1 (Siemens type T.), is held in position with a strip of bent brass or aluminium or a pair of clamps made from No. 16 wire can be used.

To make provision for the use of a battery eliminator as a source of H.T. supply an earthing condenser (C_7) of 1 mfd. capacity is provided.

Screening.—An earthed metal screen serves as a barrier to prevent interaction between the apparatus comprising the tuned aerial circuit and the tuned H.F. intervalve coupling. A piece of 18 S.W.G. aluminium sheet 21in. × 7½in. is required for working to the constructional details given in the accompanying working drawing. A wooden or soft-nosed mallet should be used for making the bends, guarding all the time, in the case of hard-rolled aluminium, against a fracture.

If facilities are not available for fitting the ebonite bush recommended in the drawing, an unbushed ½in. hole will suffice. The hole through the ebonite bush is ¼in.

Valve Holders (V_1 to V_6).—It is most important that the sound emitted from the loud-speaker, which throws most things into vibration in the room in which it is operated, shall not react on the valves. In its worst form the sound waves acting on the microphonic valves will set up a note of constant pitch, and, even if this condition is not noticeable, some degree of interference will result if the set is operated within the range of the loud-speaker, and a form of distortion will be introduced. As the loud-speaker is particularly liable to throw the baseboard into vibration, antiphonic cushions must be inserted under the valve holders and the connections made by particularly supple wire, such as Litzendraht.

To insulate the valve holders from mechanical vibration the indiarubber pads, 3½in. × 3½in., should be held down at their corners by means of screws and washers, and the valve holder bolted to the indiarubber with 6 B.A. screws and nuts, tightening them up on the rubber, so that the heads of the screws do not make contact with the wood. The sheet "Sorbo" indiarubber is about ⅝in. in thickness (pieces of bath mat), and the Aermonic valve holders bolt securely to the rubber, while a small quantity of indiarubber solution may be applied to the under face of the holder.

H.F. Intervalve Transformer (T_2).—The secondary winding comprises 70 turns of 27/42 Litzendraht wire on a 3in. diameter former, 3½in. in length. The primary and neutralising windings of No. 38 S.S.C. wire are wound on together, so that alternate turns form the respective windings. Each winding comprises 12 turns, and they are supported by eight ebonite or wooden strips so as to just clear the surface of the secondary. Great care should be taken to see that the turns do not cross or rest down in contact with the secondary.

The beginning end of one winding and the finishing end of the other are bridged across and connected to the H.T. battery terminal. The connection to the neutralising condenser is taken from the low potential end of the coil. Two ebonite or wooden posts support the coil vertically at a distance of 1½in. from the baseboard.

Suitable aerial and H.F. transformers are now obtainable.

Transformer Tuning Condenser (C_2).—This has a maximum of between 0.00027 mfd. and 0.00035 mfd., and is mounted in the same fashion as the aerial tuning condenser. Owing to convenience for baseboard mounting a Gambrell neutralising condenser (C_3) is adopted.

It is important to connect the H.T. bridging condenser (C_8) by means of a short wire from its terminal to a point close up to the transformer primary winding. Its capacity is 1 mfd.

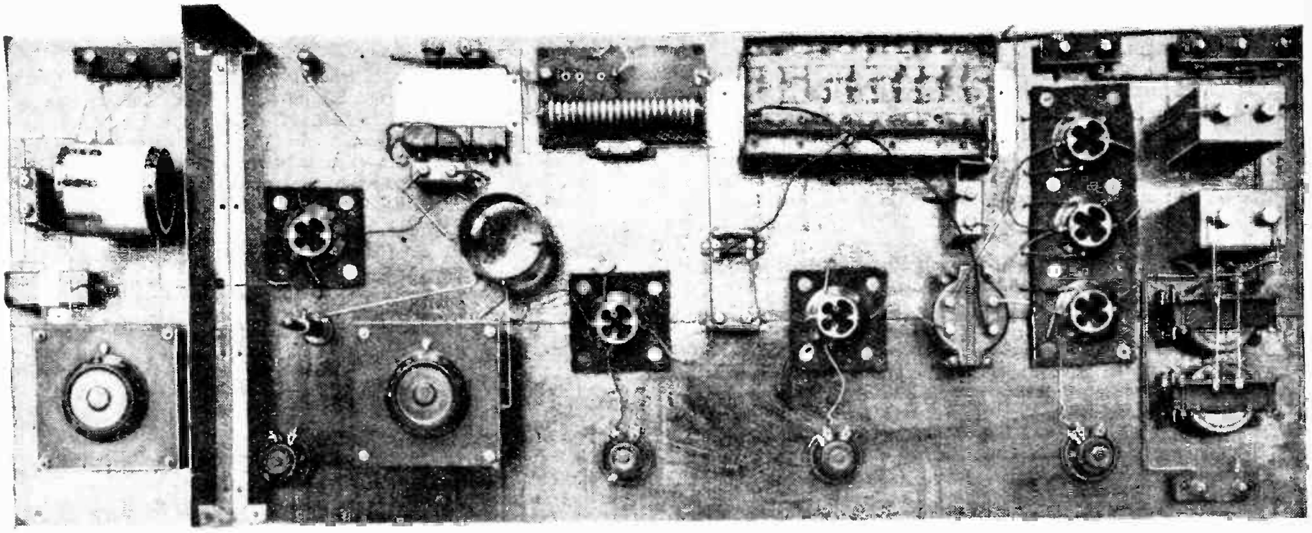


Fig. 5.—Plan view showing the arrangement of the components.

Special Demonstration Receiver.—

The filament resistance (R_1 as well as R_2 and R_3) are of a type specially suitable for screwing down to a baseboard, and have a maximum resistance of about 6 ohms.

For biassing the grid of the detector valve, which is an anode bend rectifier, three Siemens "T" cells are provided, clamped down by means of a piece of bent aluminium sheet. Thin pieces of leather strap, or No. 16 wire covered with sleeving, may be used as an alternative.

Anode Resistance (R_5).—Where facilities exist for turning slots in an ebonite rod this component may quite well be home made, and details are given in an accompanying illustration. The ebonite spool is 1in. in diameter and 5¾in. in length. The 20 slots are ⅛in. in width and depth, and carry each 450 turns of No. 47 D.S.C. Eureka wire, giving a total resistance of approximately 150,000 ohms. There are four tappings—after the eleventh, thirteenth, and sixteenth section, and at the end of the winding. These are brought out to sockets, and a wander plug connects to the terminal +H.T.2.

In winding, when passing from one section to the next the direction of winding is reversed, and a fine saw cut along the entire length of the spool provides for passing the wire along. The tapping points are made by twisting the wire round short pegs of No. 16 wire, driven into holes along the former. As an alternative to constructing this resistance, a Varley tapped anode resistance of a maximum value of 150,000 ohms or a fixed resistance in clips of 100,000 ohms may be used.

Shunting the anode resistance is a high-frequency by-pass condenser (C_4) having a capacity of 0.0001 mfd. From the terminal +H.T.2 to the L.T. – is the bridging condenser C_9, which is an ordinary low-voltage condenser having a capacity of not less than 2 mfd.

Connecting to the grid of V_3 is the coupling condenser C_5. It has a capacity of 0.1 mfd., and it is important that it should be of the mica dielectric type.

Two grid leaks should be provided of 0.25 and 0.5 megohms, so that they can be interchanged for volume control. Lower values should not be used, or the voltage drop across the condenser C_5 at low note frequencies will be appreciable compared with that across the grid leak, and loss of volume in the base will result.

Grid biassing is provided by a 15-volt grid battery (G.B.$_3$).

L.F. Transformer (Tr_1).—A low ratio transformer couples the valve V_3 to the parallel connected output valves V_4, V_5, V_6. In this case a Marconi transformer was used owing to its high primary inductance with liberal core cross section and low primary to secondary ratio.

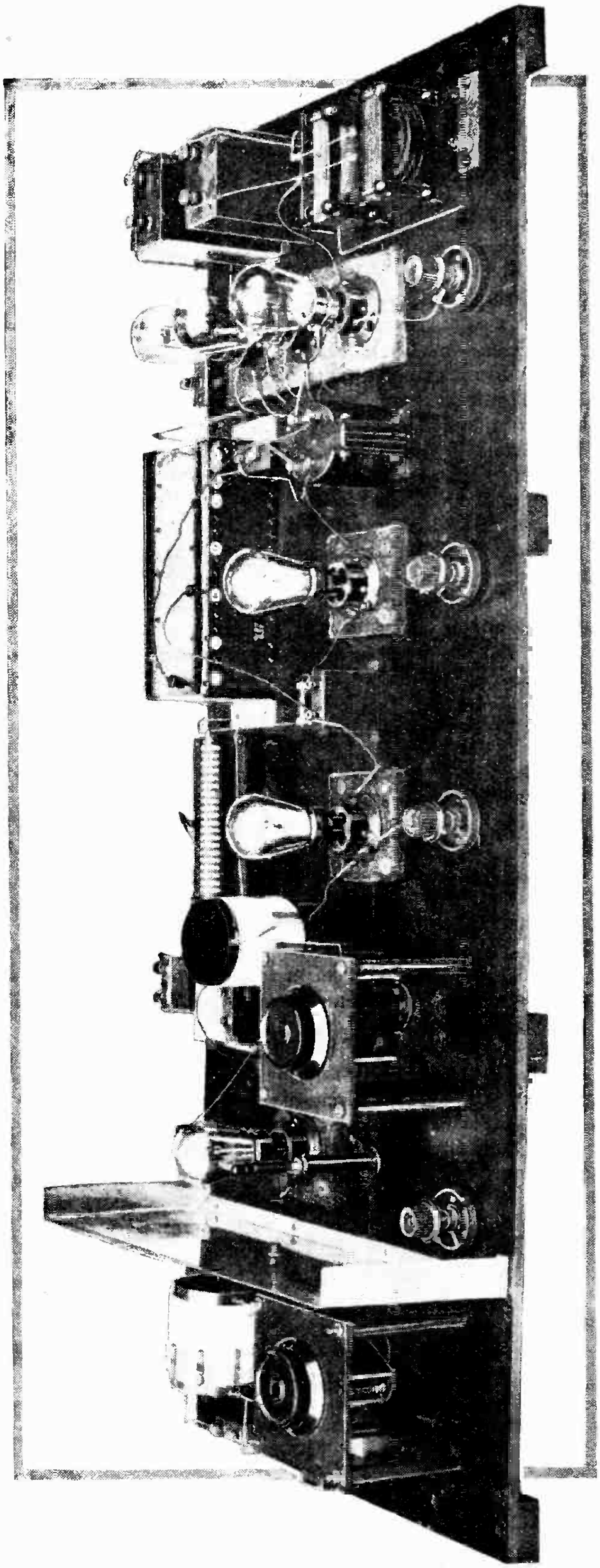
From the terminal +H.T.3 is connected a low-voltage condenser (C_{10}) having a capacity of 4 mfd.

LIST OF PARTS REQUIRED.

Wood for baseboard, 2 pieces, 9in.×4in.×⅝in., planed, and 7ft. of 2in.×1in. batten.
Ebonite for making two condenser panels, 5in.×5in.×¼in.
Ebonite panel for anode resistance, if home-constructed, 6in.×3½in.×¼in.
6in. of 1in. ebonite rod for spool.
4ft. of ½in.×¼in. hole ebonite tube for supports.
Hard aluminium sheet, 18 S.W.G., 21in.×7½in., for screen.
Aluminium sheet, 22 S.W.G., 1ft.×6in. for constructing clips for securing grid batteries.
Ebonite strip, 18in.×1in.×¼in., for mounting terminals.
2 Variable condensers, 0.00035 to 0.0005 mfd., and 0.00027 to 0.00035 mfd. Gecophone, Brandes, Ormond, J.B., or Cyldon with vernier dial.
1 Neutralising condenser for base mounting (Gambrell Bros., Ltd., 76, Victoria Street, London, S.W.1).
4 Siemens type T cells.
Grid biassing batteries of 15 and 66 volts.
6 Valve holders, Aermonic (V. R. Pleasance, 56, Fargate, Sheffield).
Piece of "Sorbo" rubber bath mat, 14in.×9in.×⅜in.
3 Filament rheostats, 6 ohms.
1 Filament rheostat, 3 ohms (Ashley Wireless Telephone Co. (1925), Ltd., Finch Place, Falkland Street, London Road, Liverpool).
1 L.F. Intervalve transformer, 1 : 2.7 (Marconiphone Co., Ltd., 210/212, Tottenham Court Road, London W.1).
Fixed capacity condensers, T.C.C., two 1 mfd., two 4 mfds., low voltage type, two 4 mfd., 600 volt type, one 0.1 mfd. mica dielectric.
2 L.F. chokes, 32 henries (W. G. Pye & Co., Granta Works, Montague Road, Cambridge).
Aerial and intervalve H.F. transformers (The B. & J. Wireless Co., 2, Athelstane Mews, Stroud Green Road, London, N.4., also Wright & Weaire, Ltd., 740, High Road, Tottenham, London, N.).
1 Varley 150,000-ohm tapped anode resistance or 100,000-ohm fixed resistance in lieu of that described if desired (Oliver Pell Control, Ltd., Granville House, Arundel Street, London, W.C.2).
1 Fixed capacity condenser, 0.001 mfd.
Dubilier grid leak clips and leak resistances of 0.5 and 0.25 megohms.
12 Terminals marked "Earth," "Aerial 1," "Aerial 2," H.T.+1, H.T.+2, H.T.+3, H.T.+4, H.T.–, L.T.+, L.T.–, L.S.+, L.S.–.
Indicating pointers for condenser dials (A. F. Bulgin & Co., 9/11, Cursitor Street, Chancery Lane, London, E.C.4).
4 ozs. No. 16 connecting wire.
6 Yards of suitable black and yellow sleeving.
Small quantity of Litzendraht wire for making flexible connections to valve holders.
2 Wander plugs for grid bias batteries.

In the "List of Parts" included in the descriptions of THE WIRELESS WORLD constructional sets 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 components used, 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 size of alternative components he may use.

Wireless World



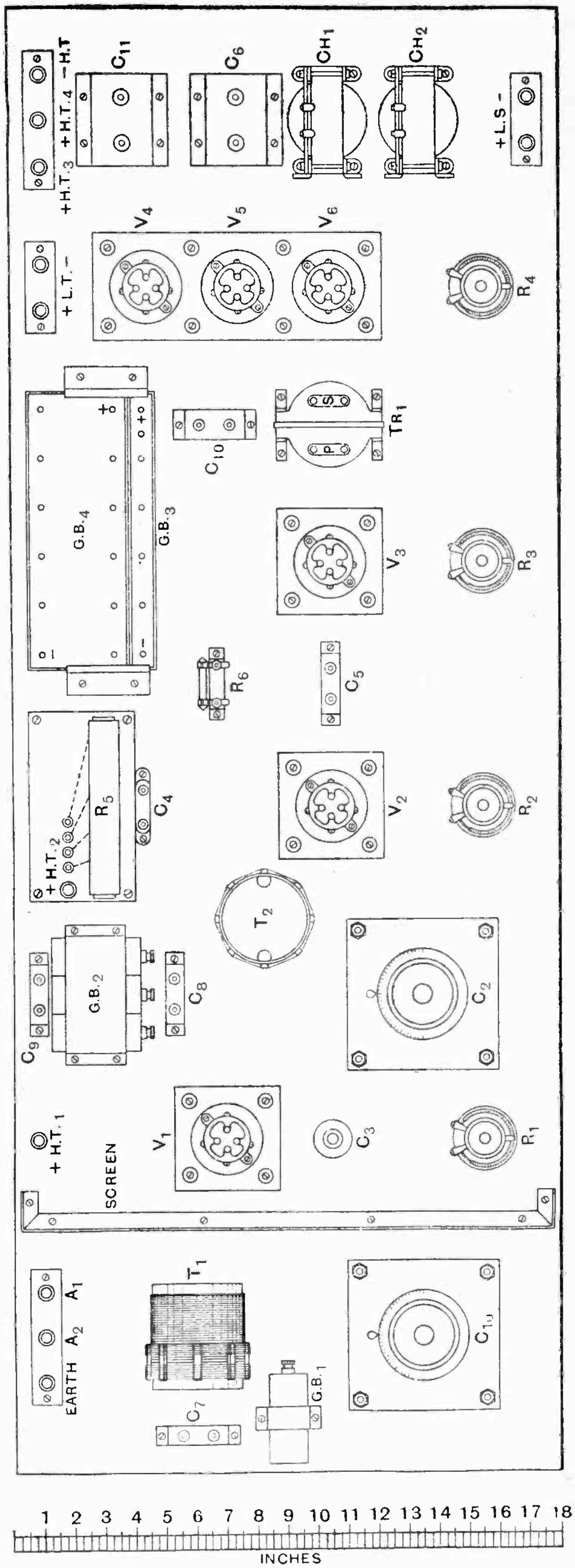


Fig. 6.—The drawing is to scale and the exact positions of the components can be readily determined.

Special Demonstration Receiver.—

The valves in the last stage are biassed by means of a 66-volt battery, though additional external grid biassing cells may readily be added when required.

Although three parallel connected valve holders are fitted, a single power valve may be found suitable for moderate output. Parallel connected 32-henry chokes (Ch_1 and Ch_2) are considered advisable, to guard against saturation with the heavy feed current taken by three parallel connected valves.

In the set shown in the illustration the filament resistance has a maximum value of 30 ohms, though to suit a single valve it may be considered desirable to connect a 2-ohm and a 6-ohm rheostat in series, using whichever is required.

Both the bridging condenser (C_{11}) and the loud-speaker feed condenser (C_6) are each of 4 mfd. capacity, and rated to withstand 600 volts.

For the elimination of parasitic H.F. oscillation in the low-frequency amplifier a high-frequency choke coil may be connected directly in the lead to the grid of V_3, while a resistance of the grid leak type, having a value of 0.25 megohms, may be inserted between the low-frequency transformer and the grid of the output valve. These are not shown in the diagrams, as the writer was unable to identify any beneficial change in the quality when these additional components were included.

Wiring.—All filament current distributing leads are of No. 16 wire in sleeving, and taken beneath the baseboard. Grid and plate connections excepting in the case of H.F. leads, which run by the shortest route, are in sleeving and kept down near the surface of the baseboard.

A practical wiring diagram has not been given in this instance as the points of branching between leads occur practically as shown in the theoretical circuit.

Selection of Valves.

Suitable valves for use in the several stages are shown in the accompanying table. Information will be given on the suitability of valves of other manufacture, and the writer has only made reference to valves that have been actually tested and used for demonstration purposes. The correct adjustments of grid bias (G.B.$_3$ and G.B.$_4$) are determined by connecting milliammeters with 10-milliampere and 100-milliampere scales respectively in the leads between +H.T.$_3$ and +H.T.$_4$ and the respective transformers and chokes. The bias is adjusted until the needle remains stationary on the strongest of signals, increasing both bias and H.T. battery potential within the limits specified for the valves until a suitable range of grid voltage swing is obtained. If the pointer of the meter will not remain steady it is an indication that there is too much grid voltage swing, and more suitable valves should be chosen, or the signal strength slightly reduced by detuning. Swinging of the needle occurs when the grid potential becomes slightly positive, or so negative that the change in anode current is not proportional to the change in grid potential.

For operating small loud-speakers with moderately high resistance windings, such as the B.S.A. cone or the Celestion, connection may be made directly to the loud-speaker output terminals, though it is, of course, essential to make use of a small variable ratio transformer when operating a coil-driven cone such as the B.T.H. Rice-Kellogg, or a home-made instrument working on a similar principle.

Anode current may be derived from an accumulator battery of adequate size, bearing in mind the load imposed by the second low-frequency stage. It is preferable to use an entirely separate battery for this last stage to prevent coupling occurring between the stages by the voltage drop across the battery when on comparatively heavy load. As to the use of A.C. battery eliminators, two independent full-wave rectifiers should be set up, one with a potential divider for feeding the first three valves, and the other supplying anode current to the last stage. The rectifying valves should be capable of giving a liberal output, such as two Marconi or Osram Type U5, or four Mullard Type DU10.

Range and Output.

The receiver is capable, on a normal outside aerial, of tuning in the majority of the British and European stations giving, in many instances, an output of satisfactory volume for demonstration purposes in a hall of moderate size owing to the particularly satisfactory performance given by the H.F. amplifier. The tuning dials can be rotated step by step without the slightest sound of heterodyning.

Used as a local station receiver for the purpose of demonstrating quality in broadcast reception, Dr. McLachlan used the actual set here described for his public lectures, arranged by *The Wireless World* at Birmingham and Glasgow. As to the merits of the set with regard to long-range loud-speaker reception, the writer demonstrated the set at a public exhibition arranged by the Southend and District Radio Society, and the dials were kept in constant rotation, moving from station to station without heterodyne whistle, the signal strength of many distant stations being comparable with that of London, some 40 miles away, with considerable volume and with a degree of quality which left little to be desired.

VALVE TABLE.

Valve Maker.	H.F.	Detector.	L.F.1.	L.F.2. Type.	Anode Volts.	Grid Bias Volts.	Anode Current per Valve, mA.
Marconi and Osram	D.E.5B.	D.E.5B.	D.E.5	D.E.5A.	120	20	7
Marconi and Osram	D.E.5B.	D.E.5B.	D.E.5	L.S.5A.	350	100	35
Mullard	P.M.5X	P.M.5X	P.M.6	P.M.256	120	20	10
B.T.H.	B.4H.	B.4H.	B.4	B.11	200	32	20
S.T.	S.T.61	S.T.61	S.T.62	S.T.63	120	20	10

HINTS and TIPS for NEW READERS

A Section Devoted to the Practical Assistance of the Beginner.

FAULTY TELEPHONES.

Experience shows that the vast majority of failures in a simple crystal receiver are attributable to faulty telephone leads, which may be due to a complete or partial disconnection in the wires, or possibly to a short-circuit. It is an easy matter to make sure whether varying or intermittent signals are due to this trouble. To make a test, the telephones may be connected to a single dry cell, and the leads should be passed through the fingers slowly, at the same time bending them slightly. If clicks are heard it may be assumed that there is a fault, and new leads should be substituted.

A similar test may be carried out without a dry cell when listening to an actual transmission, preferably during an interval in the programme, while the carrier wave is being sent out. As there will be a steady current passing through the phones under these conditions, any intermittency will be indicated by a click.

A SAFETY MEASURE.

When disconnecting a receiver it is always a good plan to remove the connecting leads from the batteries before taking them off the terminals of the instrument. By doing so, the risk of accidental short-circuits is avoided. When connecting up the set it is as well to reverse this procedure and to join the wires to the set before attaching them to the batteries.

AN H.T. ELIMINATOR FOR D.C. SUPPLY.

The simple arrangement shown in Fig. 1 will be found convenient for supplying a receiver with H.T. from D.C. mains, particularly when the ripple superimposed on the supply is not particularly pronounced. Under favourable circumstances the values of the smoothing condensers may be reduced without any harmful effects, but it is recommended that the largest capacities possible should be used.

The resistance R must be wire-wound, and, assuming a supply voltage of from 200 to 250, should have a value of from 7,000 to 10,000 ohms. This means that a current of some 30 milliamperes (more or less) will be passing through the smoothing choke L, which must be of a pattern capable of carrying this current with-

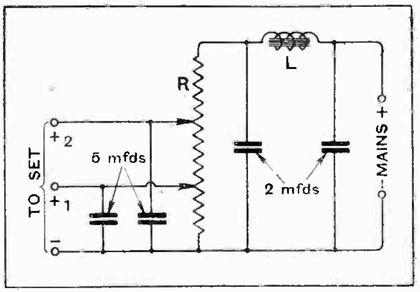


Fig. 1.—A smoothing and voltage-dividing circuit for H.T. supply from D.C. mains.

out saturation, with a reasonable margin. Two similar chokes may be connected in parallel if necessary; the effect of this will be to double the total current-carrying capacity and to halve the inductance. Its inductance should not, as a rule, be less than 15 henries, although a lower figure may give satisfactory results on a supply which is particularly free of irregularities. Generally speaking, the more sensitive the receiver the greater becomes the need for elaborate smoothing devices, with large inductances and condensers.

Although tapped wire-wound resistances are now obtainable at a price so low that it is hardly worth while for the amateur to make them, a few constructional hints may be of interest to some readers. No. 40 S.W.G. Eureka wire carries a current of the order of 30 milliamperes without undue heating, and has a resistance of 37 ohms per yard. A total length of about 190 yards will thus be required for a 7,000-ohm resistor. Some ten or twelve tappings should be provided; the first-mentioned number will generally be ample, as the modern valve, working in a straightforward circuit, is not critical as to H.T. supply, and the "tricky" circuit is in any case unsuitable for operating on a simple eliminator of this kind.

The coil may be wound in slots cut in a grooved former, and it will be convenient to make the number of grooves coincide with the number of tappings required; these may then be taken from the junction between sections.

The ohmic resistance of the choke may often be ignored, so for practical purposes it is easy to get a reasonably accurate idea of the voltage applied to the set, if it is remembered that the voltage across the output terminals for feeding the set is proportional to the amount of the resistance R in circuit, but only when there is no flow of current. Thus, assuming a mains voltage of 240 and a resistor of 7,000 ohms, if we connect the lead joined to output terminal + 2 to the centre point of the resistor, the voltage existing between this point and the common negative terminal will be half that of the supply (*i.e.*, 120 volts). As soon, however, as we begin to take current for the valves there will be a fall of potential across the part of the resistance in circuit (3,500 ohms). This loss, allowing a consumption of 7 milliamperes (a reasonable figure), amounts to nearly 25 volts. Accordingly, if a pressure of 120 volts is desired, the + 2 tapping is moved slightly above the centre point, or, in other words, nearer the positive end of the resistor. Imagine it connected to such a point that the output circuit (+ and – terminals) are tapped across four-sevenths of the total resistance. The voltage on open circuit, or when current is not being taken from the eliminator, will amount to about 137 volts, but when a current of 7 milliamps is passing, the drop across the 3,000 ohms of resistance remaining in circuit will amount to 21 volts, leaving 116, which is very close to our requirements.

A similar procedure should be adopted in estimating the tapping point for the lead joined to the + 1 terminal, which, it is assumed, will supply the detector and other valves taking a low anode voltage.

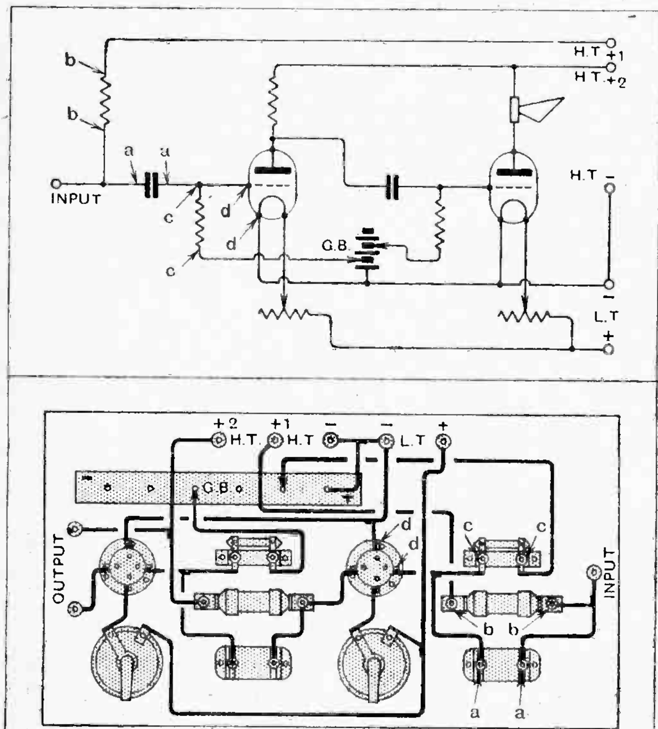
The amateur is strongly advised to content himself with two output voltages; more elaborate arrangements than that shown are possible, but they have few advantages, as the majority of modern sets may be made to work well with a common voltage for all valves except the detector. Extra grid bias may, however, be required for H.F. and first-stage L.F. amplifiers. When anode bend detection is used it is often permissible to feed all the valves from a common supply; in this case the + 1 terminal, together with the 5 mfd. condenser connected between it and the negative lead, may be eliminated, with a consequent saving in expense.

DISSECTED DIAGRAMS.

Point-to-point Tests in Theory and Practice.

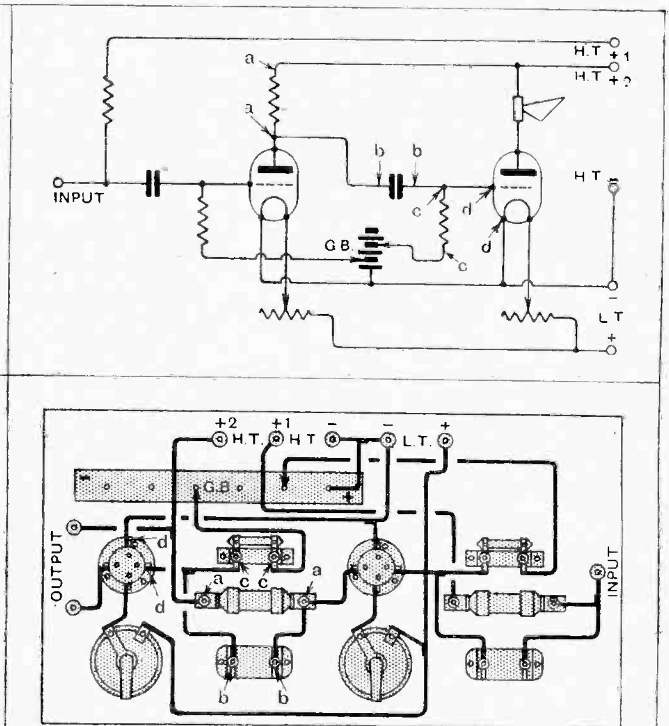
No. 60.—A Two-valve Resistance-coupled Amplifier.

The present series of diagrams is intended to show simple methods of locating faults in typical wireless receivers. Failing a sensitive galvanometer, it is suggested that a pair of telephones with a small dry battery should be used as an indicating device. These tests will show not only actual faults, but will reveal the small leakages which are so often responsible for poor reception and flat tuning. Batteries should be disconnected before testing.



1

The insulation of the grid condenser is tested across *a—a*, and continuity in anode and grid resistances, respectively, between *b*, *b*, and *c*, *c*. It is a matter of some difficulty for the amateur to test these high resistances without measuring apparatus, but with a pair of phones and a dry battery it is possible to form a good idea of their condition by noting the comparative loudness of clicks. The insulation of the grid circuit is shown between *d* and *d*, with grid leak removed.



2

The second anode and grid resistances are tested in a similar manner, across *a*, *a*, and *c*, *c*, as is the insulation of the grid condenser between *b* and *b*. The insulation of the grid circuit as a whole is shown between *d* and *d* (with grid leak or lead to grid bias battery removed). The insulation of the plate circuits of both valves may be tested between the H.T.– and and H.T.+2 terminals, while the various joints in the wiring may be checked.

CURRENT TOPICS

News of the Week in Brief Review.

BRAILLE WIRELESS JOURNAL.

The first wireless journal for the blind has just been started by the well-known French publishing house of Chiron in Paris. It is printed in Braille.

oooo

INDIAN BROADCASTING APPOINTMENT.

Mr. L. B. Page, director of the Hull relay station of the B.B.C., will leave England shortly to become director of the Indian Broadcasting Company's new station at Bombay.

oooo

GENERAL FERRIÉ AS GUEST OF HONOUR.

Sir John Reith will preside at to-day's luncheon of the Anglo-French Luncheon Club at Princes Restaurant. The guest of honour will be General Ferrié, the well-known French wireless expert.

oooo

SIGNS OF PEACE.

The Department of Commerce, Washington, has just received a letter from a New York citizen asking whether he might remove the seals placed on his wireless equipment by the naval authorities when America declared war on Germany in 1917.

oooo

POLICE WIRELESS RUMOUR.

The recent newspaper report that the police chiefs of Scotland Yard contemplate equipping two fast cars with wireless for the purpose of dealing with motor bandits is not officially confirmed. On enquiry at Scotland Yard a *Wireless World* representative was informed that nothing of the sort is being planned at the moment.

oooo

R.S.A. LECTURE ON LAMPS AND VALVES.

"Some Studies in connection with the manufacture of Electric Lamps and Thermionic Valves" is the title of a lecture to be given this evening (Wednesday) at 8 o'clock by Mr. Clifford C. Paterson, O.B.E., M.Inst.C.E., M.I.E.E., F.Inst.P., at the Royal Society of Arts, John Street, Adelphi, W.C.2. The lecturer is Director of the Research Laboratories of the General Electric Company, Wembley. Sir Oliver Lodge will preside.

LIGHTHOUSE WIRELESS.

The *Daily News* and the *Star* Fund for equipping British lighthouses and lightships with wireless receivers has closed with a total of £2,512 17s. 11d.

oooo

A BRAZILIAN SCRAP HEAP.

A glut of obsolete wireless apparatus is stated to be upsetting the Brazilian radio market. Old gear is being sold at such low prices as to interfere seriously with the importation of up-to-date apparatus.

oooo

THE ALL-POWERFUL LISTENER.

At the request of broadcast listeners the Portland (Oregon, U.S.A.) City Council has passed an ordinance forbidding the use of violet ray, X-ray, and other high-frequency apparatus between the hours of 7 and 11 p.m.

oooo

FIRE AT NORTHOLT.

A fire at the G.P.O. station at Northolt, Middlesex, on February 2nd, interrupted the service for a short time. The outbreak occurred in an auxiliary hut containing inductance coils, but the staff were able to extinguish it before the Uxbridge fire brigade arrived on the scene.

TROUBLE IN VIENNA.

Wireless reception in Vienna is suffering acute interference from a number of new electrical massage machines. In fact, it is difficult to distinguish between message and massage.

oooo

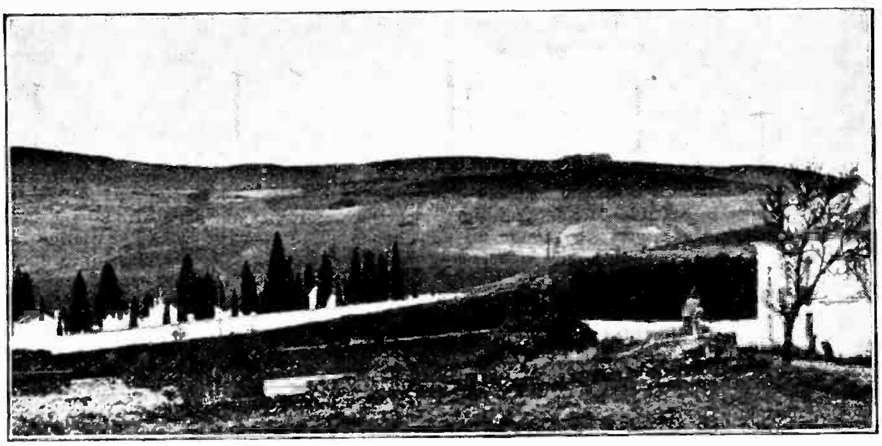
BROADCAST ADVERTISEMENTS IN AMERICA.

In issuing a tariff of radio advertisements, the National Broadcasting Company of America announces that no applications for advertising time will be considered unless the applicant agrees to continue his usual amount of advertising in the Press and on the hoardings.

oooo

AMATEUR CALLS THE ANTARCTIC.

Mr. C. W. Goyder (G2SZ), whose success in communicating with the Norwegian whaler *Sir James Clark* while the vessel was in the Antarctic, was referred to last week, has repeated his achievement. As arranged during the previous communication, Mr. Goyder called the ship (AQE) at 8.30 a.m. on Sunday, February 6th, and received a prompt reply. The whaler was at Ross Barrier, some 250 miles within the Antarctic circle.



FIRST PORTUGUESE INTERNATIONAL WIRELESS STATION. A general view of the new Marconi beam station at Alfragide, nine miles west of Lisbon, by means of which the Portuguese capital will be in direct touch not only with the principal cities of Europe, but with the Portuguese islands, the colonies in East and West Africa and with South America. The three masts on the left are for communication with Rio de Janeiro; those on the right are for the Loanda and Mozambique services. Suspended between the central masts is the aerial for European communication.

IN THE LAND OF THE CHRYSANTHEMUM.

By 1928 Japan will have a wireless station with a power of 600kW, according to a report in *Eastern Engineering*. The station will be the property of the Japanese Wireless Telegraph Co., an official concern enjoying the support of Parliament.

oooo

P.M.G. ASKS FOR "SUBSTANTIAL FINES."

In fining two Doncaster residents for installing wireless apparatus without a licence, the magistrate said that this was the first case of the kind to be tried by the Doncaster West Riding Court. The Doncaster Postmaster said that the Postmaster-General had instructed him to ask for substantial fines. The defendants were fined £1 each.

oooo

LIGHTEST WIRELESS TRANSMITTER.

What is believed to be the world's smallest wireless transmitter has been tested with success by the United States Marine Corps aviators. The transmitter, which embodies quartz control, weighs 5½ lbs., is 9 inches high, and 10 inches from front to rear. Operated in an aeroplane, it has been heard at distances up to 250 miles.

oooo

TRANSATLANTIC TELEPHONE SERVICE EXTENDED.

A further extension in the transatlantic telephone service took place on Saturday last, February 12th, when the service became available to and from all places in the States of Michigan, Illinois and Wisconsin. The charge for a call from Great Britain to any place in these States is £15 12s. for the first three minutes and £5 4s. for each additional minute or fraction thereof.

oooo

WIRELESS MECHANICS FOR R.A.F.

Five hundred aircraft apprentices between the ages of fifteen and seventeen are required by the Royal Air Force for entry into the Schools of Technical Training at Halton, Bucks, and at Flowerdown, near Winchester. One of the principal trades open to boys is that of wireless operator-mechanic. Full particulars can be obtained from the Royal Air Force, Gwydyr House, Whitehall, London, S.W.1.

oooo

WIRELESS IMPORT DUTY IN IRELAND.

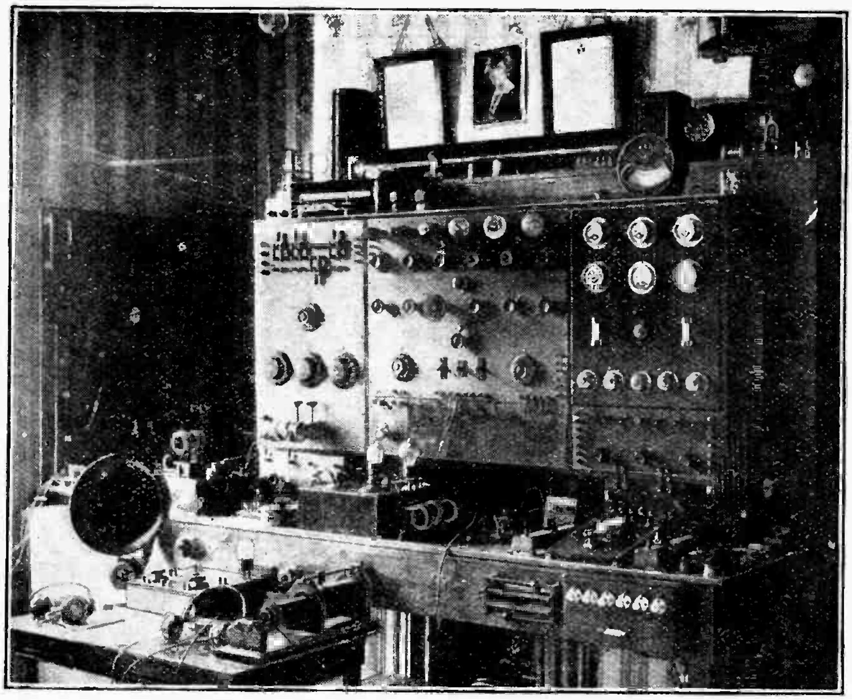
That it was impossible to abandon the present import duty on wireless apparatus was one of the points stressed in a recent speech by Mr. J. J. Walsh, Postmaster-General of the Irish Free State. The Government, he said, intended to spend a large amount upon the development of broadcasting, including the erection of a station at Cork in the near future and a high-power station later, and it relied upon the duty as well as the licence fees to meet the expenditure.

oooo

EXPENSIVE CRYSTAL SET.

For working a crystal set without a licence William Ernest Beckwith, of Sutton's Dwellings, City Road, E.C., has been fined 25s. at the Old Street Police Court.

oooo



NOT A TRANSMITTER! This imposing array of apparatus comprises the receiving station of Mr. J. Pearce, of Wimbledon. Several separate receivers are included.

ADVISORY COMMITTEE FOR MARCONI CO.

The board of Marconi's Wireless Telegraph Company, Ltd., have agreed to the appointment of an advisory committee to make recommendations as to the future control and conduct of the business of the company. The committee includes Lord Ashfield, Lord Buckland, Sir Hugo Hirst, chairman of the General Electric Co., and Mr. F. A. Szarvasy, chairman of the British, Foreign and Colonial Corporation. It is believed that changes in the company's directorate are contemplated.

oooo

BROADCASTING PICTURES IN AUSTRIA.

The Austrian Broadcasting Company is reported to be conducting experiments in the transmission of pictures by the Thorne Baker method, closely similar to that described in *The Wireless World* of March 24th, 1926. The tests are under the control of Captain Otto Fulton.

oooo

PEACE IN U.S. ETHER?

The contending parties in the U.S. Senate have reached a compromise on the vexed question of the control of radio. It is understood that an independent commission will exercise control for a year, after which the commission will deal only with matters of appeal or controversy, the administration passing into the hands of the Chamber of Commerce.

THE PATENT SITUATION IN CANADA.

On January 10th, at Ottawa, commenced the hearing of some radio patent litigation, of immense importance to the Canadian radio trade, which is not without interest to British manufacturers, and indirectly to the British public. The litigation in question is concerned with tuned radio-frequency amplification—the grid leak and neutralisation, and it is instigated by the Canadian General Electric Company against the Fada Radio Corporation of Canada.

On the one side, the interests of the Canadian General Electric in this litigation may be taken to be identical with those of the Canadian Marconi and Westinghouse Companies, the Northern Electric Co. (The Standard Electric of Canada), and possibly also those of the De Forest Crosley Company.

On the other hand the Fada Radio Corporation being a licensee under the Hazeltine Neutrodyne patents, has the support of the Hazeltine Corporation. In the circumstances the fight, which is already in progress, is certain to be a very stiff one. It is, in fact, the first serious wireless patent litigation which has taken place in Canada, and it may be taken as evidence of the fact that the Canadian radio trade is now well-established and considered to be worth fighting for.

The patents in litigation and their British equivalents are as follow:—

Canadian patent.		British equivalent.	
208,583	..	147,147	to Alexanderson.
244,847	..	147,148	to Langmuir.
174,690	..	—	to Hartley.
241,138	..	119,365	to Rice.

Measurements on RADIO-FREQUENCY AMPLIFIERS.

III.—The Input Impedance of an Amplifier.

By R. L. SMITH-ROSE, Ph.D., D.Sc., A.M.I.E.E., and H. A. THOMAS, M.Sc.

IN previous articles it has been explained that the amplification which can be obtained when a small E.M.F. is inserted in a tuned circuit is due to three factors:—

(*a*) The normal amplification due to the system of valves and coupling components adopted;

(*b*) The increase or reduction of the value of this amplification due to internal coupling effects in the amplifier;

(*c*) The increase or decrease of the overall amplification due to the retroactive effect of the amplifier directly upon the tuned circuit.

It is this last effect which will be considered in the present article.

Taking the simple case of a single valve connected across the tuning condenser it is obvious that there is an alternating current path between the grid and filament of this valve, and this path is in parallel with the tuning condenser.

Since there is a small capacity between the grid and filament and a very high resistance, we can represent the circuit as an impedance, and it is usual though not fundamentally necessary to represent this impedance as a condenser and a resistance in series.

Considering this case only, we observe that a current flows through this resistance and therefore develops power, which can be considered as the input power required to operate the amplifier looked upon as a relay.

Since this power is derived from the input tuned circuit, we have effectively increased its resistance. The amount by which the normal high-frequency resistance of the tuned circuit has been increased can easily be calculated if the input impedance is known. This means that the E.M.F., acting across the tuning condenser and operating the amplifier, is reduced when the shunt circuit is inserted.

However, the case of a single valve is not so simple as this. There is a capacity between the grid and the anode, a resistance of much lower value between the anode and filament, namely, that given by the anode voltage divided by the anode current, and a capacity between the anode and filament.

If we consider the case of a single valve with an external anode resistance R, as shown in Fig. 1 (*a*), we can consider the valve circuits as the network shown in Fig. 1 (*b*). The grid-filament capacity is C_{FG}, the grid-anode capacity is C_{GA}, and the anode-filament capacity is C_{AF}. The grid-filament resistance is R_{FG}, and the anode-filament resistance is R_{AF}. The whole of the complicated circuit to the right of GF in the figure is a shunt network to the tuned circuit, and the output E.M.F. which is applied to the next stage is taken across R. It is therefore apparent that the valve capacities and resistances will form part of the effective added impedance. A closer consideration of the case, however, shows that the load in the anode circuit plays a very important part in the value of the impedance. For example, Fig. 2 shows the values of the effective resistance and capacity of a particular valve, as calculated by Miller[1] for a wavelength of 2,000 metres, and with various values of external resistance inserted in the anode circuit. These curves show that the effective

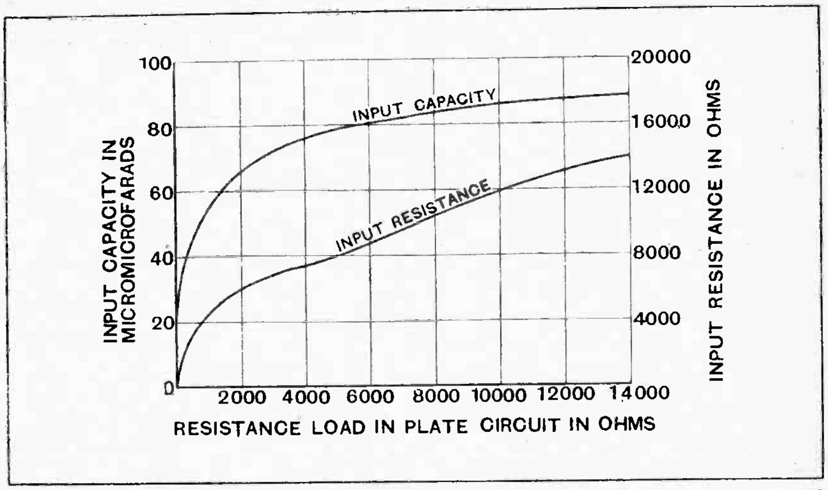


Fig. 2.—Curves showing dependence of input capacity and resistance on value of resistance in anode circuit.

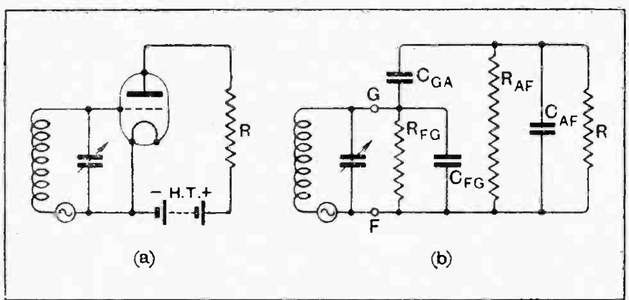


Fig. 1.—Single valve amplifier and equivalent circuit.

[1] J. M. Miller: "Dependence of the Input Impedance of a Three-electrode Vacuum Tube upon the Load in the Plate Circuit." *Scientific Papers of the Bureau of Standards*, No. 351.

Measurements on Radio-Frequency Amplifiers.—
resistance and capacity increase as the anode resistance is increased.

If we insert an inductance in place of the resistance in the same anode circuit we obtain an interesting result, viz., that although the capacity component is still positive, the resistance component for most cases is negative. Curves given by Miller for a wavelength of 940 metres

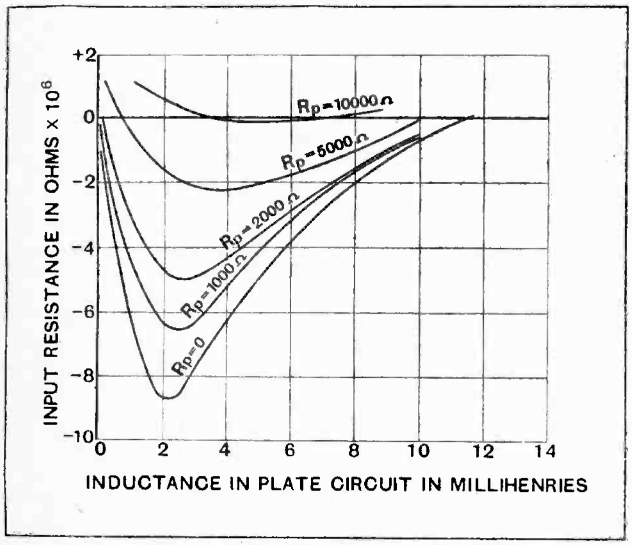


Fig. 3.—Effect of inductance in the anode circuit on the input resistance.

and using the same valve as before show this effect very well.

In Fig. 3 the input resistance is plotted against the anode inductance for various values of the resistance of this inductance, and the effect is seen to be most marked with a low anode circuit resistance.

Fig. 4 gives the effective capacity component. The variations are here not so marked.

When the negative resistance reaches a certain value,

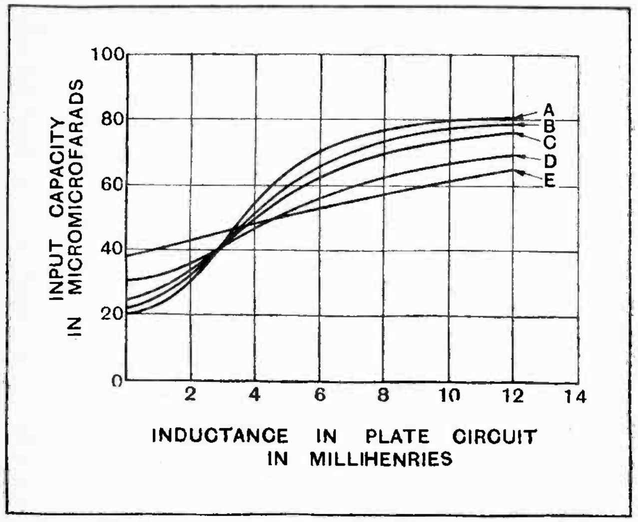


Fig. 4.—Variation of input capacity for different values of inductance in the anode circuit. Resistance values of the inductance windings are as follow: A, 0; B, 1,000 ohms; C, 2,000 ohms; D, 5,000 ohms; E, 10,000 ohms.

the power given back by the anode circuit may be just equal to the power taken from the input circuit; in other words, the effective resistance of the tuned input circuit may become zero and oscillation will begin.

There is therefore a maximum value of inductance which can be inserted in the anode circuit to give stability. This value will be dependent upon the valve constants and will be small for high frequencies.

It is thus seen that even when the grid is negative with respect to the filament the load introduced by the valve may be considerable.

The load is a positive one for a resistance or resistance and capacity combination inserted in the anode circuit, but when the load in the anode circuit is inductive, the input impedance may be negative, and if this inserted negative resistance is sufficient to neutralise the natural resistance of the actual input circuit, oscillations may occur due to the coupling through the tube itself.

Measurement of Input Impedence.

The results given previously are theoretical, and it remains now for us to consider a suitable method of measuring the actual input impedance of the amplifier. If the high-frequency resistance of the tuned circuit is determined with and without the amplifier shunt, it is

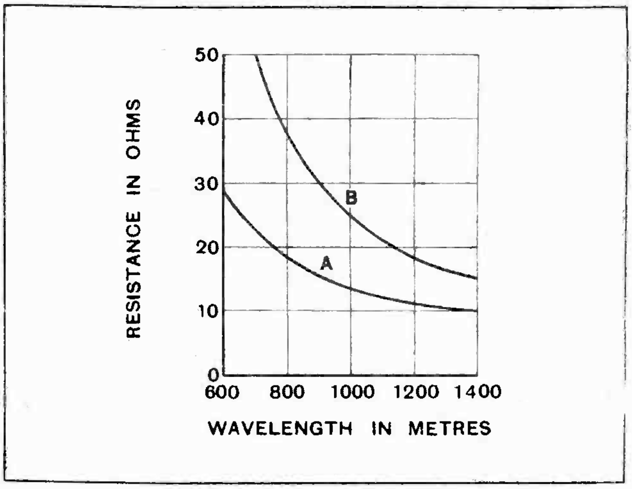


Fig. 5.—Effective resistance of input circuit; A, isolated; B, connected to the amplifier.

easily possible to determine the effective value of the shunt circuit.

The usual method of determining this resistance consists of inserting a known non-inductive resistance into the circuit and determining the fall of current in that circuit, or the fall in voltage across the circuit. If the voltage across the condenser is V before the insertion and V_R when a resistance R is inserted, we have obviously

$$\frac{V}{V_R} = \frac{R_e + R}{R_e}$$

where R_e is the effective circuit resistance.

Inconsistent results were obtained with this method due to the fact that an alteration of the tuned circuit resistance produces changes in the amount of the retroactive effect due to the amplifier; in other words, the load is not constant for both cases. It was found necessary to

Measurements on Radio-frequency Amplifiers.—
maintain the tuning circuit conditions constant while any determination of input impedance was being made.

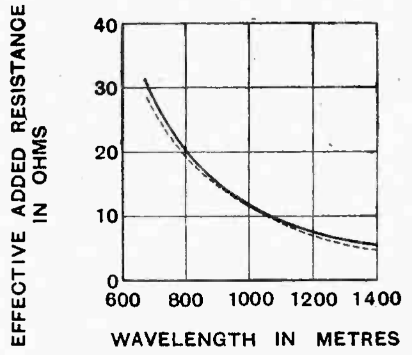


Fig. 6.—Added load on input circuit due to first valve of amplifier. The full-line curve is plotted from experimental data, the dotted curve representing calculated values.

The method adopted consists in obtaining the resonance curve of the circuit, from which the decrement and high-frequency resistance can easily be obtained. This resonance curve can be obtained in two ways :—

(*a*) By injecting a constant frequency E.M.F. and varying the tuning condenser of the input circuit.

(*b*) By keeping the tuned circuit and amplifier constant and varying the input frequency.

The latter method is preferable, since the amplifier remains constant. The input leads into the screened room which were used previously for direct injection are connected to a small coil which is placed several feet away from the tuned input circuit. Sufficient E.M.F. is in-

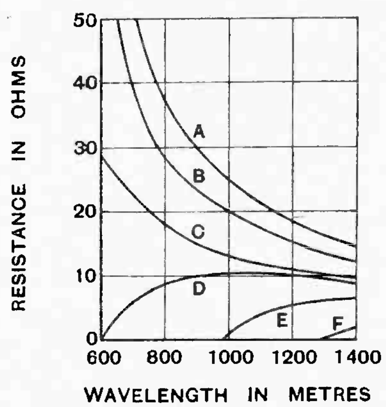


Fig. 7.—Variation of input circuit resistance for different reaction settings. A, no reaction ; B, reaction coupling set at 0 ; C, input circuit only ; D, reaction set at 20 ; E, reaction at 30 ; F, reaction at 50

duced into the input circuit by this means to give a telephone signal of average strength. The output current in the rectifier is measured by the vibration galvanometer as before, and the frequency of the oscillator is slightly varied on either side of resonance, so that a resonance curve can be obtained. The rectifier was found to obey a square law, and so the galvanometer scale was converted to a square law, thus making its readings proportional to the injected E.M.F., and, therefore, to the current in the tuned circuit.

Resonance curves could be obtained with ease by this method, and the resistance could be determined with an accuracy of 1 per cent.

It was now necessary to find the normal resistance of

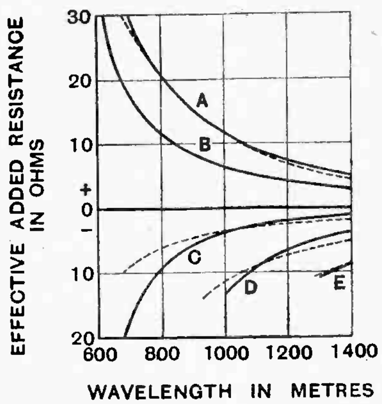


Fig. 8.—Effective added resistance due to amplifier under various reaction conditions. Calculated curves are indicated by dotted lines. A, no reaction ; B, reaction at 0 ; C, reaction at 20 ; D, reaction at 30 ; E, reaction at 50.

the coil without the amplifier. For this purpose the inserted resistance method is applicable. A power oscillator was used to induce a current in the tuned circuit, this current being measured by a thermal ammeter. When a non-inductive resistance was inserted, the current was less, and from the two readings the resistance can be obtained.

Various values of the tuned circuit inductance were used, but only one case will be given to serve as an illustration of the method.

The amplifier used for these tests consisted of a rectifier followed by two audio - frequency transformer - coupled stages. Dull-emitter R type valves were used.

Fig. 5 gives the effective resistance of the tuned circuit with and without the amplifier.

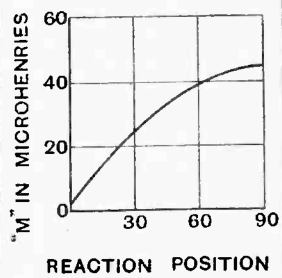


Fig. 9.—Experimental determination of mutual inductance, M, of reaction coil and input circuit coil.

If we now consider the extra added resistance due to the amplifier we shall obtain the characteristic shown in Fig. 6, and we see that a positive load is always introduced by the presence of the amplifier, the value of this load varying with the frequency.

The theory of this added load has been examined for the particular case, and the dotted curve shown in Fig. 6 gives the theoretical value. The close agreement shows

Measurements on Radio-frequency Amplifiers.—
how well the actual performance agrees with the calculated performance. The value of the shunt resistance was found to be 87,600 ohms, and the effective capacity was 9 micromicrofarads.

The anode circuit of the rectifier contained a reaction coil. Now, if this coil be coupled with the tuning inductance an E.M.F. is induced into the original circuit, which E.M.F. may augment the original, thus giving a bigger current in the tuned circuit. This is equivalent to saying that the effect of reaction is to reduce the circuit resistance. The particular reaction coil used was fixed to a spindle and dial, which was graduated in divisions from 0 to 90, the latter value corresponding to the maximum coupling.

The resistance of the same tuning coil when the reaction coil was inserted at various settings is shown in Fig. 7.

It is seen that with the reaction dial set at 30, the resistance is zero below 1,000 metres, and with it set at 50 the resistance is zero below 1,300 metres. This means that the amplifier is unstable and will oscillate.

If we now subtract the coil resistance, we obtain Fig. 8, in which the effective added load is shown plotted against the wavelength. Several important results are at once noticed. The effective added resistance may be positive or negative, but does not change sign with variation of frequency. A particular setting of the reaction coil can be found where the effective added resistance is zero. For this particular case, also, the added resistance will be zero at all wavelengths.

If the reaction is so adjusted that the negative resistance is nearly equal to the coil resistance at a particular wavelength, thus making the set just stable, a diminution of the tuning capacity will produce oscillation, whereas if this capacity is increased in value, the set becomes more stable. The actual mutual inductance was measured and the theoretical results obtained are shown graphically by the dotted lines in Fig. 8.

The agreement is here fairly good, and shows that the behaviour is comparatively consistent with theoretical predictions. The maximum coupling of the reaction coil to the primary coil is only 32 per cent. when the dial setting is 90.

The actual value of this mutual inductance is shown in Fig. 9 for the different settings.

In conclusion, it has been shown that the effect of reaction and the effective added load due to the amplifier can be predicted for this case. However, insufficient evidence is available to enable us to apply these results to other cases. The general theory, of course, is applicable, but detailed information has not yet been obtained.

MECHANICAL PROPERTIES OF QUARTZ CRYSTALS.

DR. A. MEISSNER has recently discovered a remarkable property of quartz crystal resonators which he has demonstrated before the "Kongress der Naturforsche und Rezte" in Germany.

It appears that a strong current of air emanates from the sides of a quartz crystal when it is placed between electrodes and excited by resonance from a powerful radio-frequency oscillator. In some circumstances the air current is sufficiently strong to blow out a small candle or set in motion a small fan.

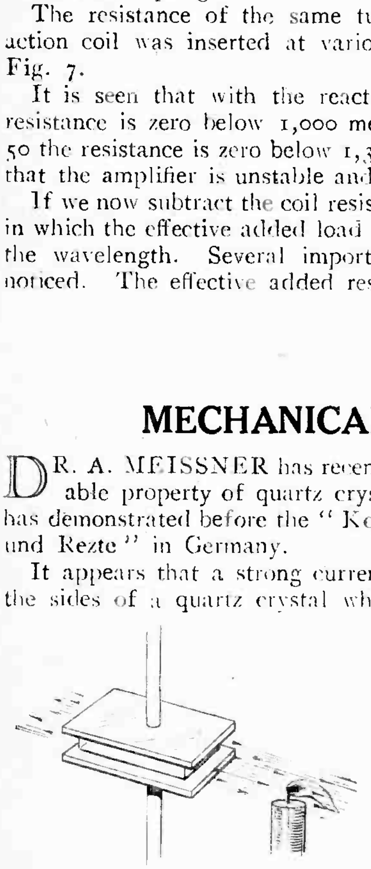


Fig. 1.—The air current generated by an oscillating quartz crystal when strongly excited is sufficient to extinguish a candle flame.

Another effect which must be ascribed to the same cause is the rapid rotation of the crystal between the electrodes when the applied E.M.F. is sufficiently high. This rotary motion takes place when the crystal is lightly touched at one corner to overcome the initial contact friction with the lower electrode, and the speed of rotation increases until finally the crystal jumps out of the gap between the electrodes, often falling more than a foot away from the apparatus.

The rotation is due to forces of reaction, acting on the surfaces producing the air streams. Only part of each side of the crystal (as shown in Fig. 3) is active in producing an air current, and as the reactive forces operate on diagonally opposite corners, a rotary motion is imparted. Small air currents are produced by the other pair of sides, but their effect is negligible.

So far, a satisfactory explanation of the effect has not been forthcoming, but it is thought that it may be in some way due to the fact that the velocities of air particles near the surface of the crystal are far higher than the velocity of sound in air. It would also appear that there is a direct connection between the "blowing" phenomenon and the optical properties of the crystal. Thus, when the crystal exhibits right-hand rotation of polarised light (dextro-rotatory), the mechanical rotation is in a clockwise direction, and when the crystal is laevo-rotatory, the motion is anti-clockwise.

H. K.

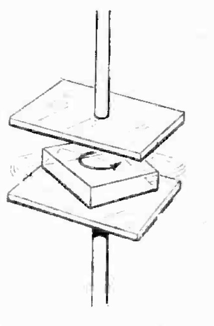


Fig. 2.—Reactive forces brought into play in producing air currents cause the crystal to revolve inside the condenser gap.

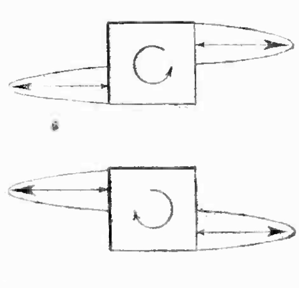
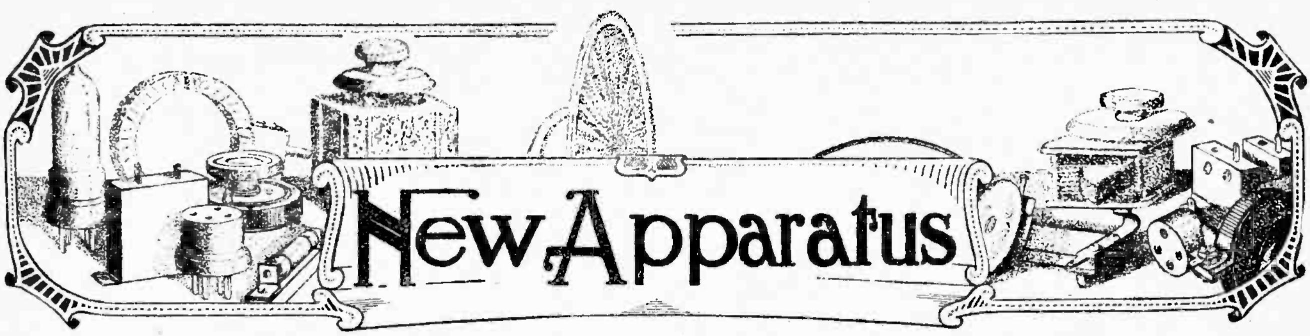


Fig. 3.—The distribution of the areas from which the air currents originate is related to the optical properties of the crystal.

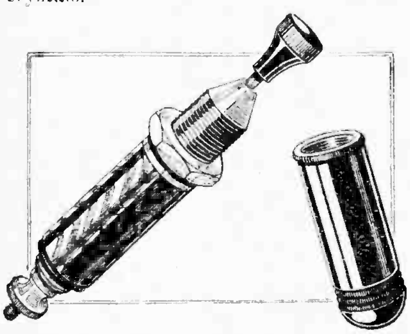


A Review of the Latest Products of the Manufacturers.

WELL-FINISHED DETECTOR.

A crystal detector of the enclosed type is manufactured by the Jewel Pen Co., Ltd., 21-22, Great Sutton Street, London, E.C.1.

It consists of a small ebonite barrel with metal end caps, a screw-on cap being provided to protect the plunger used for adjusting the contacts between the crystals.



Panel mounting Perikon detector with removable cap.

As regards workmanship this detector is exceedingly well finished, the surface of the ebonite parts resembling in appearance, in respect of the high-grade polishing and knurling, the barrel of an ebonite fountain pen. The metal parts are well machined and have a nickel-plated finish.

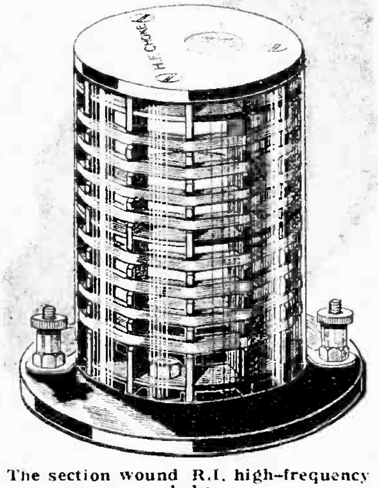
The crystal contact is of the Perikon type, the pressure between the crystals being adjustable, while a sensitive point is easily found by pulling the crystals out of contact against the spring and rotating the adjusting knob. This crystal detector can either be mounted between clips or inserted through a hole in the instrument panel. The screw-on cover protects the adjusting knob and prevents the setting being tampered with when once the crystal has been properly adjusted.

o o o o

THE R.I. H.F. CHOKE.

The winding of a high-frequency choke coil must possess a minimum of self-capacity, and at the same time with a low value of self-capacity the inductance of the coil must be sufficiently high to permit of its use for reception on 1,600 metres as well as on the normal broadcast band and short wavelengths. A sectioned winding is undoubtedly the best when a high value of inductance is the aim, a method which is adopted in the high-frequency choke of Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, London, W.C.1.

No more solid dielectric material than is absolutely essential is used in the construction of the frame which supports the sections. In all there are eight sections nearly 2 in. in diameter, rigidly supported on twelve fibre strips suitably stiffened in the middle and at the ends to prevent bending. The choke coil is designed for baseboard mounting and is secured to a thin, well-finished ebonite base. Screws, nuts and terminals are nickel-plated, the ebonite has a good matt surface, and the top plate is engraved, giving this component the appearance of a high-grade piece of apparatus.



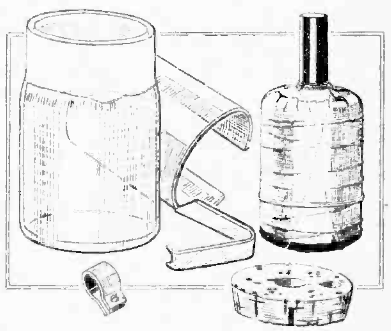
The section wound R.I. high-frequency choke.

o o o o

WET H.T. BATTERY.

Considerable interest is being shown in the use of small, wet Leclanché cells for the making up of high-tension batteries. The principal advantage is that the cells can be repeatedly recharged, whilst a battery of these cells costs very little more than the ordinary dry cell battery.

A reliable type of cell is obtainable from R. S. Smetzer, 6, Hauberk Road, Lavender Sweep, London, S.W.11. The carbon rod is surrounded with the depolarising compound which is contained in a linen wrapper, and is similar in construction to the positive element used in the construction of sack Leclanché cells. The base of the positive element is impregnated with wax so as to permit of the carbon rod reaching to the bottom of the cell and at the same time providing for the electrolytic action to take place through the depolariser. A circular zinc is used with an extension piece for making the terminal, which is preferable to soldering a connecting wire on to the top of the cylinder. The small jars are fitted with waxed corks, which prevent both evaporation and "creeping," whilst the tops of the jars are treated with wax both inside and out. No statement can be made as to the actual working life of a cell of this type, but it is probably at least equal to that in the small type cell used in dry H.T. batteries, and when exhausted can be reconditioned, of course, at a small cost.



Small type Leclanché cell for the making up of a wet high-tension battery.

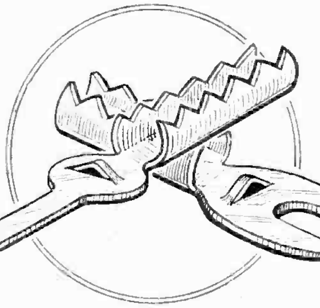
o o o o

SPADE AND TAG CONNECTORS.

In the connecting up of receiving sets the large number of leads which are required are invariably left with the ends frayed and the strands of the flexible conductor twisted together.

The amateur is strongly recommended to make use of some simple form of tag which can quickly with the aid of pliers be clamped on to the ends of the wire.

By this means much more reliable connection is made with the terminals, the danger of frayed strands in the conductor causing short circuits is avoided, and the insulating covering is neatly held in position.



Useful connecting tags which can easily be clamped on to the ends of flexible wires.

Suitable tags specially intended for clamping to the end of flexible wires are obtainable from Sydney Jones & Co. (London), Ltd., Dudley House, 28, Endell Street, London, W.C.2. These connectors are stamped from moderately thick brass and are given a nickel-plated finish. Two types are available, one for inserting under the screw-down type of terminal, and the other as a pin-connector for use as a telephone tag or for holding down under a terminal in which a hole is made through the spindle.

TRADE NOTES.

Valve-making Window Display.

A striking demonstration of valves in the making is now being carried out daily in the showroom windows of the Edison Swan Electric Co., Ltd., at Queen Victoria Street, London. A young lady is seen operating an electrically driven valve-stem-making machine, the valves being of the well-known R.C.2 type. The display not unnaturally attracts large crowds all day long.

oooo

Cossor's "Radio Mail."

The current number of the *Radio Mail*, the bright little monthly published by Messrs. A. C. Cossor, Ltd., of Highbury Grove, London, N.5, contains notes on resistance capacity coupling and reaction control, together with a graphic account of the now famous "valve dropping test."

oooo

G.E.C. Valve Research.

We have received from the General Electric Co., Ltd., of Magnet House, Kingsway, W.C.2, an illuminating account of the Company's many and varied activities during 1926, particularly in the direction of research. Among the subjects coming under review were metallurgy, refractories, glass, refrigerating machines, and electrical cleaners.

It is stated that the principal development in thermionic valve research was in the direction of increased size. In the water-cooled anode types oscillators are now made up to 15 kW input, and modulators to 10 kW. dead loss. A rectifier has been constructed working up to 25,000 volts with a maximum plate current of 8 amperes. The capacity of dull emitting transmitting valves has been increased from 75 to 450 watts input and indirectly heated cathode receiving valves have been developed for working off A.C. mains.

oooo

The Bowyer-Lowe Short-wave Set.

In an attractive brochure entitled "Round the Earth on Short Waves." Messrs. The Bowyer-Lowe Co., Ltd., describe the construction of a short-wave receiver specially designed for the 20-200 metres waveband. Photographs, diagrams, and a blue print simplify the task of the constructor. The brochure is obtainable, price 1s., from the company's works at Letchworth, Herts.

oooo

Useful "Exide" Sheet.

Messrs. The Chloride Electrical Storage Co., Ltd., of Clifton Junction, near Manchester, have just issued a useful sheet (Form No. 1,015), suitable for mounting on a wall, giving full details regarding the charging and maintenance of every type of Exide accumulator. The information refers to conditions in temperate, not tropical, climates.

oooo

"Varta" Monoblock Batteries.

Messrs. Afa Accumulators, Ltd., of 9a, Diana Place, Euston Road, London, N.W.1, are now placing a distinctive blue and gold label on each of their well-known "Varta" Monoblock accumulators, in order to avoid confusion with imitations of obscure Continental origin. Each label bears a description of the particular type of battery, together with brief details regarding charging, etc.

oooo

Tribute to Dubilier Condenser.

Messrs. The Dubilier Condenser Co. (1925), Ltd., of Ducon Works, Victoria Road, North Acton, London, W.3, have just received news to the effect that Commander B. L. Gottwaldt, who was in charge of the wireless apparatus in the airship "Norge" which flew over the North Pole to Alaska last year, used a wavemeter fitted with Dubilier fixed and variable condensers. The condensers were taken from stock in Norway.

oooo

Lectures on Osram Valves.

A new series of lectures entitled: "The Development and Use of Osram Valves for Perfect Broadcast Reception" have been prepared by the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2. Mr F. E. Henderson, A.M.I.E.E., the lecturer, will address members of the Stretton (Manchester) Radio Society to-morrow (Thursday), and students of the Leicester Technical Schools on the day following.

oooo

Building Battery Eliminators.

"How to Build Your Own High Tension Eliminator for A.C. or D.C." is the title of a new 20-page illustrated booklet issued by Messrs. The Telegraph Condenser Co., Ltd., of Wales Farm Road, North Acton, London, W.3. Details are given for the construction of a filter unit for D.C. mains, and of a rectifying unit for A.C., and the book includes some useful pages on the theoretical side of the subject. Copies of the booklet can be obtained direct from the Company, price 3d. in stamps to cover postage and part cost of production.

oooo

Non-Fraying Insulation Tape.

The amateur on the look out for an insulating tape which will not fray will find his requirements met by the Bulldog Brand Non-Fraying Insulating Tape manufactured by the Pomona Rubber Co., Medlock Works, London Road, Manchester, from whom we have received a descriptive leaflet.

oooo

A New H.F. Choke.

A new component produced by Messrs. L. McMichael, Ltd., of Wrexham Road, Slough, Bucks, is the "M.H." H.F. Choke (price 9s.), the most important feature of which is its low self capacity. The choke has a slotted barrel former similar to that in the well-known "M.H." H.F. transformer, but the ends have been coned, giving a gradual reduction of diameter, thus providing the ends with an extremely low self-capacity. The choke can be mounted either vertically on its base, or (by removing the base) direct on an existing terminal point.

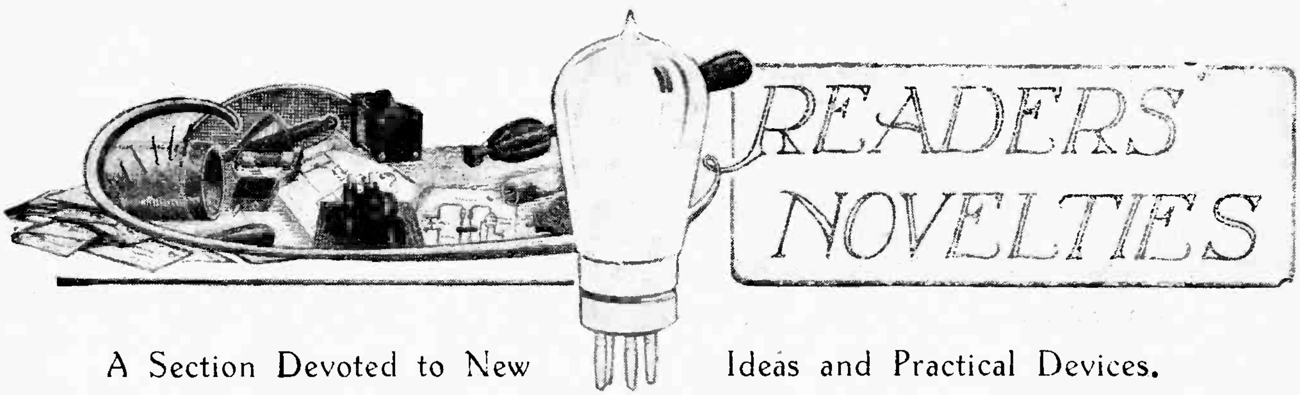
SHORT-WAVE MARINE WIRELESS EQUIPMENT.

At the request of the Cunard Steamship Company a complete short-wave transmitter and receiver were installed in the liner Carinthia, which is at present on a round-the-world pleasure cruise from New York.

The apparatus has been specially designed for a wave range of 25 to 50 metres, and has been constructed and installed by Messrs. Siemens Brothers & Co., Ltd.

Through the co-operation of the British Post Office, arrangements were made for traffic to be worked through their Research Station at Dollis Hill, and the Radio Corporation of America also arranged for messages to be transmitted from and received at their stations at New York and San Francisco. It may be mentioned that during the Christmas season the Carinthia despatched 700 Christmas greetings by wireless direct to the Radio Corporation of America's stations when the vessel was approaching New Zealand at an average distance of about 10,000 miles. Also while off Cape Leeuwin, Australia, communication was established with the Radio Corporation starting at New Brunswick, U.S.A., a distance of nearly 12,500 miles. This constitutes a record for commercial wireless between ship and shore.

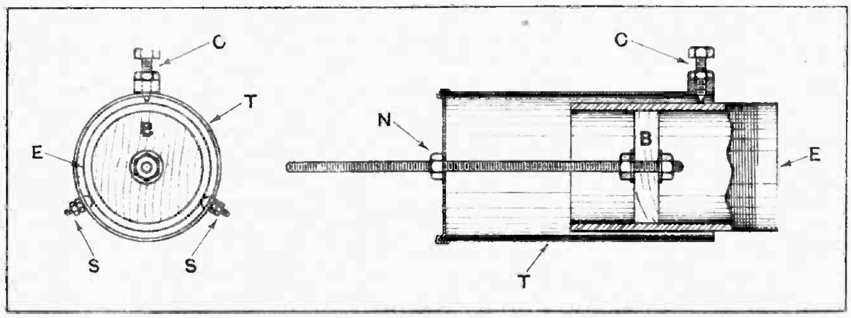
It is of interest to note that the S.S. Carinthia is the first British vessel to handle commercial messages on short waves (i.e., waves under 100 metres) with a British Post Office Station. It is anticipated that the results obtained by the installation on the S.S. Carinthia will add considerably to our knowledge of the possibilities of commercial traffic on waves below 100 metres for mobile services.



A Section Devoted to New Ideas and Practical Devices.

SCREWCUTTING EBONITE TUBE.

The original method of preparing spacing strips for "Everyman's" transformers consisted in cutting a thread of 32 per inch on the outside of an ebonite tube 2in. to 3in. in diameter and dividing the tube into strips. Generally speaking, a screwcutting lathe is required, but an alternative method is possible and is illustrated in the diagram.



Cutting thread on ebonite tube for "Everyman's" spacers

A cocoa tin, T, is fitted with a nut, N, soldered to the bottom in a central position. To the end of a length of screwed rod passing through the nut is bolted a wooden disc, B, which is a driving fit inside the ebonite tube, E. The thread is formed by a pointed cutter, C, which is adjustable, and the tube is kept central by round head supporting screws, S, fitted slightly out of line with the cutter so as not to damage the thread. The ebonite tube is rotated by hand at the end, E, the screwed rod merely acting as a guide.—H. W. M.

oooo

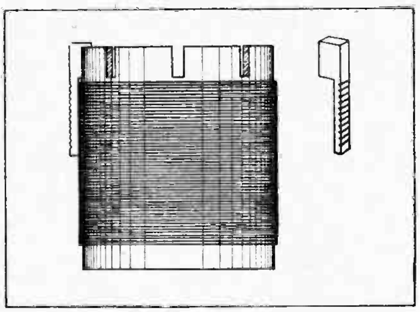
WAVEMETER MODIFICATION.

Neon lamp wavemeters are frequently used by amateurs to check the wavelength of their transmitters, an ordinary domestic neon lamp being used to indicate resonance when plenty of power is available. The lamp is mounted on the panel of the instrument in a standard batten holder from which it can be easily removed and replaced by a plug adaptor. If a crystal detector and terminals for phones are mounted on the adaptor and connected up in series with the plug sockets the wavemeter is quickly converted into a crystal receiver, with which it is possible to judge the quality of telephony modulation during transmission.—J. C. B.

oooo

"EVERYMAN'S" SPACERS.

If difficulty is experienced in equally spacing the ebonite strips used to support the primary winding of the transformers in the "Everyman's" series of receivers the method shown in the sketch will be found helpful.



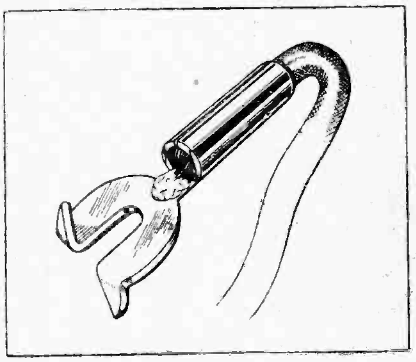
Simple method of fixing spacing strips for the primary winding of an H.F. transformer.

The ebonite strips are prepared with a step at one end twice the normal depth of the spacing strip. This step engages in slots cut at equal intervals in the edge of the Paxolin tube. Great care should be exercised in cutting these slots so that they exactly fit the ebonite spacers and are parallel to the axis of the coil, otherwise the object of the device is defeated.—E. T.

oooo

SPADE TERMINAL HINT.

Spade terminals frequently work loose under the influence of strains on the wire, and may cause serious damage, should they be L.T. leads, by coming in contact with any part of the H.T. battery. A very simple method of guarding against this contingency is shown in the sketch. It consists simply in turning over the ends of the spade in opposite directions with a pair of pliers.—A. F. S.



Safeguarding spade terminal connections.

Amateur International Prefixes.

With reference to the letter from the Postmaster-General which we published in last week's issue, we have received a further communication on the subject of the use of prefixes in Great Britain and Ireland, which, being of interest to our readers, we give below :—

"I am directed by the Postmaster-General to acknowledge the receipt of your letter of January 31st, and to thank you for the action you propose to take in the matter (the publication of the previous letter). He has agreed to the use of the prefixes GI and GW to denote stations in Northern Ireland and the Irish Free State respectively, but the use of the prefix GC has not been authorised.

"In no circumstances can an international prefix properly be used in connection with stations which are authorised to use sending apparatus with artificial aerial only, that is, those whose call signals consist of a figure followed by three letters.

"I am, Sir,
"Your obedient servant,
"(Signed) W. E. WESTON,
"For the Secretary."

o o o o

The letter from Mr. A. M. Houston-Fergus, which we published on page 122 of our issue of January 26th, has brought in some interesting correspondence on the subject of the use of "DE" and "CQ" by British transmitters, from which we give the following extract, with the writer's permission :—

"Suppose I call you up when you are bothered with atmospherics.

"Under G.P.O. practice you would get :—

G 2ZC G 2ZC G 2ZC DE G 2QY G 2QY G 2QY,

which can be sorted out, and, if you take it as 2QYG, one or both of us wants some lessons in Morse.

"What would happen with American calling is :—

2ZC 2ZC 2ZC UG 2QY 2QY 2QY,

and now who is being called?

"You see, it does not matter whether the single 'DE' gets through at all, because everybody expects it on the British system, and the important key letters are repeated three times each. Whereas by the American system, if an X coincides with the single intermediate, you have to wait for the whole call to be repeated.

"Then about CQ calls. To a commercial operator, these connote: 'My professional honour is at stake, because I have a message which I can't deliver by normal route, please help me out.' Why should the amateurs fill the ether with these mild SOS calls, when their traffic is better described by 'TEST,' meaning 'I want further co-operation in my experiments, please help me.'

"The trouble is that the U stations are numerically preponderant, and, being licensed for traffic, they copy commercial procedure very closely. You know how jealously the G.P.O. regard their message monopoly, and I do not think it would be tactful for us to press for a change, when TEST expresses our activities better, and, incidentally, takes less time to send than CQ."

We Britishers have the reputation of being a slow-going nation, but there is usually some good reason why sudden changes should not be made without considering every aspect of the case. Americans, on the other hand, in their zeal for reform, are sometimes too precipitous in their action.

o o o o

General Notes.

With reference to the note in our issue of February 2nd of Mr. Lawler's successful interchange of messages with Iceland, several correspondents claim to have forestalled him.

Mr. H. J. Powditch, who is operating the station G 5VL at Porth, St. Columb Minor, tells us that he was in touch with IC AG1 on November 25th, 1926, and communication was maintained for some time until AG1's valve burnt out. He also states that the Icelandic station is again transmitting, and that he will be pleased to forward any reports to him from stations who have not his address.

Mr. E. G. Ingram (G 6IZ), Aberdeen, states that Mr. G. Gore (G 5DA), Berwick-on-Tweed, worked with BG1 in Reykjavik in 1925, but does not give us the exact date.

Mr. H. Hiley, G 2IH, also worked the same station for over an hour at 1.10 a.m. B.S.T. on June 26th, 1925, using an input of about 25 watts to a T.15 valve.

o o o o

Mr. A. J. Baker (G 6QH), 23, Third Avenue, Bush Hill Park, Enfield, writes that on February 2nd he was in communication for an hour with AI DCR, the well-known station operated by Mr. R. J. Drudge-Coates at Rawalpindi. He was using an input of six watts from a D.C. hand generator to a D.E.4 valve. On January 29th, using the same power, he exchanged signals with U 3PF, Mr. W. P. Brown, at Manoa, Pennsylvania, who reported the signals to be very steady D.C.

o o o o

Time Signals.

Now that the B.B.C. has altered the time for transmitting the six dot seconds from 10.0 p.m. to 6.30 p.m., there must be many listeners who are then journeying homewards after their day's work, and, in consequence, are unable to set their watches to the exact Greenwich time. We would remind these that the Eiffel Tower sends out the new international time signals from 10.26 to 10.30 p.m., followed by the rhythmic or vernier signals from 10.31 to 10.36 p.m.

The daily schedule of French time signals is :—

Bordeaux, LY, on 18,900 metres, C.W., and Issy, OCDJ, on 32 metres, C.W., simultaneously.

0756—0800	G.M.T.	International.
0801—0806	G.M.T.	Rhythmic.
1956—2000	G.M.T.	International.
2001—2006	G.M.T.	Rhythmic.

Eiffel Tower, FL, on 2,650 metres, spark.

0926—0930	G.M.T.	International.
0931—0936	G.M.T.	Rhythmic.
2226—2230	G.M.T.	International.
2231—2236	G.M.T.	Rhythmic.

For the benefit of those unacquainted with the time-signal codes we would state briefly that the International system, apart from preparation and closing signals, is as follows :—

1st Minute.—The letter "X" sent every five seconds, followed by 6 dots, of which the last marks the end of the minute.

2nd Minute.—The letter "N," followed by 6 dots.

3rd Minute.—The letter "G," followed by 6 dots, the final dot being exactly at the hour or half-hour, as the case may be.

Rhythmic or vernier time signals consist of a series of 306 signals transmitted in 300 seconds. Each minute begins with a dash, which is followed by 60 dots, the final signal at the end of the 5th minute being a dash.

o o o o

New Call-signs Allotted and Stations Identified.

G 5HR G. W. Henley, 526, Wandsworth Road, Clapham, S.W.8.

G 6DR D. E. Scarr, Hollydene, Hailgate, Howden E. Yorks: transmits on 45 metres.

GI 5ZY T. Smith, Inverary, Whitehead, Belfast.

GW 15C W. Bryan Bates, Baltrasna, Ashbourne, Co. Meath, I.F.S.

GI 2BLQ H. Polley, 75, Clifton Road, Bangor, Co. Down, Northern Ireland.

Revised Regional Scheme—World's Biggest "S.B."—Caution in Plymouth—Transatlantic Relays—Developing the Announcer's Art—An Old-fashioned Hoax.

A Daventry Forecast.

There seems to be a distinct possibility that "Daventry Junior," the new experimental high-power station of the B.B.C., may be sending out actual programmes early this summer during broadcasting hours. Much will depend, of course, upon the success of the tests which have already been referred to in these columns. But in any case the formal opening of "Daventry Junior" as a fully fledged regional station will be delayed for a considerable period. November is a likely month for the ceremony.

oooo

The New Scheme.

Last week I was able to make reference to a revised regional scheme, the substance of which was laid before members of the Wireless Organisation Advisory Committee by the Chief Engineer at a Savoy Hill meeting on January 31st. It is understood that the older plan is superseded, provision being made for the erection of perhaps four "super" stations, each with a power of 50 kilowatts. "Daventry Junior" will be the first of these; where will the others be?

oooo

Placing the High-power Stations.

One of them will almost certainly be situated near, but not in, London; and in placing the others we may take it that the B.B.C. engineers will avoid thickly-populated areas in order to give town listeners every chance of picking up alternative programmes.

oooo

Sympathy.

The sympathies of all listeners will be with those unfortunate individuals who live under the aerial of a 50kW. station. Unless the science of selectivity is developed very considerably, these luckless people will scrape up very little of an "alternative" nature. But there will be consolation in the fact that the local station will be audible on anything that even looks like a wireless set. Sometimes, of course, their prayers for a local breakdown may be answered.

oooo

World's Biggest "S.B." Effort.

The speech of President Coolidge before Congress on Tuesday next, February 22nd, will be broadcast from no fewer than thirty-seven stations, so making the largest S.B. "chain" which has yet been undertaken in the United States, or in fact in any other country in the world. Approximately 25,000 miles of landlines will be used for this broadcast. KDKA, Pittsburg, and 2XAF, Schenectady will both transmit the speech on 63 metres and 32.79 metres respectively. The transmission will begin at 5.30 p.m. (G.M.T.).

oooo

FUTURE FEATURES.

Sunday, February 20th.

LONDON.—The Wireless Military Band.
BIRMINGHAM.—Classical Favourites.
CARDIFF.—Pontypool Town and District Silver Band.
MANCHESTER.—Song Recital by John Van Zyl (bass).

Monday, February 21st.

LONDON.—Musical Comedy Extracts and Variety.
ABERDEEN.—Old Favourites.
BELFAST.—Derry Soloists.

Tuesday, February 22nd.

BIRMINGHAM.—City of Birmingham Police Band.
BOURNEMOUTH.—Reminiscences of Opera.
MANCHESTER.—"Round Europe."
NEWCASTLE.—Light Instrumental and Vocal Concert.
GLASGOW.—Scottish Towns Series—Renfrew programme.

Wednesday, February 23rd.

LONDON.—R. A. Roberts in "Dick Turpin."
MANCHESTER.—An Afternoon with Samuel Pepys.
GLASGOW.—Handel Anniversary Programme.

Thursday, February 24th.

LONDON.—Regimental Feature with the Wireless Military Band.
BIRMINGHAM.—Schumann Programme.
CARDIFF.—"Spoiling the Broth," played by Station Radio Players.
ABERDEEN.—Scottish Concert.
BELFAST.—Symphony Concert.

Friday, February 25th.

LONDON.—"Orpheus," an opera by Gluck.
BOURNEMOUTH.—"Guy Wetherby's Dilemma," a comedy.
MANCHESTER.—"The Kreutzer Sonata"—Winifred Small and Maurice Cole.
BELFAST.—Claude de Ville, Pianoforte Recital Series.

Saturday, February 26th.

CARDIFF.—War Time Reminiscences.
NEWCASTLE.—A Nautical Concert.
BELFAST.—Mabel Constanduros (entertainer).

From a Local Paper.

"Moscow is not such a difficult station to get in Nottingham providing one has a receiver equal to the task."

I agree.

oooo

Captain Eckersley's Programme.

As one who was responsible for many of the early broadcast programmes, Captain Eckersley, chief engineer of the B.B.C., should know as much, perhaps, as any of the officials at Savoy Hill about programme building. On March 4th listeners will hear *his* programme. "Light, bright and varied, with a leaning towards the humorous," sums up the fare which he will provide. This programme was originally fixed for February 17th, but has had to be postponed.

oooo

To-morrow's National Concert.

Signor Bernardino Mollinari will conduct to-morrow's B.B.C. national concerts at the Albert Hall. The following is the full programme:—Concerto of the Seasons (Vivaldi, transcribed Molinari); Fifth Symphony, C Minor (Beethoven); Ballet Suite, "La Giara" (Alfredo Casella); "The Pines of Rome" (Respighi); Overture, "Sicilian Vespers" (Verdi).

oooo

The Appeal Which Didn't.

A display of caution on the part of the director of the Plymouth relay station brought about a piquant situation on Sunday, February 6th.

This was the occasion of the novel charity appeal made by Sir Gerald du Maurier on behalf of the Hampstead General Hospital. Sir Gerald, it will be remembered, couched his appeal in the form of an imaginary telephone conversation with the P.M.G. in which he requested, with all the urgency and excitement of a typical 'phone caller, that a certain sum of money should be forwarded to the hospital.

But the Plymouth station director, imagining that the S.B. lines had run amok in the telephone exchange, promptly switched off! Plymouth listeners are still wondering what all the fuss was about.

oooo

Transatlantic Relays.

It seems a pity that the B.B.C. cannot announce beforehand when an attempt is to be made to relay American broadcast programmes. Last week, when Keston's reception from 2 XAF of the Ten Eyck dance band, Albany, U.S.A., was relayed through all B.B.C. stations from 11.35 p.m. onwards, many listeners who had already switched off would probably have waited up for the fun if an announcement had been made earlier in the evening.

An official at Savoy Hill tells me that transatlantic relays are attempted only on Tuesdays. On these nights Keston is "on the prowl."

oooo

New Movement at Savoy Hill.

"Brighter announcing," "the living link," "the personal touch"—these are some of the inspiriting phrases now on the lips of the select at Savoy Hill. They explain, inadequately, the aim of a new movement which is being set afoot by one of the most popular personalities connected with broadcasting, Mr. Rex Palmer.

Briefly, the idea is to secure continuity of atmosphere in the evening's programme by strengthening the liaison between announcers and by introducing into the proceedings a note of unity such as is often missing at the present time.

Shattered Illusions.

Mr. Palmer points out that very often the announcer in, say, No. 2 studio has little idea, when his turn comes to take over the programme, what sort of artistic atmosphere has been built up by his predecessor in another studio. The result is that many listeners find the change of tone and manner somewhat shattering.

Steps are now being taken to ensure that every announcer can hear through the medium of headphones what is going on in any other studio. Thus when chamber music is to be followed by a horticultural talk in another studio, we shall be let down as lightly as possible!

oooo

Developing the Announcer's Art.

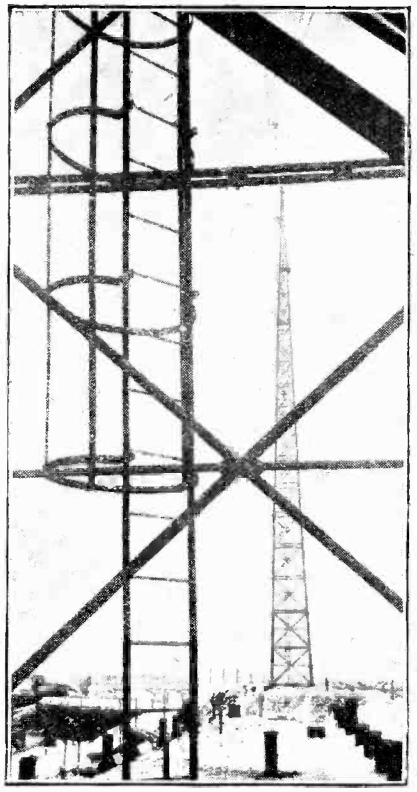
In the opinion of Mr. Palmer, the art of announcing is destined to receive much fuller recognition than it gets at present. Many listeners fail to realise how much responsibility falls on the shoulders of the announcer and to what extent a programme can be made or marred by the manner in which he discharges his duties. He must "keep things humming," maintain the correct time schedule, reassure nervous artistes, and carry out a hundred and one jobs over and above the simple duty of making himself agreeable to the listening public. Moreover, he must always be prepared for the most frightful emergencies!

oooo

A Revival.

Let us not be downcast. The graceful art of the broadcast hoax as expounded by Father Ronald Knox, is not dead.

On Wednesday, December 29th, the Johannesburg broadcasting station gulled a good many people. On that evening the Transvaal Radio Society, which was responsible for the programme from JB, announced that an attempt would be made to relay an American short-wave station. Soon after 8 p.m. listeners heard an announcement from the "International Electric Company's station WEXL, Albany, Noo York," followed by nasal back chat and a selection on a ukulele. Fading occurred at regular intervals, atmospherics poured in, and the proceedings were further enlivened by the howls of supposed local oscillators.



POLAND'S NEW STATION. This picture, which has just arrived from Warsaw, shows one of the completed masts of the new broadcasting station now under erection in the grounds of the Mokotov fortress, near the Polish capital.

TRANSMITTING ROOM AT WARSAW. This photograph shows a small portion of the transmitting gear at the new Warsaw station, which it is rumoured is capable of a power of 50 kilowatts. The provisional wavelength of the station is 1,050 metres.

oooo

Hoaxing the "Hams."

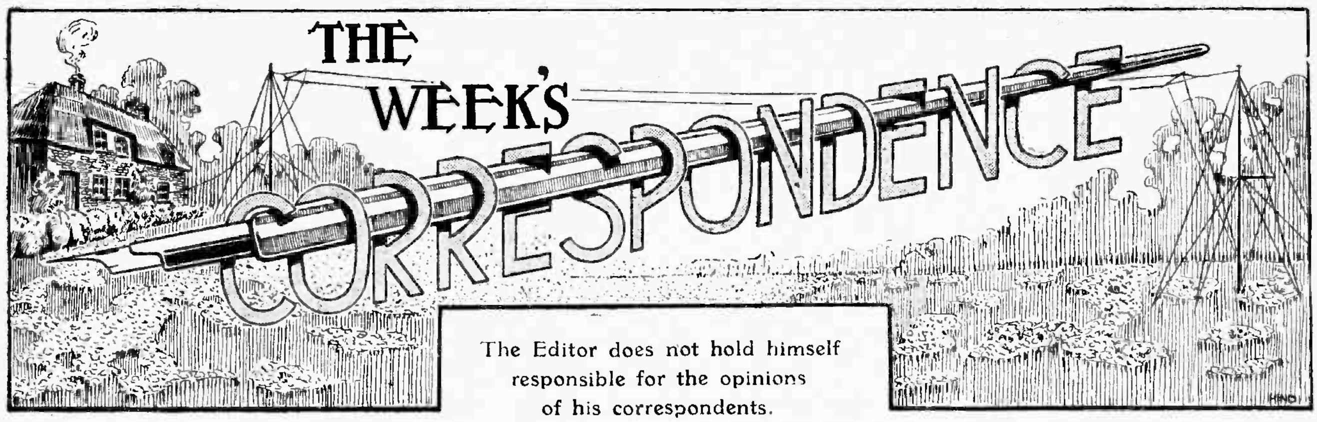
The fake was produced under the direction of Mr. Grant Dalton, Vice-President of the Transvaal Radio Society. "Fading" was accomplished by the judicious use of potentiometer, while howling and atmospherics were manufactured with ease by the use of a superheterodyne in the transmitting room. And lest some of the more sceptical "hams" should attempt to tune in the transmission direct from America Mr. Innes, of A3Y, picked up JB's programme and relayed it on short waves.

So let us not be downcast!

oooo

"J.B." in Trouble.

Johannesburg station, by the way, was threatened with extinction a fortnight ago through lack of funds. At the present moment it is being run by the Transvaal Radio Society.



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.

VALVE PRICES.

Sir,—Mr. John Bunting's letter, published in your issue of January 12th, interests me considerably, and I think perhaps your readers may like to know my experiences.

A year ago I was living in France, and, being none too satisfied with the performance of French wireless valves, I bought some of a very well-known other foreign make. Now the name of these valves is a world-wide byword, and their quality and longevity leave nothing to be desired. The general purpose valves cost 35 francs (5s. at that time) and the power valves (with a large anode and a "W" filament) cost 50 francs, or just over 7s. These were the ordinary retail prices, after paying a heavy import duty into France. Furthermore, the currency of their country of origin was at parity, so that the rate of exchange was not responsible for the low price.

Now I come to the worst part of my terrible story. These same valves are also made in England by agreement with their original makers, and I understand that sometimes the valves themselves are made abroad, but have their bases put on in England, and the finished article is sold as "British made." The only difference in the finished specimens of the two countries is that the foreign ones have brown bakelite bases, and the British ones black. At the time of which I speak the price in England of the general purpose valves was 16s. 6d. and of the power valves 22s. 6d. The present prices are 14s. and 18s. 6d., and the advertisements tell us that "these reductions bring the valves within the reach of all." Considering the foreign prices of 5s. and 7s., including $33\frac{1}{3}$ per cent. duty, it seems to me that our British friends prefer enormous profits, a "ring," and a comparatively small turnover to small profits and quick returns.

In addition to this, the British manufacturers have obtained an agreement from the foreign firm not to export the valves to the British market, and legal steps are taken to prevent their coming in through other foreign agents.

Surely this sort of policy only puts a brake on industry and denies both work and pleasure to thousands.

There seem to be very few British manufacturers who stand out against the "ring," but such as there are, I wish them all prosperity, and I hope they will receive the greatest possible support from British citizens.

Bedford. CHARLES G. N. POOLMAN.
January, 1927.

Sir,—I read with interest Mr. John Bunting's letter on the subject of the high price of power valves. This apparently applies only to the British market. Perhaps the "valve ring" can explain the "ramp" in a satisfactory manner to the interested public. Personally, I should like to know why a French or Dutch made power valve can be purchased for 11s. or 12s. while similar British articles cost 18s. 6d. British goods may be best, but the price is all out of proportion to the difference in quality, in this case at all events.

When will manufacturers understand that small turnover, big profit, is not economy or common sense? J. BAILEY.
London, S.W.17.
January, 1927.

Sir,—Mr. John Bunting's explanation of the high prices of British wireless valves may be correct, but there is another aspect of the case which requires some explanation from the valve manufacturers.

In an advertisement in the issue of the Belgian radio journal "Radio Science" dated February, 1926, there is a full-page advertisement of "Ediswan" valves. At the same time a similar advertisement appeared in the British radio Press.

The following table shows a comparison of prices in Belgium and England for the *same valves* :—

Type.	Price in Belgian francs.	Equivalent sterling prices.	Actual British prices.
A.R.	35	6s. 6d.	8s. 0d.
A.R.D.E.	42.50	8s. 0d.	16s. 6d.
A.R.06	42.50	8s. 0d.	16s. 6d.
P.V.5	65	12s. 2d.	18s. 6d.
P.V.6	65	12s. 2d.	22s. 6d.
P.V.8	65	12s. 2d.	22s. 6d.

Not only are the British prices higher, but there is a difference in price of 4s. between the P.V.5 and the P.V.6 and 8; all this, notwithstanding the cost of freight and duty into Belgium.

That was happening a year ago—are things any different to-day?

In the Australian "Wireless Weekly" for November, 1926, are shown prices of "Mullard" valves at an all-round price of 13s. 6d. each, whereas the prices in England for the same valves are 14s. and 18s. 6d. each respectively, according to type.

The Australian price in this instance has to include cost of freight.

It would appear that citizens of the British Isles who wish to support home industries have to pay dearly for the privilege of doing so. Is it to be wondered at that thousands of people in this country purchase valves of Continental make, which give as good a performance as the British makes, and which enable the purchasers to save a considerable sum?

This state of affairs will continue until the British valve manufacturers cease to make the British public pay high prices to enable them to sell at cheaper rates abroad.

Belvedere. WILLIAM A. MILLER.
January, 1927.

Sir,—In *The Wireless World* for January 12th a correspondent refers to the valve prices in this country being on the high side, with which I am in complete agreement.

It was rather significant that the raising of the price of the particular valve referred to practically coincided with the amalgamation of the two big manufacturing bodies.

Many of us would like to know how the standard six-volt valves can be sold in America at $2\frac{1}{2}$ dollars (about 10s.), and in this country anything from 14s. to 22s. 6d. is asked for them.

It cannot be cost of manufacture, seeing that the same firms in both countries must have access to the same machinery and patents. Perhaps the manufacturers can enlighten us.

Fraserburgh. A. BRUCE.
January, 1927.

Sir,—I have a copy of a New Zealand paper in which a half-page advertisement is devoted to valves of one of the largest English manufacturers. The 4-volt 0.06 valve sold in this country at 14s. 6d. is advertised at 7s., the 4-volt 0.1 power valve at 13s. against 18s. 6d. Doubtless your readers will draw their own conclusions from the above. Personally, I shall never pay "ring" prices as long as it is possible to obtain valves manufactured by first-class Continental firms at less than half English prices. W. F. BEAMISH.

Wallington.

January, 1927.

Sir,—I acknowledge receipt of your letter of the 14th January calling the attention of the B.R.V.M.A. to correspondence in your journal relating to the prices of British valves in this country.

The members of this Association are glad to have this opportunity of dispelling the erroneous impression apparently existing in the minds of some of your readers that it is the function of the B.R.V.M.A. to maintain the prices of valves in this country at an uneconomic level.

It is the aim of this association so to fix the prices of British valves as to give the public good value for money; to give the retail and wholesale trade a reasonable profit to ensure good service; provide for the cost of past and future research work on valve development and leave a fair margin of profit for the manufacturers.

Numerous factors have combined to enable the foreigner to "dump" valves on the British market at a price which enables him to retail at two-thirds of the British-made valve or even less. Some of these are:—

(1) Manufacturing costs abroad, which are far lower than in this country, due to lower taxes, lower rates, infinitely lower wages and much longer working hours.
(2) Rates of exchange.
(3) The large number of types called for by the huge variety of wireless sets sold in this country, for which foreign and imported valves do not cater.
(4) That British manufacturers have led the world in the development of the wireless valve—itself a British invention—and intend to continue to do so, which means great expenditure on research work, much of which can never be put to commercial use.
(5) The great superiority in the quality of British made valves and the vigorous tests to which they are subjected and which causes to be rejected all valves not up to the high standard set by the B.R.V.M.A.

That there is, in a few instances, a great disparity between prices for British valves in this country and those advertised overseas may be due to the sale of semi-obsolete or transit damaged goods.

The list prices ruling for British valves in Australia, New Zealand, South Africa, and other British Colonies are in some cases lower and in others higher than in this country. Where prices are lower, due to competition with countries with depreciated currency, manufacturers sacrifice profit to keep their factories over here employed.

I might perhaps be permitted to add that the last sentence of the letter from Mr. Beamish, in which he states that he would not think of buying an Association valve so long as he could buy a Continental valve of good make at cheaper price, does, of course, suggest one reason why the English manufacturers have not yet been able to reduce their prices to a low level.

It will be appreciated that if, at any rate for a time, all British users were prepared to pay the higher price for the British article, it would enable the manufacturers to manufacture on a larger basis and thus help to reduce the manufacturing costs. The benefits of such a reduction the British manufacturers have always shown themselves prepared to pass on to the consumer. The manufacturers here are, naturally, constantly watching the cost of production in its relation to turnover over any given period, and as soon as they find there has been such an increase in turnover as to reduce manufacturing costs, a reduction in price immediately follows.

Your readers will have noticed that this has been the practice during the past few years, and that the present selling prices of valves have been considerably reduced, such reduction being due to increased sales and the consequent reduction in manufacturing costs.

BRITISH RADIO VALVE MANUFACTURERS' ASSOC.

February 4th, 1927. H. HOWITT, Secretary.

WET BATTERIES FOR H.T. SUPPLY.

Sir,—In reply to "Sal Ammoniac's" letter in the February 2nd issue of *The Wireless World*, I enclose my own experience with wet Leclanché cells for H.T. batteries.

About eighteen months ago I made up two batteries of 40 cells each, using discarded cells from pocket batteries, with new zincs and connections soldered. At the time my set was a three-valve 1-v-1, and averaged about three hours' daily use. When new the voltage was 90, but dropped rapidly and remained about 55 for a period of about three months. Then a rapid deterioration set in, dropping to 40 volts, and was then discarded. This was before firms were supplying separate sacks for making up one's own battery. Since then I have tried new sacks (small size), with various strengths of sal-ammoniac, and also have tried the addition of zinc chloride. All cases, however, with small sacks, I find, lose at least 30 to 40 per cent. of full voltage, and if used freely become useless.

Last August I made up a 26-cell battery, using large sacks 1in. diameter, 1½in. high, celluloid containers and separators. The cells were of generous size, allowing plenty of electrolyte. The voltage of this battery stood at 22 volts to this last week, when it has become dead through corrosion. The set in use is at present the "Everyman's Four" since its publication; previously, a two-valve set, employing two power valves, was used. To sum up, in my opinion, the small size sacks are not large enough to do their work, but the large size, with plenty of electrolyte, would do so for a moderate output.

This type of battery is certainly "handy" for the man of limited means, being easy to make up, renew, and look after, and I should like to see a more reliable cell brought out.

London, S.W.18. F. J. EARP.

February 6th, 1927.

Sir,—Your correspondent "Sal Ammoniac," in the current issue of *The Wireless World*, expresses disappointment with the results obtained from a battery of small Leclanché cells used for H.T. supply. He admits that the battery is still functioning correctly after some months' service, but that the voltage has dropped remarkably in a few weeks.

It is evident that, in common with a large number of people, "Sal Ammoniac" does not realise that the small sack elements in these Leclanché cells become exhausted in due course, and require to be renewed just as much as the zinc and sal-ammoniac solution. To assume otherwise is quite wrong, but I am sure that a false impression has been created, principally by the advertisements of certain suppliers of these small cells, but also by correspondents' articles in the less technical wireless journals. The latter profess to show how to make up an H.T. battery of small fluid cells from *exhausted* elements extracted from discarded dry batteries. How on earth one can expect results from exhausted depolarising material is beyond my comprehension.

I would like to add that these little sack cells are excellent for H.T. supply assuming that a size of cell is chosen which is capable of giving, for a considerable period, the discharge rate required by the receiving apparatus. E. ATKINS.

London, S.E.7.

February 4th, 1927.

Sir,—With reference to "Sal Ammoniac's" letter in the issue for February 2nd, regarding his experience of wet Leclanché cells for H.T. supply, I should like to give my experience, which, I think, has definitely proved the reverse of his.

In January, 1926, I built up a battery of 66 cells, supplied by Messrs. Siemens Bros., Ltd., designed, I believe, to give a current of 15 or 20 milliamps. This battery, when completed, showed a voltage of 103, and was put to use on a 1-v-1 receiver (consumption approximately 6 milliamps.), on February

2nd, 1926, since when it was in continuous use daily for about nine months, working never less than four hours per day. For the last three months it has been employed, under similar conditions, on a 0-v-2 receiver (consumption approximately 7 milliamps.), and to-day the voltage stands at 88.

I may add that I took extreme care in building the battery. Although no soldered connections were used, I was very careful to avoid any possibility of creeping, so common in some forms of Leclanché cells, by keeping everything scrupulously clean and dry. The care that I spent, combined with the excellent salt supplied by Messrs. Siemens Bros., Ltd., I think has contributed in no small way to my success. H. COWARD.

Sittingbourne.

February 2nd, 1927.

Sir,—The experience of your correspondent "Sal Ammoniac" with wet H.T. batteries is not unusual, unfortunately.

About twelve months ago I purchased 120 cells of a well-known make, and although every care has been taken to prevent creeping, and to insulate them well by standing them on waxed boards, and the makers' instructions regarding the use of a certain make of sal-ammoniac have been followed, I have had nothing but trouble with them. After about three months' use a dozen or so of the cells showed a *reversed* voltage of 0.1, and a large number of the others were down to 1 volt. This, in spite of the makers' claim that the cells will deliver 30 milliamps., whereas the load on my cells had not, except for a brief period of two or three hours, exceeded 10 milliamps. The cells are normally used on a two-valve set.

After considerable trouble the makers offered to clean a number of the cells. They did so, but after a week or two they were as bad as ever.

In consequence, I have had to return them to the makers again, but a few which have been sent to me for test after recleaning are still unsatisfactory.

It is a peculiar fact that the dealer from whom I bought my cells, and who has had a great many years' experience in electrical matters, has had more trouble than I have had. Three or four other users of these cells have also had similar trouble to my own.

It would appear that these troubles cannot be due entirely to the users. JAS. HUDSON.

Manchester.

February 2nd, 1927.

Sir,—In reply to "Sal Ammoniac's" letter in your issue of February 2nd, may I state I have experienced the same trouble?

In October I made up a wet battery of 63 cells, using all new large double-capacity sacks.

The tops of the jars were given a coat of acid-proof paint, and when completed a few drops of liquid paraffin was placed in each cell to stop creeping.

The voltage was never 1.47 volts per cell, as the total reading was 73 to 75 volts for the 63 jars. Lately the voltage has dropped to about 30 volts, and I have started to wash out and refill.

I am not the only one who has had this trouble, as I know of four fans who have given up in disgust.

Perhaps some of the firms who advertise this kind of battery could enlighten us on the subject. DISAPPOINTED.

Darlington.

February 6th, 1927.

Sir,—I should like to add my experience to that of "Sal Ammoniac" regarding the wet type of Leclanché battery as used for H.T.

Last July I purchased from a well-known firm a 90v. wet Leclanché battery, thinking that by so doing I should be saved both trouble and expense.

After about three weeks of use the voltage dropped from 83 to 70, and continued to do so until it was reading below 60. I then returned it to the makers, and on receiving it back found they had replaced all the sacks with new ones.

Unfortunately, however, it soon developed the same trouble, and at the time of writing is again at the makers under test.

My set (two-valve) takes less than 6 milliamps, and I did not have this trouble with the dry type of Leclanché.

I was led to believe when I purchased this battery that, provided the instructions were carefully followed and the battery was not overloaded, all that would be needed for its good behaviour was the renewal of zincs when necessary.

London, S.W.18. R. J. POULTER.

February 4th, 1927.

ARRANGEMENT OF PROGRAMMES.

Sir,—As a regular reader of your excellent paper I should like to state that I am not at all in agreement with those of your correspondents who object to the broadcast talks. I find the talks and news the most interesting part of the programmes, while also enjoying the music, especially Albert Sandler's and Emilio Colombo's orchestras, very much. If anything would induce me to give up listening, it would be the discontinuance of the talks and the devotion of most of the programme time to revues and comedians, for which I have no use.

Roe Wen. COUNTRY LISTENER.

February 7th, 1927.

Sir,—The remarks you make about the educational experts at the B.B.C. produce an inartistic atmosphere in which I have never lived. I would sooner starve in a garret than have to live in such an environment as you describe.

The manufacturers' point of view is, or seems to be, the only thing to be considered; if so, they are taking a wrong-headed view of things as to those of us who dislike jazz, etc., an alternative programme was promised; this was a definite promise or I should not have spent so much on wireless goods. If they stick to this one-sided view I will see to it that I never spend another penny on wireless. The working-men—many of them—are longing for education by wireless, they want to rise, and in these days it is only by education they can rise. They deplore so much that they have to miss the school lectures, which are magnificent.

The most selfish part of your scheme is that you will not yield us one little bit of the programme; if you will not do this, at least make haste to get an alternative programme which was definitely promised.

Surely England has not sunk so low that a short lecture cannot be listened to.

I was brought up in a progressive Midland town, and the rich and poor had to work and study there. I afterwards lived abroad and was struck with the superior education of the working people. I hope the alternative programme will soon materialise. L.R.A.M.

February 2nd, 1927.

[Our correspondent has evidently mistaken our meaning; we did not suggest that educational efforts are undesirable but that progress in this direction should proceed not too rapidly and with caution.—ED.]

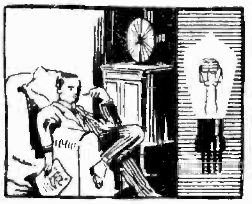
B.B.C. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—It is good to note from your correspondence page that, at long last, the infallibility of the B.B.C. transmission is being assailed.

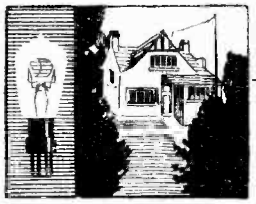
One is tempted to think that the impression of perfection which the B.B.C. has, unquestionably, tried to convey has been inspired less by their engineers than by the commercial element in their midst. Be this as it may, surely the time has now come for a frank avowal that the transmissions are never perfect (or anywhere near it), and also that, at times, they are decidedly bad. Take, for instance, their transmissions of pianoforte playing. At times these are jarring and cacophonous, whilst at other times they are quite pleasant to hear. This shows clearly that the transmission is to blame, for the two effects can be observed over and over again on the same receiver. Is it not time that a really serious attempt was made to get over the difficulties of pianoforte transmission and reception? The pedal notes in the organ are doubtless good to hear, and it is a great achievement to be able to transmit and receive them. Let us all shake hands about that. But, after all, there are some of us who would be glad to sacrifice a little in that direction if only we could get better piano music!

E. C. RICHARDSON.

West Byfleet, January, 1927.



NEWS FROM THE CLUBS.



Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Repairing Accumulators.

Members of the Bristol and District Radio Society had an opportunity of seeing practical work carried out by an expert on January 28th, when Mr. A. E. Pendock gave a fascinating demonstration of accumulator repairs, including lead burning with the aid of the oxygen blow-pipe. Several members then attempted the same task with rather mixed results. The general opinion was that the job is an easy one when you know how.

Mr. Pendock had on view a range of Hart accumulators, and answered a number of questions relating to battery care and charging.

Hon. secretary: Mr. S. J. Hurley, 46, Cotswold Road, Bedminster, Bristol.

oooo

Harmony in the Club Room.

The fourth annual dinner of the Hackney and District Radio Society took place on Thursday, January 20th at the Talbot Restaurant, London Wall, and proved a great success. In proposing the toast of the "Society," Mr. F. Jenkins referred to the fact that it had been established for 4½ years. Many members had joined and many had dropped out, but now they had 55 "live" members. Submitting the toast of "The Chairman," Mr. George Sandy said that Mr. Cunningham had proved a most ideal chairman for a period of nearly four years. He had many calls upon his leisure, but he had always found time to come to their Monday meetings. For this they were grateful to Mrs. Cunningham, and as a little recompense to her from the members he asked Mr. Cunningham to accept for her a box of chocolates.

Responding, Mr. Cunningham said that the society was notable for the harmony which existed among the members. They never had any quarrels, and although there were keen discussions, there was not the slightest personal animosity.

Hon. secretary: Mr. G. E. Sandy, 61, Lauriston Road, South Hackney, E.8.

oooo

Switches and Switching.

A lecture on switches was an interesting feature at the last meeting of the Southport and District Radio Society, the speaker being Mr. P. K. Carmichael, a member of the society. The lecturer described a large number of different types of switch, and explained the uses of switches in modern receiving sets.

Visitors are welcomed at the society's meetings, held every Monday at 8 p.m. in the St. John Hall, Scarisbrick Street. The hon. secretary is Mr. E. C. Wilson, of "Lingfell," Kirklees Road, Birkdale.

FORTHCOMING EVENTS.

WEDNESDAY, FEBRUARY 16th.

Royal Society of Arts.—At 8 p.m. At John Street, Adelphi, W.C.2. Lecture: "Some Studies in Connection with the Manufacture of Electric Lamps and Thermionic Valves," by Mr. C. C. Paterson, O.B.E., F.Inst.P. In the chair: Sir Oliver Lodge, M.A., LL.D., D.Sc., F.R.S.

Edinburgh and District Radio Society.—At 8 p.m. At 117 George Street. Talk on "A Moving Coil Loud-speaker," by Mr G. N. Fordyce.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Lecture and Demonstration: "Super-Heterodyne Receivers," by Mr. O. H. Patterson (G2YY).

Tottenham Wireless Society.—At 8 p.m. At the Institute, 10, Bruce Grove, N.17. Demonstration of the Lodge "N" Receiver, by Mr. F. J. A. Hall.

THURSDAY, FEBRUARY 17th.

Stretford and District Radio Society.—At "The Cottage," Derbyshire Lane. A Night with the Society's Transmitter, 5SS.

FRIDAY, FEBRUARY 18th.

Radio Experimental Society of Manchester.—Talks and Demonstration on "Crystals and Oscillating Crystals," by Mr. J. Levy

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Questions Night, conducted by Mr. A. M. Bage.

Sheffield and District Wireless Society.—At the Dept. of Applied Science, St. George's Square. Lecture (with Demonstrations): "Mechanical Analogies," by Mr. A. F. Carter, A.M.I.E.E.

MONDAY, FEBRUARY 21st.

Northampton and District Amateur Radio Society.—At 8 p.m. At the Cosmo Café, The Drapery. Lecture by Mr. R. G. Turner.

Hackney and District Radio Society.—At 8 p.m. At 18-24, Lower Clapton Road, E.5. Loud-speaker Contest.

Life of H.T. Batteries.

The "expectation of life" in regard to H.T. batteries of various sizes was dealt with by Mr. Towell (of Messrs. Siemens Bros., Ltd., Woolwich) at the Muswell Hill and District Radio Society meeting on January 26th. By means of a number of lantern slides the members were afforded a glimpse of the various processes through which the batteries pass in the course of manufacture. Hon. secretary: Mr. Gerald S. Sessions, 20, Grasmere Road, N.10.

oooo

Draping in the Studio.

Mr. J. F. Stanley, B.Sc., A.C.G.I., hon. secretary of the General Committee of Affiliated Societies, gave an informal address on "Conditions Affecting the Design of Broadcasting Studios" at the meeting of the Ilford and District Radio Society on January 26th. Mr. Stanley provided some interesting information on standing waves of sound, echo, growth of sound, and the absorption of sound waves by various materials such as drapery, carpets, concrete, and plaster. The Broadcasting Corporation, he said, had now abandoned the use of many layers of draping in their studios, and had concentrated more upon suitable draping for the studio roof or upper part of walls. By moving these drapings a difference from between ¾ and 1½ seconds could be made in the period of reverberation, a point which had a great advantage in arranging different types of transmissions.

Communications should be addressed to the hon. secretary, 50, Empress Avenue, Ilford.

oooo

Loud-speakers on Test.

An exciting "Loud-speaker Contest" took place at the last meeting of the Bradford Radio Society at which fourteen commercially manufactured instruments and three of the home-made variety were hidden behind a screen and judged upon their merits by an audience of sixty members. Each instrument was tested on a Burndept Ethophone III receiver, which gave excellent results on the local station. Each instrument was given a minute's test for volume, after which the same procedure was adopted with regard to clarity of reproduction.

The results of the test were illuminating. The best amateur loud-speaker was that constructed by Mr. Haigh.

Hon. secretary: Mr. E. A. Cowling, 1,145, Leeds Road, Bradford.

oooo

The Story of the Loud-speaker.

Many new facts in connection with the manufacture of loud-speakers were outlined by Mr. Rickets, of the Amplion Co., at the last meeting of the Croydon Wireless and Physical Society. Aided by an excellent selection of lantern slides, the lecturer gave a fascinating account of the development of the loud-speaker, beginning with the days of the Bell telephone and concluding with details of the latest type of instrument for mass demonstration purposes. Mr. Rickets described the action of various types, such as the reed, induction, electro-dynamic, air-blast, and the piezo-electric, and numerous sound amplifying devices were illustrated on the screen. A lively discussion followed, in which visiting members of the Caterham and District Radio Society took part.

Visitors are welcomed to all meetings of the society. Particulars can be obtained from the hon. secretary, Mr. H. T. P. Gee, Staple House, 51 and 52, Chancery Lane, London, W.C.2.

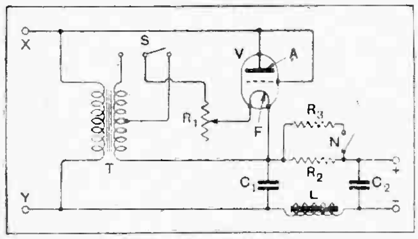
Recent Inventions

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 Unit.
(No. 262,190.)

Application Date: Sept. 7th, 1925.

A particular form of smoothing circuit is incorporated in a mains unit described in the above British patent. Referring to the accompanying illustration, it will be seen that the alternating current supply is shown at XY, and is taken direct to the anode A of the rectifying valve, which is shown as a three-electrode valve with the grid and anode joined together. The filament F is heated by a transformer T, and a variable resistance R_1 controls the filament current. In order that valves having filaments rated at various voltages, such as bright and dull-emitter valves, may be employed,



Rectifying and smoothing unit for A.C. mains. (No. 262,190.)

the transformer is provided with a switch S, which connects the filament to either of two tappings. The smoothing circuit comprises two condensers C_1 and C_2, arranged on either side of a combination of resistances and a choke. The negative lead contains a choke L between the two condensers, while the positive lead contains the resistances R_2 and R_3. These, if desired, may be placed in parallel by a switch N. The specification states that the choke may be of the order of 51 henries, the resistance R_2 about 9,000 ohms, and R_3 about 100,000 ohms.

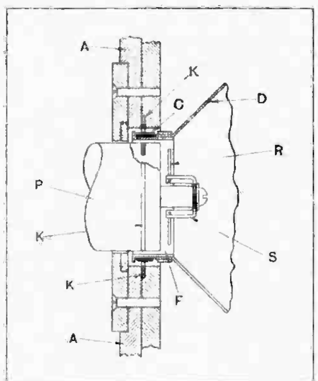
o o o o

Coil-driven Diaphragm.
(No. 250,931.)

Con. date (U.S.A.): April 20th, 1925.

A modification of the Rice-Kellog type of loud-speaker is described in the above British patent by C. W. Rice. Readers are no doubt familiar with this type of speaker, which consists esentially of a light diaphragm driven by a moving coil working in a strong magnetic field. An electro-magnet is utilised in which the turns are arranged concentrically, the moving coil being located in the annular gap between the two poles. It is mentioned in the specification that the impedance of the coil at various audio-frequencies is determined partly by its ohmic resistance and partly by its reactance.

At very low frequencies the impedance is due almost entirely to its resistance, while at higher frequencies the reactive component may predominate. This, however, tends to give rise to unequal response over the usual speech and music bands, and the object of the invention is to flatten out the response curve, so that for a given voltage over the entire frequency range there will be an equal response. This is accomplished by associating one or two short-circuited turns, preferably in the form of a copper ring, with the moving coil, so that the copper ring acts as a short-circuited secondary winding to the coil. This, of course, considerably lowers the impedance of the winding, and hence tends to equalise its response over the entire range, particularly with the higher frequencies. The accompanying illustration indicates one arrangement of the invention, where a light diaphragm D, the edge of which is omitted, is fixed to a coil C wound on a cylindrical former F, and joined to the truncated portion of the cone. The magnetic system comprises a cylindrical pole P and an annular pole A, energised in the usual way from a source of direct current supply, and the moving coil C is located in the gap between the two poles. The coil C is maintained in position partly by means of supports in the form of light rods R fixed to a spider S, screwed to the end of the pole piece P. The free edges of the conical diaphragm are also supported by thin leather, rubber, silk, or similar material. Two copper rings K are let into the two pole pieces, *i.e.*, the central pole piece P and the annular built-up pole piece A. These rings act as a short-circuited secondary winding to the moving coil C. Lines of force emanating from the moving coil due to speech currents will link with the copper rings, thus lowering the impedance of the coil, thereby bringing about the desired effect.



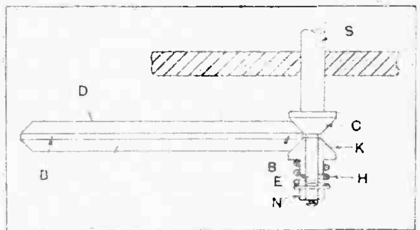
Coil-driven loud-speaker movement with copper damping ring. (No. 250,931.)

o o o o

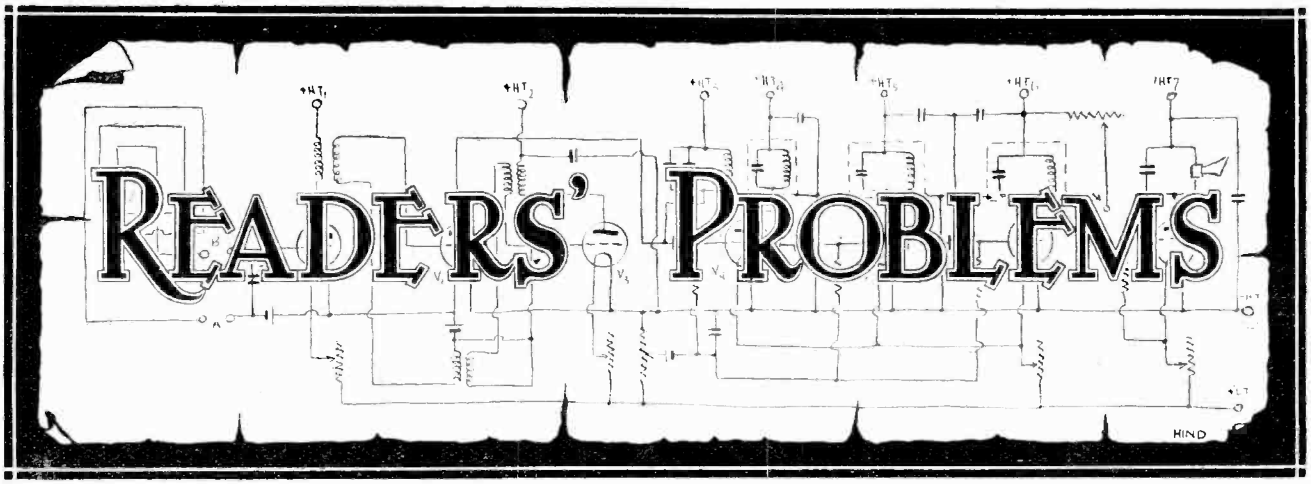
Slow-motion Drive.
(No. 261,476.)

Application date: August 19th, 1925.

A very ingenious form of drive is described by H. G. Gowring and the Western Electric Co., Ltd., in the above British patent. The object of the invention is to obviate the necessity for the accurate assembly of two shafts, or similar driving means, such as the slow-motion device of a variable condenser. One arrangement of the invention is shown in the accompanying diagram. Here a disc D mounted on a shaft (not shown) has to be driven from another shaft S. The edge of the disc is bevelled at B, the bevelled portion being gripped between two cones on the shaft S. One cone C is integral with the shaft, while an extension is screwed and carries a nut N and a helical spring H working against another cone K, which is shown in cross-section, and is free to move on the extension of the shaft. The spring exerts sufficient pressure on the two cones to cause them to grip the edge of the bevelled disc. Thus, rotation of the shaft causes the cone member C to drive the bevelled edged disc by virtue of the friction between the two. A reduction in gear is also obtained, and it will be obvious that the freedom imparted by the spring controlled cone K does not necessitate the two shafts being correctly aligned.



Slow-motion drive. (No. 261,476.)



"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Filament Current from D.C. Mains.

I have a three-valve receiver, the valves consisting of one R.5.v. bright emitter, one D.E. valve taking 0.35 amp. at 5 volts, and one P.M.6, and would like to use my 240-volt D.C. mains for both H.T. and L.T. supply by building a high-tension eliminator. Will you kindly tell me if it is practicable to use the mains in this case, and if not, what other alternatives do you suggest? J. M. K.

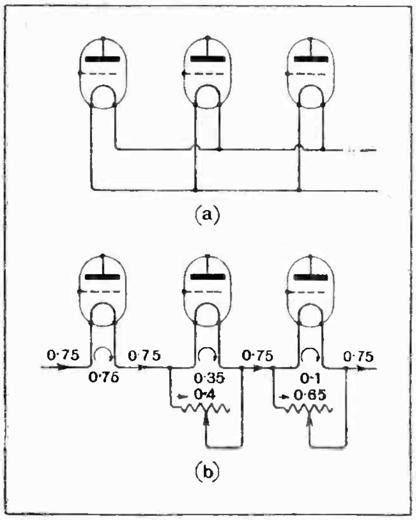
There is every advantage in using the mains for supplying the set with H.T., but the L.T. supply is a different matter altogether, and is liable to be rather expensive under the conditions you require.

The bright emitter valves take a filament current of 0.7 to 0.8 of an ampere and the P.M.6 takes only 0.1 ampere, so that the problem at once arises as to how to connect the filaments of the valves to obtain the most economical results.

The *easiest* way to connect the filaments of the valves is to arrange them in parallel, just as they are connected to the L.T. accumulator at present, but this is far from being the best and most economical way, for the following reason: When the filaments are in parallel, the total current taken is 0.75 for the R.5.v. + 0.35 for the D.E. valve + 0.1 for the P.M.6, making a total of 1.2 amperes. This current has to be taken from the 240 volt mains, and the unwanted 235 volts (since the valves only require 5 volts) dropped in a suitable series resistance. The *power* consumed by this arrangement is 1.2 amps. at 240 volts, or 288 watts, although the power actually expended in heating the filaments is only 1.2 × 5, or 6 watts, the remaining 282 watts being wasted as heat in the series resistance.

Certainly this series resistance is useful in providing a means of supplying values of H.T. for the valves, but the power consumed in the H.T. circuit may be, perhaps, 12 milliamps at 240 volts (this is rather on the high side), or 0.288 watts only—so that the H.T. power is negligible compared with the L.T. power required.

Putting the problem into £ s. d., the cost for 1,000 hours at 6d. per unit is only 1.75 pence for H.T. and £7 4s. for L.T. supply. Now 1,000 hours represents about 2½ hours per night for a year, which is probably quite a fair estimate for the average use of a broadcast set.



Parallel connections of valve filaments (a), and series connections (b) with parallel rheostats recommended for use with D.C. mains.

It is obvious from the foregoing example that it is not going to pay to run the valves in this fashion. Another alternative is to run the valve filaments in series, but as each one requires a different current, those requiring smaller currents must be shunted with more or less resistance so that only the correct current passes through the filament. The arrangement required is shown in the diagram. This arrangement will be more economical than that first discussed, as the current will only be the maximum required by one filament, i.e., 0.75 amp. The power consumed in this case will be 0.75 amp. at 240 volts, or 180, and the cost for L.T. for 1,000 hours will be £4 10s. at the same rate as before—the cost for H.T., of course, remaining the same. The great disadvantages of this particular method consist in the very great care with which the shunting resistances must be adjusted and the necessity for changing over the resistances if it is desired to interchange the valves for experimental purposes. For safety the shunting resistances should be set so that there is very little resistance in circuit before switching on to the mains, and then each resistance *increased* to increase the current through the corresponding valve.

The question of cost has been gone into rather at length to prepare the way for the suggestion which will really give the best results, namely, that of scrapping the R.5.v. and the D.E. valves and substituting modern low temperature valves consuming a current of the order of 0.1 amp.

It will now be shown that this last suggestion, besides giving better results owing to the undoubted superiority of modern dull emitter valves over their earlier type, and more so over the bright emitters, will be by far the cheapest in the long run, even though apparently the most expensive in first cost.

The two valves will cost, say, 14s. each, making a total of £1 8s. Against this, the total current taken will be 0.1 amp. with the valves in series, and thus the power consumed is 0.1 × 240, or 24 watts. For 1,000 hours the cost is, therefore, 12 shillings only, so that for 1,000 hours the total cost of the new arrangement is £2. The valves may be interchanged as desired, since they all take the same current, and the performance of the set will be better with this scheme than with the old valves. Moreover, the latter will still be available for experimental purposes.

The Wireless World AND RADIO REVIEW (14th Year of Publication)

No. 391. WEDNESDAY, FEBRUARY 23RD, 1927. VOL. XX. No. 8.

Assistant Editor: F. H. HAYNES. Editor: HUGH S. POCOCK. Assistant Editor: W. JAMES.

Editorial Offices: 139-40, FLEET STREET, LONDON, E.C.4 - - Editorial Telephone: City 4011 (3 lines).

Advertising and Publishing Offices: DORSET HOUSE, TUDOR STREET, LONDON, E.C.4.

Telephone: City 2847 (13 lines). Telegrams: "Ethaworld, Fleet, London."

COVENTRY: Hertford Street. *Telegrams:* "Cyclist Coventry." *Telephone:* 5210 Coventry.

BIRMINGHAM: Guildhall Buildings, Navigation Street. *Telegrams:* "Autopress, Birmingham." *Telephone:* 2970 and 2971 Midland.

MANCHESTER: 199, Deansgate. *Telegrams:* "Iliffe, Manchester." *Telephone:* 8970 and 8971 City.

Subscription Rates: Home, 17s. 4d.; Canada, 17s. 4d.; other countries abroad, 19s. 6d. per annum.

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

MORE PROGRAMME SUGGESTIONS.

SUBSEQUENT to the suggestions which we have made for a better arrangement of programmes so that various sections of the listening public are catered for over longer periods in programme transmissions, we find that many proposals have been made in other quarters endorsing the view that "scrappy" programmes consisting of items of mixed appeal are unsatisfactory. One proposal in particular which has come to our notice recommends that various types of programmes should be confined to specified wavelengths so that the listener would know that on a certain wavelength he would get talks, on another wavelength music, and so forth. This appears to be an attractive proposition, but it seems to us that there are many difficulties in the way of solution of the problems along these lines. The "My Programme" idea introduced by the B.B.C. seems to be a good basis on which to work in the building of programmes, provided that the author of "My Programme" compiles a programme strictly to his own tastes, which, we assume, are representative of the tastes of one section of the community; but several of the "My Programmes" which have been put on in the past have been so varied in character that it is difficult to believe that all the items are special favourites of the author; rather it would seem that the author has tried to put himself in the position of the B.B.C. programme authorities themselves, and has compiled a programme which he thinks should appeal to most tastes.

By all means let us have more "My Programmes," provided we can count on the author to follow his own tastes and please himself without worrying about sections of listeners who do not belong to his "group."

○○○○

CONTENTS.

IDENTIFYING TRANSMISSIONS.

The problem of the identification of transmissions is one which remains of very special interest to our readers. A good deal of correspondence discussing systems which could be put into operation to assist us in identifying foreign transmissions has appeared recently in this journal, and it was announced that the subject was included on the agenda for the recent Broadcast Conference held in Brussels. We learn that, unfortunately, so much other business had to be got through on that occasion, particularly in connection with allocation of wavelengths for the longer-wave stations, that the question of providing an international system of call-signs to overcome the present difficulty of station identification had to be shelved for a future occasion. We are now given to understand that at a further meeting of the European representatives of broadcasting, to be held in Geneva in April, this question of a system of call-signs will be dealt with. In common with all owners of sensitive receiving sets, we look forward with great interest to the result of the deliberations of this conference.

A Three-valve Set for the Long and Short Broadcast Wavelengths.

By W. JAMES.

DURING the last few months the writer has described three receivers, all of which have one or more stages of radio-frequency amplification. We have first the "Everyman's Four" receiver, which has turned out to be the most popular set of the season; this has one stage of radio-frequency amplification. The second receiver is known as "Everyman's Three-valve" receiver; this also has one stage of R.F. amplification. Thirdly, we have "The Wireless World Five," with its two stages of R.F. amplification. Judging by these three receivers it would seem that the writer is a firm believer in radio-frequency amplification—and, indeed, this is true; but there are circumstances in which a very simple broadcast set that is capable of receiving the local station and Daventry at really good strength and that gives as nearly perfect quality as can be obtained is ideal. Such an instrument can be so designed that, used with a first-class loud-speaker, it will give far better quality for the same volume of sound than any gramophone.

Now, what has the average non-technical person in mind when one speaks of a broadcast receiver? He has in mind a simple set which is turned on and off by means of a

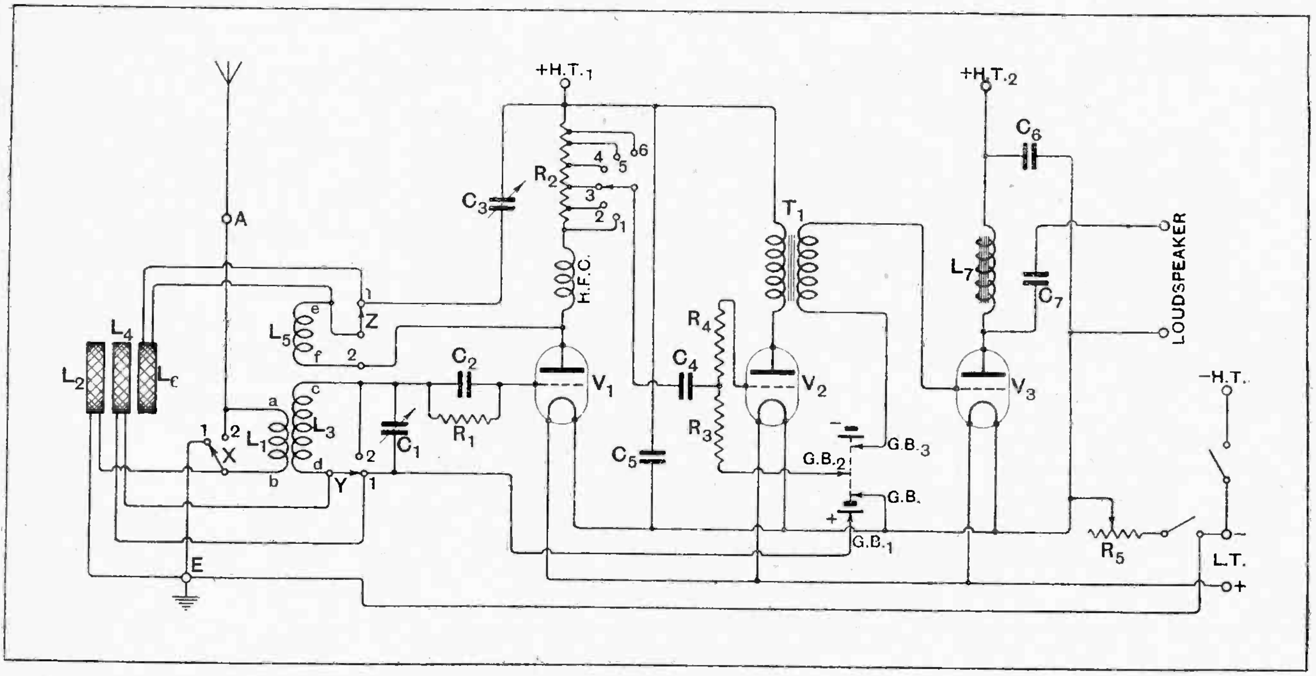


Fig. 1.—Explanatory diagram of the receiver. L_1, L_3, L_5, lower wavelength coils; L_2, L_4, L_6, longer wavelength plug-in coils; X Y Z, three-pole change-over switch; C_1, 0.0005 mfd.; C_2, 0.0002 mfd.; C_3, 0.00025 mfd.; C_4, 0.1 mfd. mica; C_5, 2 mfd.; C_6, 5 mfd.; C_7, 2 mfd.; R_1, 1 megohm; R_2, tapped 60,000 ohms wire wound; R_3 and R_4, 0.25 megohm; R_5, 6 ohms resistance; H.F.C., high-frequency choke coil; T_1, 3.5 : 1 transformer; L_7, 32-henry choke; V_1, detector valve with high amplification factor; V_2, amplifying valve with moderate A.C. resistance; V_3, "super power" valve.

Quality Three.—

switch knob, he expects to receive the local station or Daventry by moving a second knob, and he most certainly expects the receiver to have an effective strength control to enable him easily to regulate the volume of sound emitted by the loud-speaker.

Taking these things in order, we find that the "on" and "off" switch presents no difficulty, the one in the set illustrated here being mounted on the terminal strip at the back. It is fitted in this position so that the filament and anode circuits are broken or connected at the point where the power is joined to the receiver. The switch is of the type which makes or breaks the filament and the anode circuit, and is shown as two separate switches in the explanatory diagram (Fig. 1): it can be seen in the illustration of the back of the receiver.

The Circuit Used.

It is a little more difficult to arrange for Daventry or the local station to be received merely by actuating a switch, but this receiver is so designed that it is necessary only slightly to retune after moving the switch. That is to say, if the local station is received with the tuning condenser at 50 degrees and the switch knob "up," Daventry will be received with the switch knob "down" and the condenser set at about 60 degrees, depending on the coils and the aerial in use. The illustration at the head of this article shows that the set has two large knobs and dials; the left-hand one is for tuning the aerial circuit and the right-hand one is a reaction control. It is for the reader to decide whether or not the amount of reaction applied to the aerial circuit shall be sufficient to produce self-oscillation; this can be controlled by the coils as described below.

A volume control is easily provided, and comprises a switch connected to the detector valve in such a way that the amplitude of the signal applied to the first low-frequency amplifying valve can be varied from the full amount to one-sixth, in six steps. A switch of the one-hole fixing type is used, and its knob can be seen at the bottom of the centre of the panel.

On the front panel, then, we have the aerial tuning and reaction condensers, the long and short wavelength switch, and the volume control.

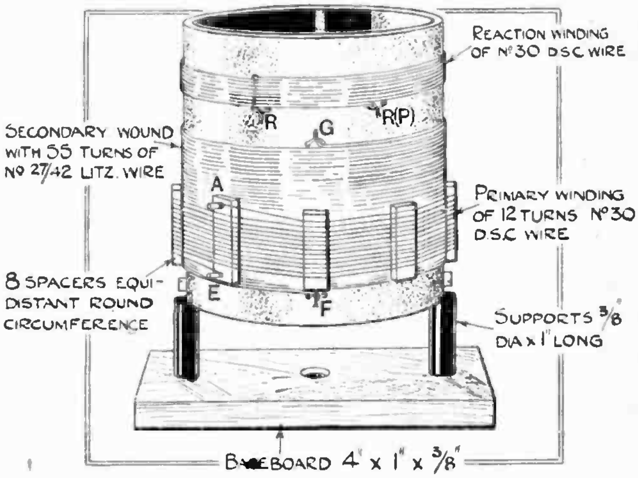
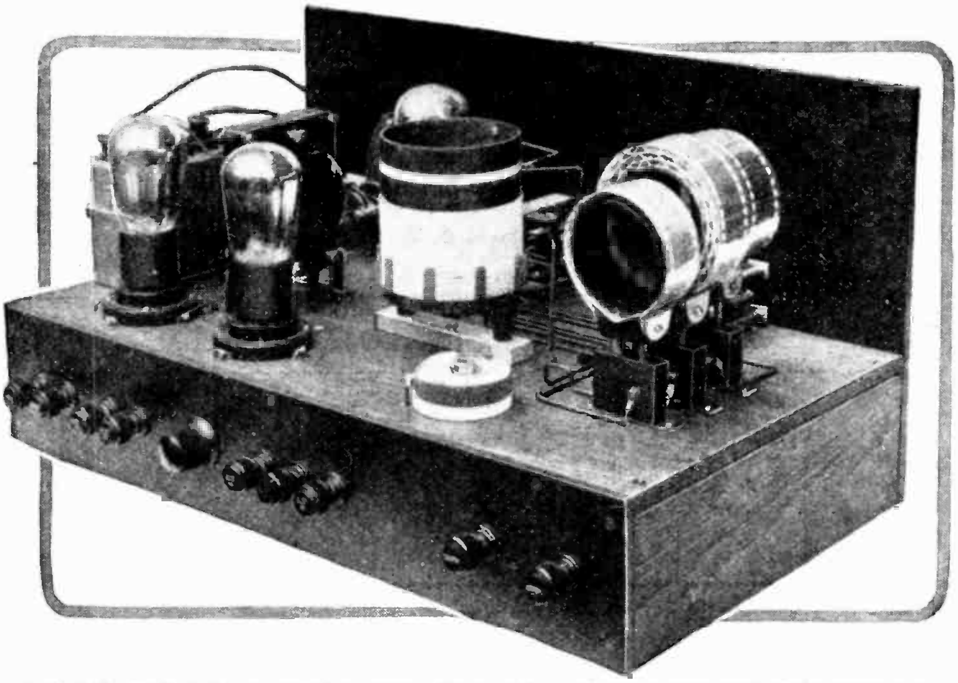


Fig. 2.—Details of the lower wavelength coils, comprising the aerial, secondary and reaction windings. The former is of Paxolin, the supports of ebonite, and the base of wood.

At the back of the receiver is a strip of ebonite carrying the aerial and earth terminals, the battery and loud-speaker terminals, and the "on" and "off" switch.

Turning now to the explanatory diagram, Fig. 1, it will be seen that coils L_1, L_3, and L_5 are used together; similarly with coils L_2, L_4, and L_6. A three-pole two-position switch having movable contacts X, Y, Z, is used to transfer the coils, the respective contacts being marked 1 and 2. With the switch contacts in the position shown in the drawing the aerial circuit is completed from terminal A through L_1 to earth, *via* switch X at point 1. The secondary circuit is completed by contact Y at point 1, and includes the tuning coil L_3 and condenser C_1. This circuit, it can be seen, is connected to the detector valve V_1 *via* the grid condenser and leak, C_2, R_1, and to the grid battery at GB_1.

In the anode circuit of the detector is the reaction coil, and L_5 is connected by contact Z at point 1. The three coils L_1, L_3, and L_5 are for



View of the back of the completed receiver. Many of the parts are mounted below the baseboard. The three plug-in coils on the right-hand side are for reaction, secondary and aerial circuits for the longer wavelengths. The "on" and "off" switch knob can be seen fitted to the terminal strip.

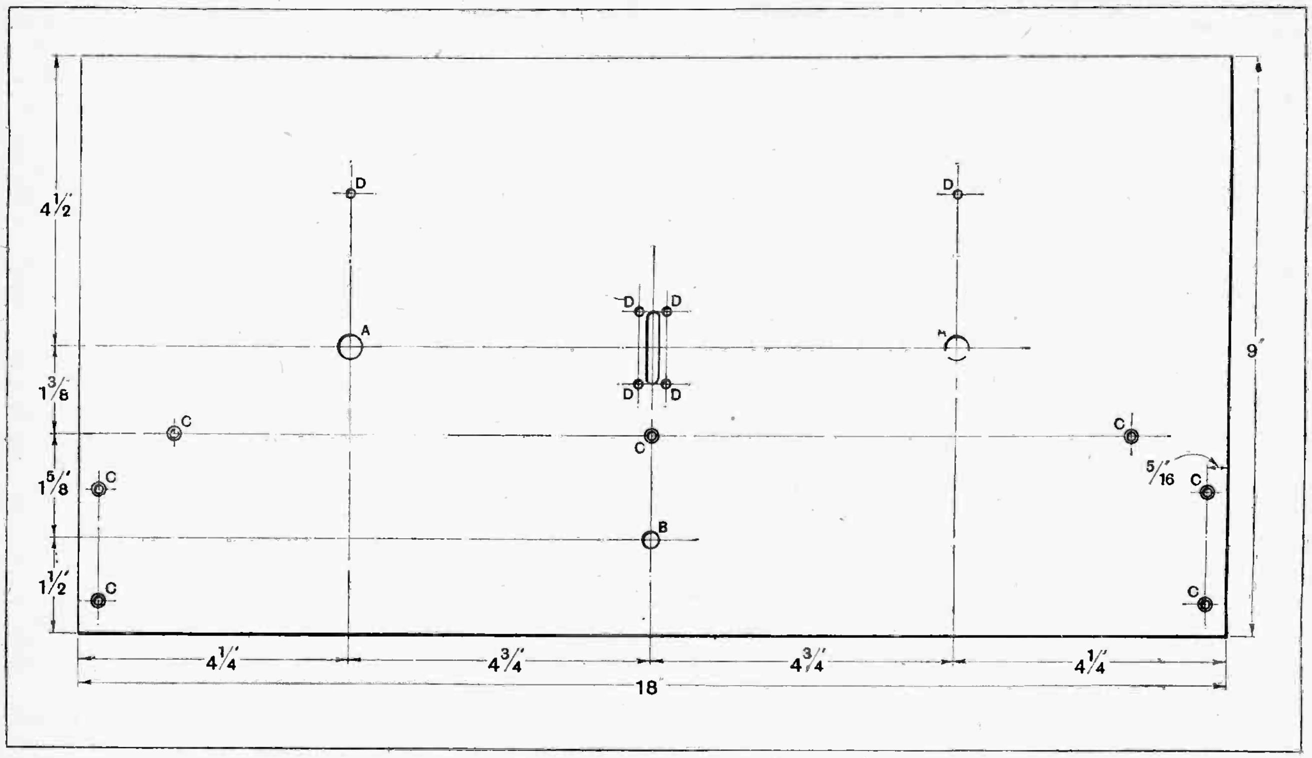


Fig. 3.—Front panel of ebonite : A, 3/8in. diameter ; B, 1/4in. diameter ; C, 1/8in. diameter and countersunk for No. 4 wood screws ; D, 1/8in. diameter.

the 200 to 550 metres range of wavelengths and are wound on a single former, as shown in Fig. 2. It will be noticed that when the lower wavelength coils are connected the long wavelength coils are short-circuited; these sets of coils are well spaced in the receiver and are at right angles. It would, therefore, be expected that the two sets will not interact, and such is found to be true in practice, for no difference in signal strength can be detected when the three coils L_2, L_4 and L_6 are removed from or put back in the set. Similarly, when the switch is moved to the long-wave position, that is position 2, the coils L_1, L_3, and L_5 are short-circuited and coils L_2, L_4, and L_6 are connected ; the latter coils are of the plug-in type. Three single coil-holders are used, it not being necessary to vary the relative positions of the coils when once the best position for them has been found. These coils can be seen in the illustration of the back of the receiver, the plug-in coil nearest the front panel being included in the aerial circuit.

Coils L_2, L_4, and L_6 being interchangeable, the reader is probably asking himself why coils L_1, L_3, and L_5 are required at all. The answer is twofold. In the first place, it is more convenient to have the two complete sets of coils connected to the circuit so that the working of a switch will connect the set of coils required rather than to have to open the cabinet and to change the coils when it is desired to move from the local station to Daventry. Secondly, an aerial-grid coil comprising L_1 and L_3,

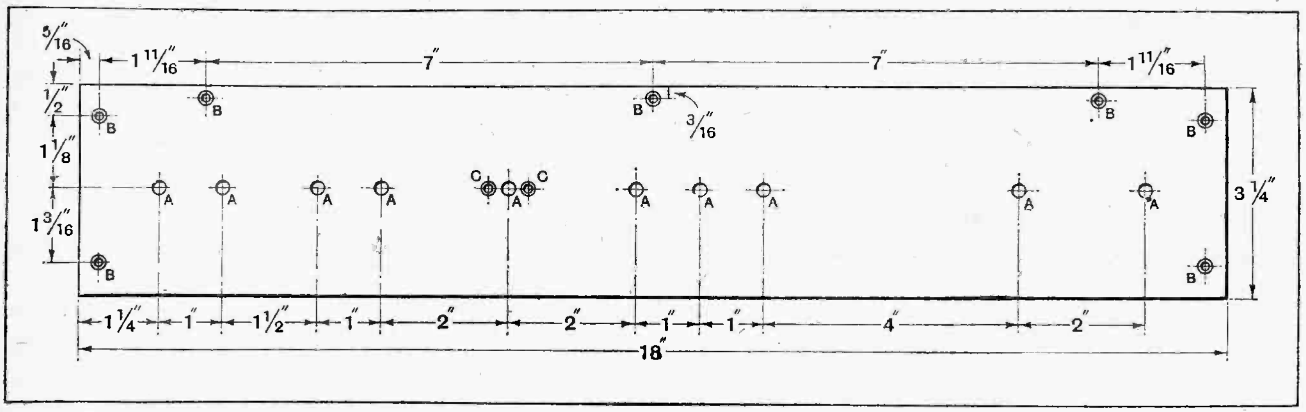


Fig. 4.—The ebonite terminal strip : A, 7/32in. diameter ; B, 1/8in. diameter, countersunk for No. 4 wood screws ; C, 1/8in. diameter, countersunk for No. 6 B.A. screws.

Quality Three.—

having a secondary of Litzendraht and a primary winding of ebonite spacers, is far more efficient than a pair of plug-in coils, and is easily constructed. The reaction winding L_5 is merely a coil of a few turns of fine wire wound at one end of the aerial grid transformer.

Choice of Components.

Grid circuit rectification, using a grid condenser C_2 and grid resistance R_1, is employed, the return end of the grid circuit being connected to the positive terminal of the grid bias battery at GB_1. The filament negative wire is joined to plug GB; hence the voltage of the grid circuit with respect to negative L.T. can be varied by altering the position of plug GB. The grid circuit is positive with respect to negative L.T. by the voltage of the grid bias battery included between GB_1 and GB; further, the working characteristics can be varied within limits by adjustment of the plug GB. If the voltage between GB and GB_1 is six, the grid is more positively biased than when the voltage GB to GB_1 is less than six. This adjustment is an extremely useful one, for not only can the effectiveness of the rectifier be varied, but the reaction circuit is also affected. Reducing the positive bias applied to the grid circuit has the effect of smoothing the reaction control when a valve with a high amplification factor and a fairly low A.C. resistance is used as the rectifier.

It might be thought when quality is the first consideration that anode bend rectification should be used instead of grid circuit rectification, but it is essential to use grid circuit rectification if smooth reaction is required, and, further, provided the grid circuit rectifier is properly proportioned the method is not inferior to anode rectification as it is normally used.

In the anode circuit of the rectifier V_1 is a radio-frequency choke coil H.F.C., which is in series with a tapped wire-wound resistance. The resistance R_2 has six tappings, which are taken to a switch; thus the voltage applied to the first low-frequency amplifying valve through the coupling condenser C_4 and resistance R_4 can be varied from the full voltage developed across the resistance to one-sixth of this amount. This tapped resistance is the volume control, and it is quite effective.

Condenser C_3 is the reaction condenser, and is connected in series with reaction coils L_5, L_6, to the end of resistance R_2 connected to $+H.T._1$. As the value of this condenser is increased the radio-frequency currents passing through the reaction coil are strengthened and the amount of reaction applied to the grid circuit increases. Condenser C_3 is in shunt with the anode resistance and H.F.C.; it therefore tends to reduce the strength of the higher audio-frequencies. This effect is negligible in this receiver, however, because a low value of anode resistance is used—60,000 ohms. Even at 10,000 cycles the reduction is merely a few per cent. The amplification of the lower frequencies is practically uniform down to a frequency of 20-30 cycles per second. This is controlled by the value of the coupling condenser C_4 and the grid leak R_3. These have values of 0.1 mfd. and 0.25 megohm respectively. Resistance R_4, of 0.25 megohm, is employed to reduce the magnitude of the high-frequency currents which tend to pass from the anode circuit of the detector to the low-frequency amplifier. As a matter of fact, very little high-frequency current passes to C_4, but R_4 is useful in reducing what little does reach C_4.

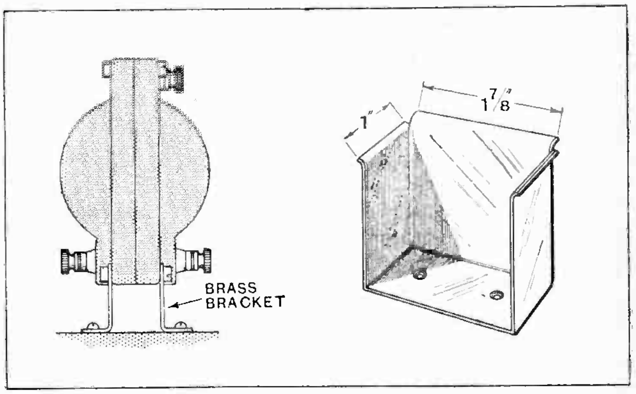
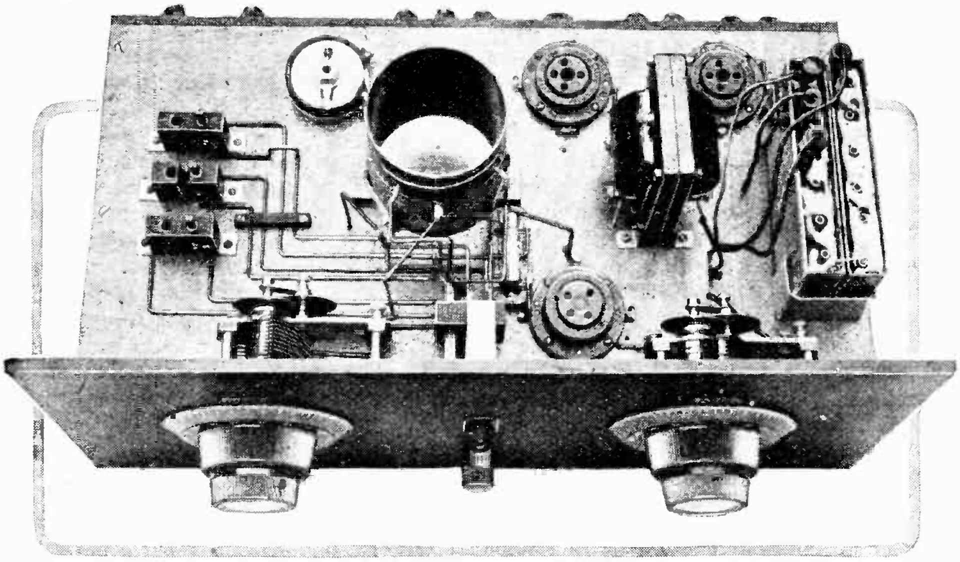


Fig. 5.—Method of mounting the low-frequency transformer and details of the battery clips, of which two are required.

A transformer is used to couple the second and third valves, the particular instrument used being a Ferranti $3\frac{1}{2}:1$. This instrument gives a remarkably uniform amplification over a wide range of frequencies when used with a valve of 25,000 to 30,000 ohms A.C. resistance.



This view shows the arrangement of the parts on the top of the baseboard. On the left are the three plug-in coil holders, in the centre the lower wavelength coils, while on the right can be seen the low-frequency transformer and the grid bias batteries.

Quality Three.—

Much better results can be obtained, however, by using a valve of lower A.C. resistance at V_2. Two effects are produced when a low resistance valve is used. In the first place low notes such as 50 cycles are amplified, and in the second place the higher notes are amplified more than those of between, say, 1,000 and 3,000 cycles; in other words, the curve is practically flat from about 100 cycles to 4,000 cycles. At this point it begins to rise, while it commences to fall again at about 7,000 cycles. This is a very useful feature, as the higher notes, which may be weakened relative to the lower notes by the tuned circuit and the rectifier, are brought up in strength.

It is important to remember, however, that the anode current of V_2 must not exceed about 3 milliamperes. The effect of reaction has been ignored in this explanation because very little, if any, reaction will normally be required when receiving the local station. It may be necessary to apply a little reaction to the tuned circuit when receiving Daventry, but as the circuit is of rather high resistance the effect of moderate reaction on quality is negligible.

This receiver will give high quality reproduction of the Daventry and local station broadcast. It is turned on by means of a switch, and the change from Daventry to the local station is effected by moving a second switch. A volume control is fitted. Several other stations can be received at fair loud-speaker strength with the assistance of the easily controlled reaction circuit.

Passing now to the output valve C_3, a choke-condenser loud-speaker circuit is used, the choke being marked L_7 and the condenser C_7. A filter circuit is quite necessary, because the anode current of the valve V_3 is considerable, this valve being of the so-called "super power" type. Choke L_7, of 32 henries, and C_7, of 2 mfds., are so proportioned that low notes are not lost.

By-pass condensers C_5 and C_6 are used; C_5 is of 2 mfds. and C_6 of 5 mfds. A large condenser is used at C_6 because the receiver is designed to amplify the very low notes as well as the higher ones, and it is, therefore, important to provide an anode return circuit of sufficiently low impedance.

A grid bias battery of 18 volts is provided in the receiver and a variable resistor R_5 is employed. R_5 is fitted inside the set, and it is adjusted to reduce the voltage of the battery to the amount required by the valve filaments, the exact value of the resistance included in the circuit depending, of course, on the current taken by the filaments.

Having explained the circuit diagram used we can proceed with the construction. First of all, the tuning coil for the lower broadcast band of wavelengths should be built. The coil with its base is shown in Fig. 2. On a Paxolin former 3in. in diameter and 3½in. long drill two holes about ¼in. apart at the point marked F, Fig. 2. Insert a piece of No. 20 tinned copper wire and twist the ends. This will serve as a terminal. This terminal is about 0.3 of an inch from the edge of the former. One end of the 27/42 silk-covered Litzendraht wire is soldered to terminal F, and 55 turns are wound on, the end of the winding being at terminal G. The length of this winding is a little over 1.9in. The reaction winding, having two terminals marked R and R (P), is of No. 30 D.S.C.; it is wound in the same direction as the Litzendraht winding, starting from terminal R (P). Terminal R (P) is ⅛in. from the grid end of the Litz winding, and 16 turns of No. 30 D.S.C. wire should be wound. The end is passed through a hole in the former and passes under the winding to terminal R.

For the primary winding, which is connected in the aerial circuit, 12 turns of No. 30 D.S.C. wire is required, the turns being wound on ebonite spacers ⅞in. or 1in. long by ¼in. wide and ⅛in. thick. The spacing of the turns is 16 to the inch, and the spacer with the two contacts A and B is provided with No. 8B.A. screws, with the rear side of the spacer well countersunk for the head of the screws. The construction of this type of coil, described by myself in many issues, will present no difficulty.

Two ebonite supports of ⅜in. diameter ebonite rod by 1in. long are used, with a base of wood 4in. × 1in. × ⅜in., as shown in the sketch.

It is important to fix the terminals in the positions indicated, as the coil is designed to enable short direct wires to be run to the remainder of the circuit.

On the ebonite front panel, which measures 18in. × 9in. × ¼in., are mounted two tuning condensers and indicators, an "on" and "off" switch, and the volume control switch. Details of the panel are given in Fig. 3, the small holes C being for wood screws. It should be noticed that the tuning condenser has a capacity of 0.0005 mfd. This is mounted on the left-hand side, while the reaction condenser, of 0.00025 mfd., is mounted on the right-hand side.

A terminal strip will have to be made, and consists of a piece of ebonite 18in. × 3¼in. × ¼in. This carries the "on" and "off" switch and the various terminals. Details are given in Fig. 4, the terminals required being as follow, reading from the left-hand side: Loud-speaker, +H.T.₂, +H.T.₁, −H.T., −L.T., +L.T., Earth, Aerial.

Two other items which will have to be made are the brackets for the low-frequency transformer and a hole for the grid bias battery. The Ferranti low-frequency transformer has been turned upside down in order to shorten the wiring. It is, of course, not strictly necessary to do this, but if the reader decides to do it four brass brackets will have to be made and fitted under the screws of the transformer, while the legs already fitted to the transformer should be removed. The battery holder consists of two pieces of brass sheet, shaped as shown in the right-hand drawing of Fig. 5. The holders should be just wide enough to hold the two 9-volt grid batteries tightly in position. *(To be continued.)*

THE LIST OF PARTS used in the construction of this receiver will be included in the second part of this article, which will appear in next week's issue.

WIRELESS ENGINEERS IN TRAINING

Apparatus and Methods at the Chelmsford Wireless College of the Marconi Company.

SO rapid are the developments in all branches of the science and art of wireless communication that it is impossible for any one wireless engineer engaged in a particular branch of the subject as his daily work to be proficient in all other branches, and it has become necessary for the larger wireless companies to maintain colleges where the wireless engineers from all parts of the world can receive specialised instruction which will enable them to make the best use of the apparatus placed in their charge.

In England a college of this kind is attached to the Marconi Works at Chelmsford, where students from all parts of the world are trained both in the application of electrical theory to wireless communication and the practical construction and operation of the intricate apparatus which is now manufactured for the purpose of carrying on wireless telegraph and telephone work on land, at sea, and in the air.

Some photographs taken at this college are reproduced, and it may interest our readers to know something of this institution. It was first established at Frinton in 1901, and in those days was run exclusively for the education of young engineers when they joined the Marconi Company's staff. In 1904 it was moved to Chelmsford to enable students to supplement their theoretical tuition by spending some of their time in the Marconi Works studying the various specialised processes of manufacture.

At the outbreak of war the school was temporarily closed, but its operations were really continued under the auspices of the War Office at a training camp near London, where officers and men were instructed in the uses of wireless in the field. After the war the school at Chelmsford was reopened, and its activities were considerably extended as a consequence of the enormous development that had taken place in all branches of wireless communication in the meantime. Its doors were also opened to selected students of all nationalities from all parts of the world who now come to Chelmsford for special courses of study.

Graded Courses.

Between fifteen and twenty students are normally in residence, including men returning from foreign service who have to bring their knowledge of recent wireless developments up to date, naval and military engineer officers from foreign countries, and engineer officers and technical officials from foreign, Colonial, and other services. The group of students shown in the illustrations come from countries as far apart as Sweden and Siam, and there are occasions when five or six different countries are represented on the students' roll.

The courses of instruction vary from one to four months, the instruction varying considerably according to the time available, the experience of the individual, and the particular class of apparatus with which he may be concerned. All students, on the completion of their course, are examined in the various subjects they have studied, and are given a certificate indicating their proficiency.

Wireless Engineers in Training.—

The college is situated at the top of a hill on the outskirts of Chelmsford, and is well equipped for indoor and outdoor work. The main laboratory is equipped with measuring instruments for obtaining experimental analyses of all classes of wireless circuits, and is provided with special model apparatus designed for the experimental demonstration of some of the more complex principles, which students may find difficulty in mastering by the more usual treatment of mathematical analyses. For example, there is a three-dimensional characteristic which can be built up from a series of curves formed of soft wire which, when erected in place, forms a "surface characteristic" representing the functions of the three-electrode valve. There is also a mechanical "synthesiser," which is of great value in explaining experimentally the integration of several periodic variations occurring simultaneously. This instrument makes it easy to demonstrate to non-mathematical students the various phenomena in alternating current work, at both high and low frequency, such, for example, as the synthesis of wave forms, the analysis of wave spectra set up by a modulated carrier wave, and the evolution of polar diagrams. This model is illustrated with Mr. A. W. Ladner, A.M.I.C.E., the superintendent of instruction at Chelmsford College, demonstrating it to a student.

Analysis of Modulated Waves.

The mechanical "synthesiser" is of Mr. Ladner's own devising, and it has been found particularly useful in demonstrating wave modulation. The modulation of radio-frequency waves by a signal is a subject that is always difficult to explain or to visualise clearly, and Mr. Ladner, conscious of this difficulty, spent much time and effort in developing this machine, which provides a method of building up a modulated wave mechanically.

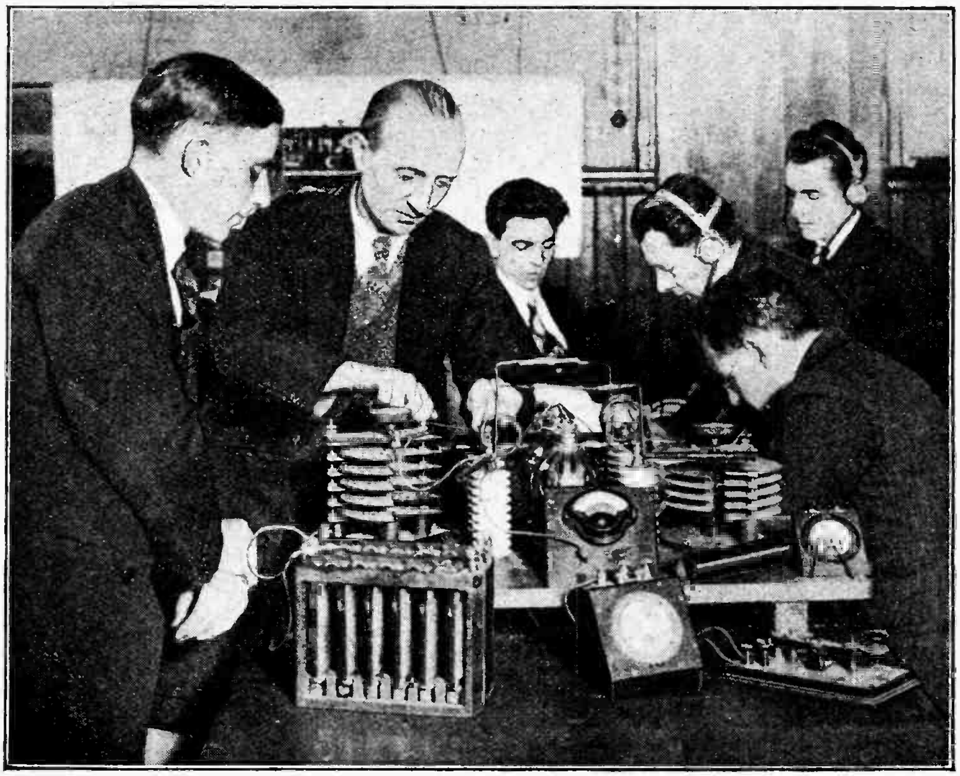
Integration of Component Waves.

A representation of a modulated wave is built up by means of drawings of its component parts reproduced on a sheet of paper attached to the screen at the back of the apparatus, and its various features can thus be studied in the process. The principle is that of integration by a connecting cord which passes successively over loose pulleys on the component cranks, and finishes on the right-hand side of the integrating arm—the long, continuous arm just above the demonstrator's pencil—the other end of the arm being pivoted on the support seen at the left. The component harmonic motions to be added are provided by crossheads driven from six continuously rotating cranks which can be seen at the top of the picture. Attached to each crosshead is a loose pulley over which the cord passes, and an infinite connecting rod which carries an extension arm holding the marking point for tracing the component frequency on the indicator paper. Thus the rotation of a crank causes its particular crosshead to move harmonically in a vertical plane, the corresponding loose pulley rising and falling in the same manner.

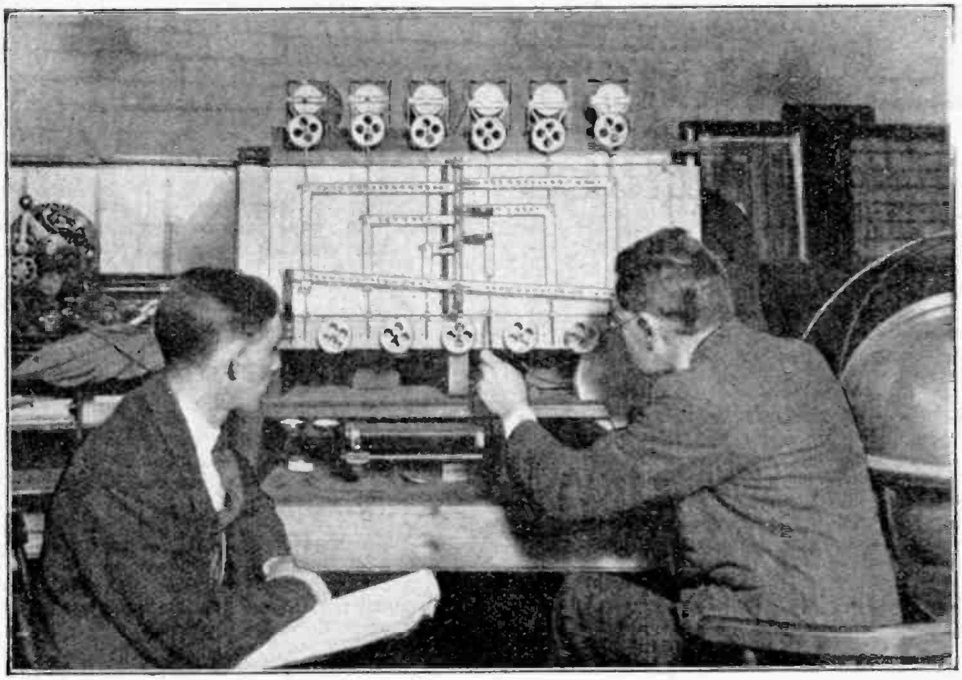
If one end of the integrating cord is held, since it passes over all the loose pulleys in turn, the motion of the free end vertically gives twice the sum of the motions of any of the component crossheads in use. Thus the movement of the arm traces the synthesis curve. As the end of the arm gives a result double the correct amplitude, the marking point of the synthesis curve is placed half-way along the arm, and thus comes into line with the marking points of the components. Simultaneously with the tracing of the resultant wave each component is also traced, and, as all the pencils are brought into line, all the tracings commence at the same position on the time base.

By means of this instrument the phases and amplitudes of the components can be studied, and over-modulation, under-modulation, carrierless transmission and reception, and the beat effect can be demonstrated and studied.

Another model is a parabolic electric wave reflector used for demonstrating beam transmission.



Students receiving instruction in the principles of short-wave transmission.



The mechanical wave synthesiser being demonstrated to a student by Mr. A. W. Ladner, the inventor.

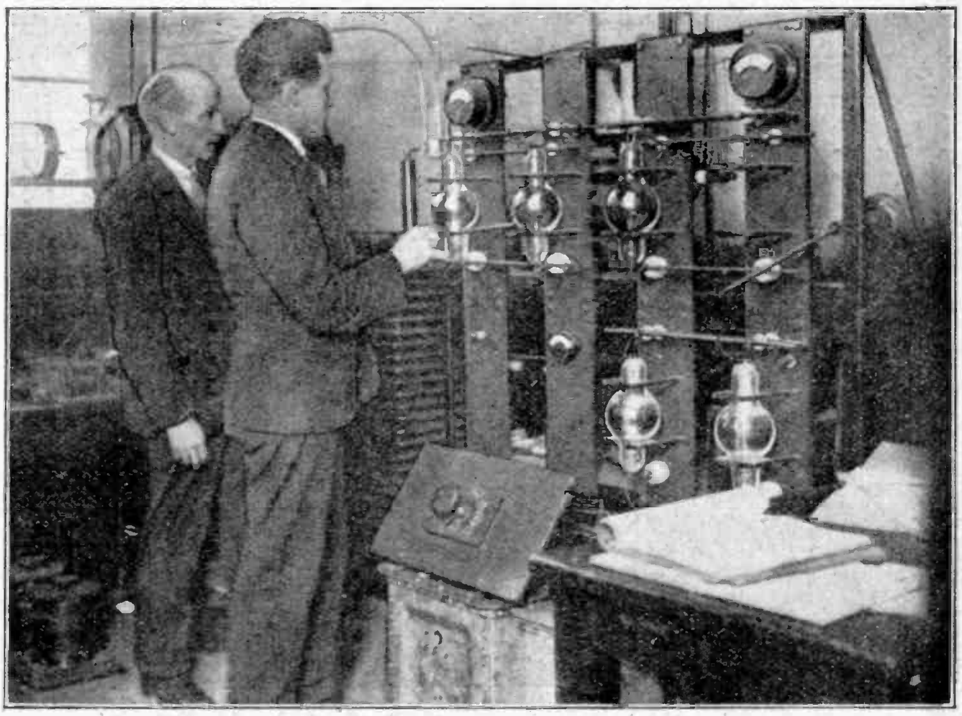
The transmitting room is equipped with a variety of components for valve transmission. These can be fitted up in various combinations on a skeleton panel, shown in one of the photographs. They are particularly adapted for teaching the students the principles underlying the various transmitting circuits, from the simple self-oscillator circuit to the more complicated independent drive and telephone modulator.

At the present time there are at Chelmsford College a number of Imperial Airways mechanics who are undergoing a four months' course of training to enable them to pass the examination necessary for the Postmaster-General's Aircraft certificate, and so to qualify as air mechanic wireless operators. This is in accordance with the decision of the International Commission for Aerial Navigation, which lays down that wireless telegraphy instead of wireless telephony shall be used for normal communication between air liners and aerodrome round stations, and that qualified wireless operators must be carried on all aeroplanes carrying ten passengers or more. During this course these men will receive instruction in sending and reading Morse telegraphy, and will be given a sound training in the construction and operation of wireless telegraphy and telephone sets designed for use on aircraft.

The instrument shown in the illustration in the title of this article is a Marconi A.D.6 aircraft telephone-telegraph transmitter and receiver, which is the standard apparatus used on all Imperial Airways passenger-carrying aeroplanes.

At the college there is also a direction-finding installation; a technical library, including all the most important standard works of reference on wireless subjects; and a well-equipped workshop where such apparatus is made which may from time to time be required for carrying out experiments.

The students are also able to take advantage of the large athletic ground attached to the Marconi Works at Chelmsford, a fact which contributes greatly towards the enjoyment of their visit.



Instructional valve transmitting panel in which the number and arrangement of valves can be varied as required.

TRANSMITTERS' NOTES AND QUERIES

Belgian Amateurs.

The first series of experimental short-wave tests conducted by the Réseau Belge with the co-operation of the S.B.R. (Société Belge Radioélectrique, Brussels) were unfortunately interrupted on account of the breakdown of an engine. A second series began on February 7th, and the Réseau Belge will welcome reports, which should state the nature of aerial used, the type of receiver, the strength and quality of speech received and its modulation, fading effects, atmospherics, and weather conditions. Unfortunately, the complete schedule of transmissions reached us too late for publication in last week's issue, so that we can only give particulars of those of the final four days :—

Feb. 23rd : Transmission from S.B.R. stations in Brussels on 50 metres, and Feb. 24th to 26th on 40 metres, at 0900 to 1000, 1230 to 1300, 1500 to 1700, and 2000 to 2100 G.M.T.

Feb. 23rd to 26th : Transmission from B82 on 15, 25, or 38.50 metres, at 1500 to 1600 and 1900 to 2000 G.M.T.

o o o o

The Royal Decree of October 30th, 1926, has given Belgian amateurs a legal status, and it is anticipated that the number of licensed stations will rapidly increase. Experimental transmitters have formed a national association under the title of the "Club des 4," with M. R. Boëll (B 4AR) as President, and Messrs. T. Courtin (B 4YZ) and R. Pirotte (B 4RS) as Vice-Presidents. The International secretary is M. R. Destrée, and the headquarters are 38, rue de Suède, Brussels.

o o o o

QSL Cards for France.

We are asked to state that cards intended for French amateur transmitters will be forwarded by the R.E.F. (Réseau des Emetteurs Français), if addressed via R. E. F. Larcher, B.P.11, Boulogne-Billancourt, Seine.

o o o o

Amateurs in Iceland.

We understand that in future amateur transmitters in Iceland will use the figure "3" as the first component of their call-signs, thus SN1 will, in future, use the call-sign 3SN.

o o o o

General Notes.

We have received a description of the transmitting station B Y8, owned and operated by M. P. Duvignau, in the laboratories of the Comptoir Radioélectrique, at Antwerp. The transmitter is the Hartley loose-coupled type with tuned choke; the input is 75 to 100 watts to three E 4M valves, taking 6 volts for their filaments and 1,000 to 1,300 anode voltage. The aerial is a single wire, 30 metres in length and 10 metres high, with a single wire counterpoise.

The receiver is an 0-v-1 Grebe type, with Marconi DE3 valves. The station is not very favourably situated, being surrounded by high buildings and near an electric tramway line, but in spite of this B Y8 has been in communication with stations in U.S.A., Chile, Brazil, Australia, Porto Rico, India, and Africa. M. Duvignau is one of the pioneers of wireless in Belgium, having been actively engaged in experiments since 1910. He will welcome all reports on the reception of his signals.

o o o o

Mr. H. Hiley (G 2IH) is now carrying out tests with small indoor aerials on a wavelength of 45 metres. He will welcome reports at his new address, 12, Cavendish Street, Keighley.

o o o o

Short-wave Stations.

We are often asked, by amateurs who wish to calibrate short-wave receivers, for a list of stations transmitting regularly on wavelengths of 13 to 75 metres. The following list of European stations has been compiled from the latest available information :—

Wave-length.	Call-Sign.	Station.
13.5	POF	Nauen.
14.0	FFW	Sainte Assise.
14.25	AGA	Nauen.
18.0	POF	Nauen.
20.0	OCTN	Toulon (transmits "A" from 1530–1540 G.M.T.).
21.0	PCTT	Kootwijk.
24.5	GLQ	Ongar.
25.0	POY	Nauen.
25.0	FFW	Sainte Assise.
26.6	AGB	Nauen.
27.0	PCPP	Kootwijk.
30.0	GBL	Oxford.
30.0	GBM	Oxford.
32.0	OCDJ	Issy les Moulins (Time signals at 0756 and 1956 G.M.T.).
33.0	OCTN	Toulon (transmits "B" from 1545–1555 G.M.T.).
35.0	BYB	Whitehall R.C.
35.0	BWW	Gibraltar, North Front.
36.0	PCMM	Kootwijk (Ministry of Posts and Telegraphs).
39.0	OCMV	Mont Valerien.
40.5	FFW	Sainte Assise.
42.0	PCUU	Hilversum.
46.0	OCMV	Mont Valerien.
47.0	POZ	Nauen.
48.0	OCTU	Tunis la Casbah (weather at 2130 G.M.T.).
50.0	AIN	Casablanca (weather at 0830 and 0930 G.M.T.).
53.0	GBL	Oxford.
53.0	GBM	Oxford.
57.0	OCTN	Toulon (transmits "C" at 1600 to 1610 G.M.T.).
70.0	POX	Nauen.
75.0	F 8GB	Sainte Assise.

o o o o

QRA's Wanted.

F 8KZ, F 8JDZ, F 8JNC, F 8PP, F 8SA, FM 8PMR, A 5JA, K 44, K 4AB, YS 7DD.

BP BC, CACW, AP5, AB4, EG 1BER, EG 1BBR.

WSP, BAD, G 2XA, OQS, P 9AB, KFZQ, PERH, VGJL.

The amateur transmitting station G 5JW at Longsight, Manchester, owned and operated by Mr. Percy Cox. This station has been, as the QSL cards show, in communication with most parts of the world on wavelengths of 44 to 46 metres, the input never exceeding 40 watts.

A TOUR ROUND SAVOY HILL.

Part III.—The Production of Echo Effects by Variable Draping and by Artificial Methods.

By A. G. D. WEST, M.A., B.Sc.

IN the last article reference was made to the "room effect" which is noticeable in transmissions from any normal-sized studio. If the studio has solidly-built walls, floor, and ceiling, the effect is not so serious as it is with a studio with lightly-built walls, which may cause considerable distortion in giving accentuation to certain frequencies or ranges of frequencies resulting in boom tones, rattle effects, and so on.

The difficulty in the ordinary studio is that it is hard to eliminate this effect entirely, even by normal draping. The adoption of the variable draping method results in variable echo, with the character of the "room effect," and quite unlike the "hall effect," which is the desirable one for certain types of transmission.

The introduction of echo effects into the transmission by electrical means is an original contribution to broadcasting technique, for which credit must be accorded to the B.B.C. The method is now a regular feature of studio transmissions from 2LO, as the present article shows.

The practical difference between these two effects can be analysed thus:

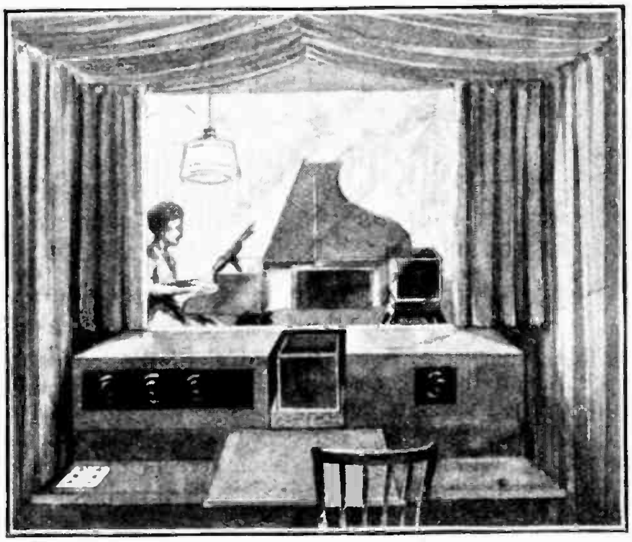
In a room the first few echoes may be individually almost as strong as the original impulse, but rapidly die away because the reflections succeed each other rapidly. In the case of a hall, owing to greater distances travelled, the first few echoes are much smaller in amplitude than the original and take longer to die away, the time between successive reflections being greater. In the former the echoes succeed with a regularity corresponding to frequencies within the musical scale, and the effect is displeasing unless heavy drapery is introduced to cut down successive echoes. In the latter they in general succeed each other irregularly, and do not give rise in themselves to the formation of a musical note, but to a prolonged reverberation background, above which the original sound stands out clearly and prominently, giving the pleasing effect that is required.

2LO's New Studio.

To give, therefore, the "hall effect," the primary requirement (on the understanding that the studio must be agreeably furnished) is that of size. To fulfil this condition the latest studio at Savoy Hill has been built with as large a volume as it was possible to include in the building itself. Chiefly required for the transmission of music by small orchestral combinations, such as octets and solo orchestral and singing items, the floor area has been limited and the volume made up by increasing the height. The primary requirement for good reverberation is satisfied in this. (In Sabine's formula, for given absorption, the time of reverberation varies as the volume.) Furthermore, an opportunity is given for producing a type of reverberation associated with a first important reflection from a high ceiling such as is given, for instance, in the lounge at the Grand Hotel, Eastbourne, where the transmission effect is universally acknowledged to be good. This studio, named No. 7, occupies part of two floors on the north side of the block, having double height, due to the removal of the intermediate floor. The dimensions are 43ft. × 20ft. 6in. × 22ft. 6in. high, giving a volume a little greater than No. 1 studio, the previous largest.

In order to give the greatest possible scope to this studio it was considered necessary to design the inner furnishings to give a variable effective reverberation period to suit all the types of items that would be taking place. The design, however, must fit in with the artistic requirements and methods that were described in the last article in connection with No. 6 studio, and must therefore incorporate a method of mounting the absorbing material invisibly on the walls.

The period of the room in its bare state, with bare floor and ceiling and bare plastered walls, was 7 seconds. This period had to be reduced very considerably, maintaining even absorption for all frequencies. The architectural design, which was worked out by Mr. M. T. Tudsbery, depended a good deal on the necessity for effective ventilation. The walls are therefore divided horizontally by a wooden ventilation channel, carrying the inlet ducts. The outlet ducts run in a wooden panelled channel running round the base of the walls. These panels are supported by vertical wooden pillars, which break up the walls into plaster panels of suitable size. Given this amount of wood surface, together with that introduced by the organ, it was found by calculation how much absorption was necessary



The B.B.C. dramatic studio No. 2, as seen from the producer's cabinet, where he controls the production of stage noises, echo, etc.

A Tour Round Savoy Hill.—

to give the required results. This absorption was introduced by covering all the panels on the walls with a layer of hair felt, half an inch thick, covered in turn with wallpaper to suit the decoration scheme. The floor is covered with a layer of Celotex, an underfelt and a thick carpet, and the variation of effect is introduced by making the draping on the ceiling variable, the heaviest possible material being chosen to give the greatest

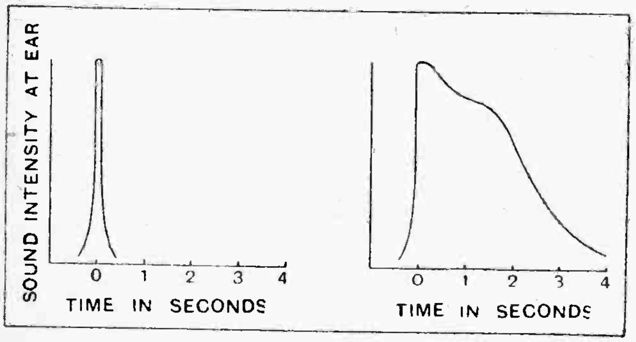


Fig. 10 Comparison between a sound impulse (left) in the studio and the same impulse as reproduced in the echo room.

variation. The following summarises the results desired and obtained:

(1) The reverberation can be varied from approximately 0.8 second to 1.6 second by drawing aside the ceiling drapery. (A good value for an octet is 1.5 second; for a solo instrument about 1.2 second.)

(2) The overall reflection is fairly even for all frequencies, the low tone introduced by the felt being compensated by the high tone reflection of the covering paper and of the wood panelling, pillars and organ. This result is determined by the fixed part of the absorption (which represents more than four-fifths of the total absorption) and thus is not appreciably altered for any changes in the variable draping.

(3) The "room effect" is reduced in favour of a tendency to "hall effect." This is on account of greater volume, and the breaking of reflections by the pillars.

(4) The room has, on account of its scheme of decoration and loftiness, a feeling of freedom which is much appreciated by artists.

(5) The results appear to be suitable within the limits of programme given, and probably represent as much as can be done to get the various desired effects with variable draping.

Artificial Methods of Obtaining Desirable Variable Echo Effects, without Altering the Studio Interior.

Some of the first experiments in varying the echo effect in a given studio were carried out by Capt. Round, of the Marconi Company, in studio No. 3 in 1923. He first of all placed artists in or just outside an open door, allowing an echo background to be formed in the corridor outside, the microphone remaining in the studio. Later he placed a loud-speaker (connected to a receiving set tuned to 2LO) outside the open door of the studio, taking care to avoid any reaction or "singing round." This automatically provided the background, but had to be discontinued when artists complained of a continual barking outside the studio while they were singing! (So much for their opinion of loud-speaker quality at that time.) The problem was later more fully investigated by Capt. Round and the author.

The method of varying echo effect by making use of the direct sound was further developed as a result of some experiments which took place in connection with a broadcast from York Minster early in 1925. As a number of microphones had to be used on this occasion a method of combining them or of fading from one to the other was worked out to enable the various parts of the transmission to follow one another without interruption. In a large echoey building of this nature, with a reverberation of about 6 seconds, it is essential for the transmission of speech to get the microphone as close up to the speaker as possible. The nearer it is the less the effect of reverberation on the transmission of the speech.

The result in question arose when, during the experiments, the Vicar Choral was carrying out a test in front of the pupit microphone, with a second microphone (to be used for another purpose) some 30 feet away. The separate microphones naturally gave vastly different results, the one a close-up dead and echo-less effect, the other an unintelligible, confused and very echoey sound. Any intermediate result could be obtained by combining the two microphones and adjusting the proportion contributed by each. In fact, by varying the controls slowly from the dead extreme to the echoey, it sounded exactly

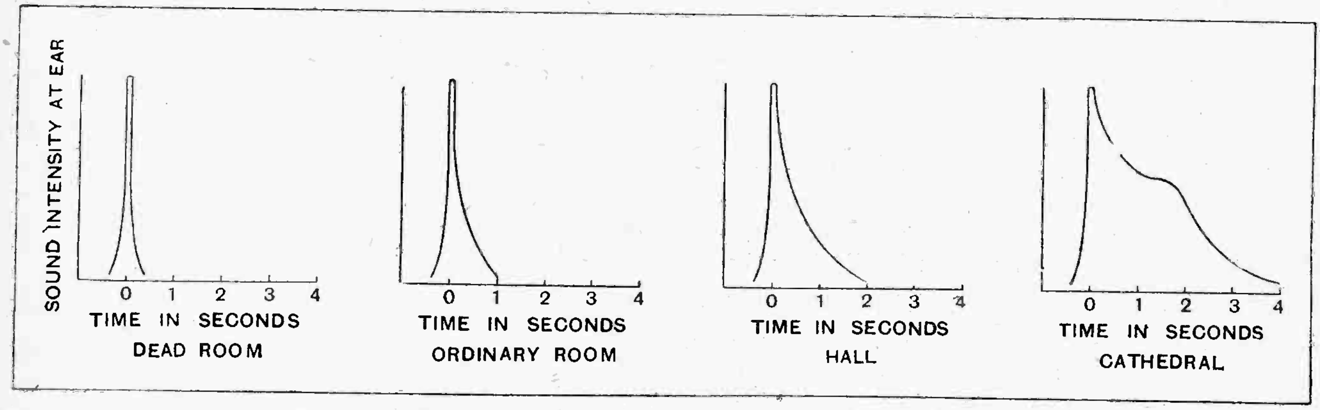
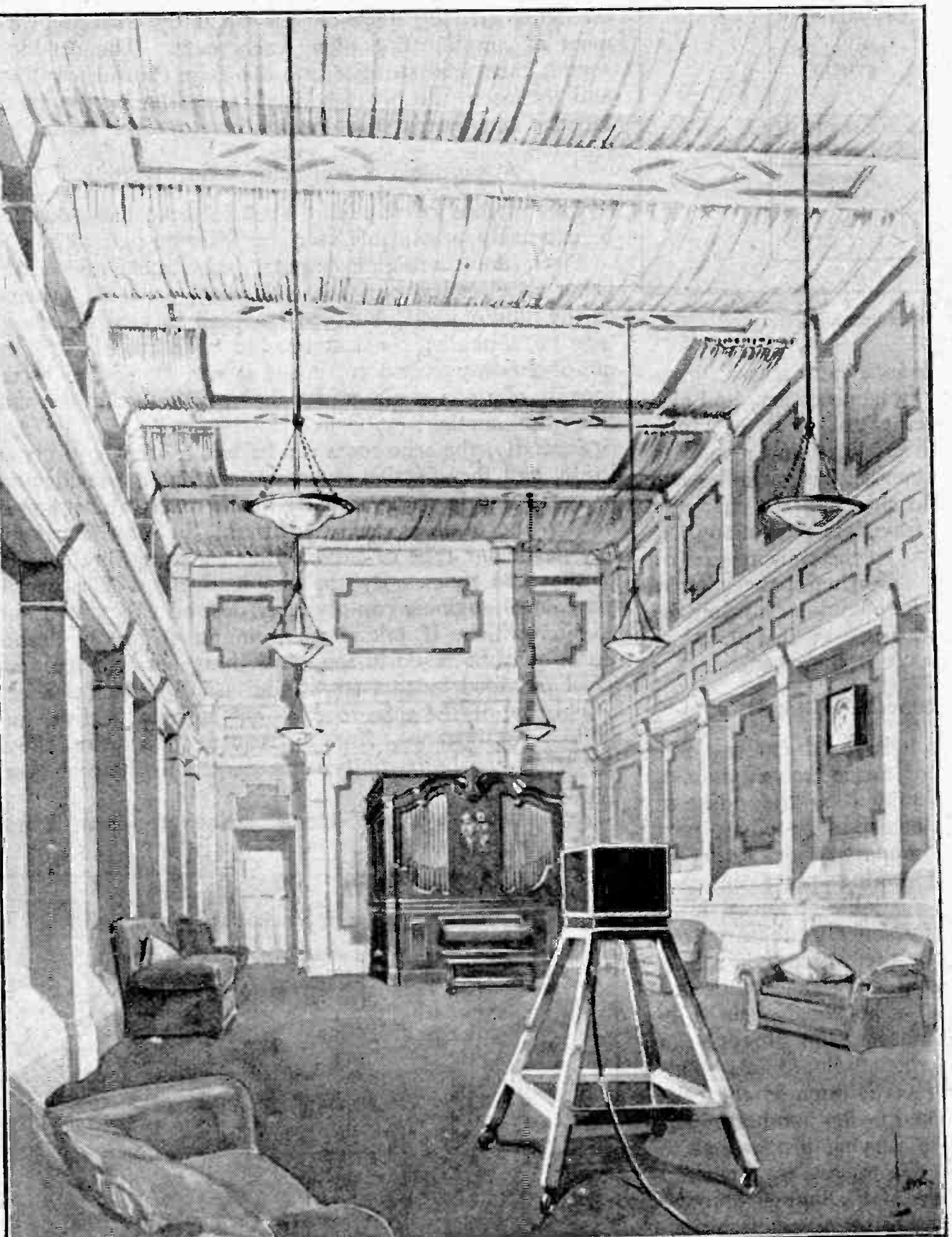


Fig. 11. Echo effects available by varying the proportions of the two effects shown in Fig. 10.

A Tour Round Savoy Hill.—

as if the talker were walking away from the microphone. The arrangement meant an easily controllable variable effective reverberation between the limits given by the two microphones independently.

The application of this principle was first tried in experiments in the transmission of orchestral music from various halls in London. In general a suitable effect as regards reverberation is obtainable by the correct placing of a microphone, but this does not necessarily mean a correct balance as regards the various instruments of the orchestra, a point that is just as important. When the hall is very echoey, the microphone has to be placed close up to the orchestra to avoid confusion and preserve detail, and this generally means that it is difficult to obtain correct balance. A suitable result is achieved by using two microphones close up respectively to the two sides of the orchestra and balancing correctly the proportions from these two microphones. If the hall is not an echoey one, placing the microphones too far away to get the right effective reverberation usually means confusion and loss of detail. The proper result can then be achieved by using one or two microphones fairly close to the orchestra giving the correct balance and using a third microphone some distance away, possibly at the back of the hall to add to the effective reverberation, the proportions from these three microphones being varied to get the balance and reverberation effects correct.



The B.B.C.'s latest studio at Savoy Hill (No. 7).

The same principle can be applied to broadcasting studios, by placing an echo microphone in an adjacent room or corridor. The room (or corridor) in this case must have a fairly large period of reverberation, which can be obtained by emptying it and leaving the surfaces of the walls, floor and ceiling perfectly bare. Music or speech in the studio is allowed to pass through an open door into the echo room, and to be reflected and to reverberate there.

Combining Two Microphones.

The proportions used in combining music from the microphone in the studio itself, and from the microphone in the echo room can be varied to give any effect in the transmission itself from that of draped room to that of a cathedral with the full realism of an outside broadcast transmission, provided that care is taken in preparing the echo room to make it one as far as possible free from the previously-mentioned "room effect." The principle is shown graphically in Figs. 10 and 11, where an original impulse in the draped studio produces a consequent prolongation of sound in the echo room. The combination of the two in various proportions gives an effective result corresponding to the reverberation characteristics of

A Tour Round Savoy Hill.—

the draped room, ordinary room, hall, and cathedral. This arrangement has been used mainly for dramatic work, the Dramatic Studio, No. 2, referred to before, having an adjacent echo room for giving a variation of effect to speech and music in plays produced there. This particular studio consists essentially of four parts; in addition to the three sections—the dramatic, echo, and noise—there is a silence cabinet where the announcer or producer of the play can get the right balance between

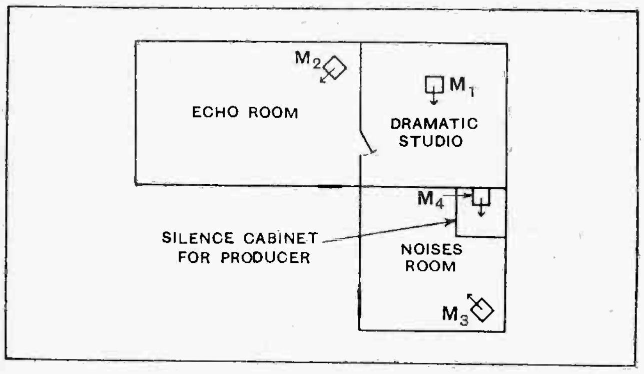


Fig. 12. Plan of dramatic studio and adjoining echo and noise rooms.

the speech of the players and the incidental noises, introduce echo and atmosphere that may be necessary, and also superimpose his voice if he wants to. For example, suppose a travelogue is being given describing a visit to a Chinese city with incidental sounds, the variable echo can be used to great advantage in changing the character of the speech and noises as the travellers pass along the streets, enter temples, and so on. In the transmission of plays its use is very effective for indicating changes in the scene. Fig. 12 gives a plan of these studios showing the placing of the microphones, and Fig. 13 the electrical connections for these microphones and their controls.

The Use of an Independent Echo Room.

The use of echo, important as it is for dramatic work, is much more so for every type of music transmission.

If the right effect can be obtained by the adjacent echo room, then it would seem to be necessary to have next door to every studio a properly prepared room to act as an echo for all transmissions taking place in that studio. With the limited space available at Savoy Hill, it is naturally impossible and impracticable to carry out such a scheme. The problem has, therefore, been solved by the use of an echo room distant from the studio, the music being introduced into that echo room electrically by means of a loud-speaker connected up through an amplifier to the microphone in the studio. This loud-speaker provides the music for reverberation in the echo room, and such sound can be picked up by another microphone in that room and added in varying proportions to the original music from the studio to give any desired effect. To avoid any possibility of "singing sound" effect, it is necessary to divide the direct music as picked up from the studio from the music that has been taken to the echo room to provide the reverberation. This can be carried out in two ways: either by the use of a second microphone in the studio, or by the use of two output circuits operating off two valves in parallel in the final stage of the studio microphone amplifier. The output from one microphone or from one circuit is taken to the loud-speaker amplifier operating a high-quality loud-speaker in the echo room. Another microphone is placed in a suitable position in the echo room to pick up the reverberating music in the echo room, which is then amplified and joined up in parallel with the music on the direct circuit. A controlling switch operating at this point varies the proportions of strength received through both circuits; that is to say, along the direct circuit, and along the circuit *via* the echo room, the respective strengths arriving more or less equal by correct adjustment of amplification along each route. The combined sounds then pass straight into the main control amplifier, and thence to the broadcasting transmitter or the simultaneous line system for distribution to other stations.

Advantages of Artificial Echo Methods.

This method of obtaining artificial echo has proved to be extremely practicable, for the following reasons:

First, the connection between echo room and studio being an electrical one, the echo room need not be close to the studio itself, but can be fitted in any place that may be suitable; for instance, in a basement or in an out-of-the-way corridor. Also, it can be easily disconnected from one studio and transferred to act in conjunction with another.

Secondly, the echo room can be left to work entirely by itself, and the effective reverberation that it provides can be controlled in value actually at the main control amplifier, so the result is easily adjustable in accordance with any particular type of item, without making any changes in the echo room. By the simple turning of a handle the control engineer can give any desired effect for transmission which, if taking place in an originally draped studio may be made to sound anything between the dead effect provided by that studio and a full cathedral effect.

Thirdly, if the echo room is not entirely perfect, and suffers, for instance, from a frequency distortion effect, this effect can be partially compensated in the echo room amplifiers.

Experiments with the use of various rooms at Savoy

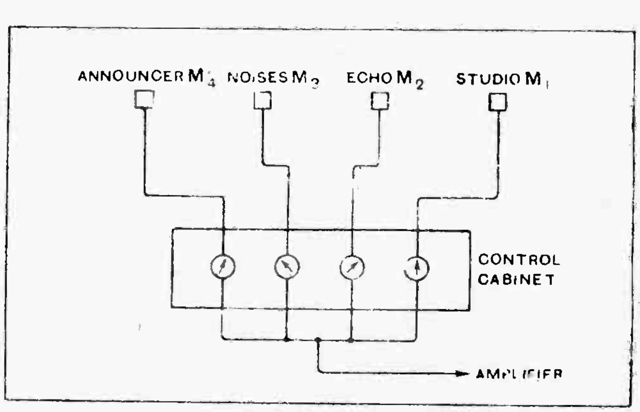


Fig. 13. Electrical connections of microphones in the dramatic studio.

A Tour Round Savoy Hill.—

Hill for echo rooms have been carried out with a view to finding out which type of room gives, on the average, the best results for this purpose. The difficulty of using small rooms is that, however clear and empty they may be, they still suffer to a certain extent from the "room effect." The result is that the reverberation has a distinct characteristic of a certain range of frequencies which, although it is not so noticeable as a "room effect" when broadcasting direct from a studio without superimposed echo effect, can still be observed by the critical ear. Such defects do not exist if the echo room be made very much larger; the ideal result would be obtained in such an echo room if it could be arranged in designing the studio and the echo room to have (1) a fairly dead studio with equal reflection characteristics for all frequencies, (2) a large and reverberant echo room with equal reverberation for all frequencies. A combination of these two in conjunction with microphone and loud-speaker apparatus having good frequency characteristics would give an ideal musical result.

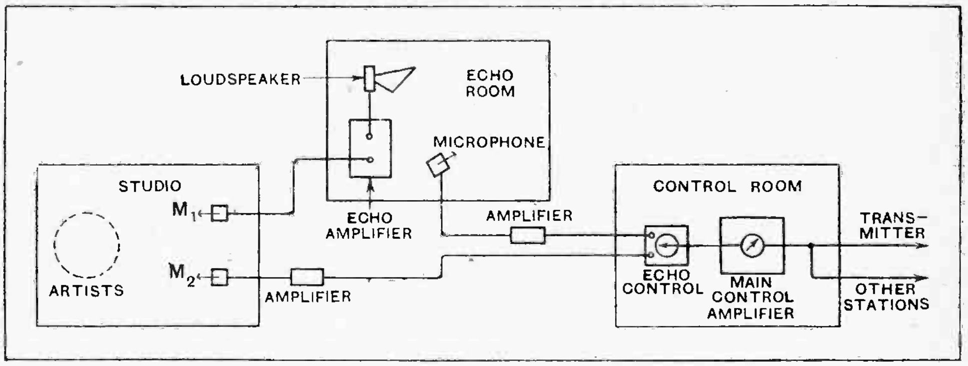


Fig. 14. Diagrammatic arrangement of artificial echo scheme using an echo room distant from the studio.

The echo room which has been used for most of the artificial echo transmission at London is the echo part of the dramatic studio. In a condition of complete isolation with all the doors closed, this room has in itself a reverberation of a high-pitched character, and although partial correction has been made in the electrical system to make the effective result more even for all frequencies, this high-frequency effect is still noticeable. The effect can be partially neutralised by introducing various obstacles such as pillars or wooden furniture into the room to break up the sound as much as possible, but both this method and the method of electrical correction have the result of reducing the overall effective reverberation very considerably, and the result is that a greater proportion of sound passing through the echo circuit has to be used in conjunction with the direct music to give a desired result than would otherwise be necessary. This would mean the possibility of slight distortion of music due to having to use a greater proportion of the part that travelled through the roundabout echo circuit. The remedy, of course, is to use a very much larger echo room having a longer period of reverberation which would give plenty in hand to allow frequency correction to be made if necessary, but probably then the need for such correction would at the same time tend to disappear.

No. 7 studio in its bare condition, with a period of 7 seconds, formed an excellent echo room for this reason, and quite satisfactory results have been obtained by the use of various unfurnished corridors, with bare walls and ceiling, resulting in a more natural effect in the artificial echo than is obtained by the use of a small room.

Problems Arising Out of the Use of Artificial Echo.

The use of artificial echo introduces many possibilities and also many problems. The first problem naturally follows from the fact that a diversity of receiving sets means such a diversity in results to listeners for a given effect in the transmission (this was referred to in the first article).

On what basis should the amount of effect to be used in transmission be determined? On the basis of the most perfect set and reproducer yet devised, or on the basis of the average type of set used by the average listener? Who is to decide how the effect should be used in relation to the item transmitted? If its use is going to add to the greater appreciation of musical transmissions, as it is certainly believed that it will do, will it be in terms of what the musicians think is best or what popularly sounds best?

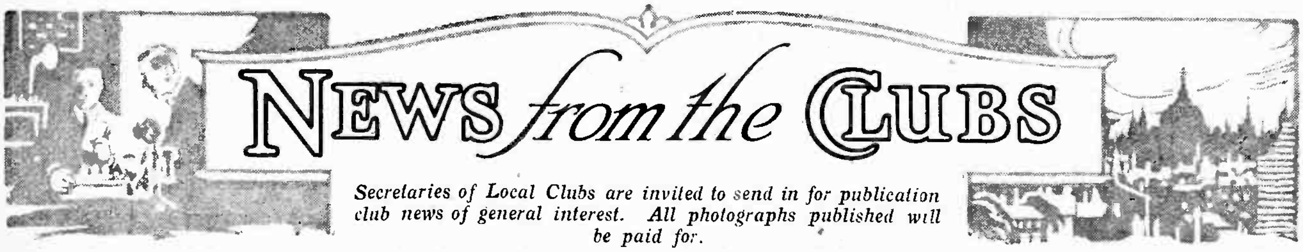
Such problems necessitate, at the present time at any rate, various compromises. In any case, the use of this effect appears to have come to stay, for it has improved enormously certain types of transmission, and can, it is believed, if used correctly, apply with advantage to every type of musical transmission. At the present time a very large proportion of the musical items transmitted from the Savoy Hill studios make use of artificial echo. A good deal of further work is, however, necessary to find out how exactly it can be used to the best advantage.

(To be continued.)

BOOKS RECEIVED.

Wireless Loud-Speakers.—A practical manual under the above title describing the principles of operation, performance, and design, by N. W. McLachlan, D.Sc., Eng. (London), M.I.E.E., F.Inst.P., has just been published. This book, which has previously been announced in *The Wireless World*, can now be obtained, price 2s. 6d. or post free from the publishers of *The Wireless World*, Iliffe and Sons Ltd., Dorset House, Tudor Street, E.C.4, on receipt of remittance for 2s. 7½d. The book deals with the whole subject of loud-speakers, but special attention is given to the design and construction of hornless types, including coil-driven instruments.

Aide-Mémoire du Radio-club de France, by A. Givelet.—Containing notes and memoranda on various components, diagrams of standard receiving and transmitting circuits, useful tables and data, the Morse code and international abbreviations, and a glossary of technical terms in French, German, English, Italian and Spanish. Pp. 190, with numerous illustrations and diagrams. Published by G. Budy et Fils, Paris.



NEWS from the CLUBS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Principles of the Neutrodyne.

A subject of great topical interest, namely, the neutrodyne, was dealt with in a fascinating lecture given by Mr. R. F. G. Holness at the last meeting of the Tottenham Wireless Society. The lecturer gave a clear explanation of the principle of neutrodyning, making use of the Wheatstone Bridge analogy, and outlined the various methods now employed. In the opinion of Mr. Holness, the best system made use of a centre tapped primary winding. The H.T. lead was taken to the centre, one outer lead to the plate, and the other to the neutralising condenser. The secondary was tuned, but any variation in tuning affected equally both sections of the primary winding. Stability over the whole wavelength range was thus obtained. The meeting concluded with a demonstration on a five valve neutrodyne receiver constructed by a member. Hon. Secretary, Mr. A. G. Tucker, 42, Drayton Road, Tottenham, N.17.

oooo

Condensers. Large and Small.

"The Manufacture and Use of Condensers for Radio Purposes" was the title of the lecture given by Mr. Hayward of the Dubilier Condenser Co. (1925), Ltd., at the last meeting of the Southport and District Radio Society. Mr. Hayward gave a careful and detailed description of the methods employed in the manufacture of all kinds of condensers from the small "grid-condenser" to be found in the ordinary broadcast receiver to the huge condenser banks employed at Rugby and other high power stations. Two interesting slides exhibited at the conclusion of the lecture showed "dial reading to wavelength" graphs of linear and square law condensers when used in parallel with a commercial plug-in coil. From these slides it appeared that the advantage of square law condensers over an ordinary type is not considerable.

The Hon. Secretary, Mr. E. C. Wilson, of "Lingmell," Kirklees Road, Birkdale, will be pleased to forward particulars of membership to any interested amateurs.

oooo

Transformer Amplification *v.* Others.

The subject of low frequency amplification received thorough and interesting treatment at the hands of Mr. A. Hall, A.R.C.S., Chief Engineer of Messrs. Ferranti, Ltd., when lecturing at the last meeting of the Stretford and District Radio Society. Mr. Hall first explained the good and bad points of the various systems of amplification and exhibited several diagrams demonstrating the respective merits and de-merits of the transformer, choke, and resistance capacity methods. Turning to the practical side, the lecturer conducted a fascinating demonstration with several test sets embodying different types of coupling. Frequent sine waves of various frequencies were emitted by means of an oscillator, and were received on each set in turn, being reproduced on loud-speakers. It was somewhat startling to discover that on a frequency of 100 a high-class transformer of three years ago was hardly audible, while a modern A.F.3 fairly filled a large room. When the frequency reached 2,000 equality was approached, but on frequencies of 9,000 and 10,000 the A.F.3 transformer again overwhelmed the other types of amplifier. As each receiver embodied a detector and two stages of L.F., it was obvious that modern transformer L.F. amplification has nothing to fear from other types. The lecture was one of the most interesting ever given before the Society.

Hon. Secretary, Mr. W. Hardingham, 21, Burleigh Road, Stretford.

oooo

FORTHCOMING EVENTS.

WEDNESDAY, FEBRUARY 23rd.

Radio Society of Great Britain.—Ordinary Meeting. At 6 p.m. (Refreshments at 5.30.) At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture and Demonstration: "Photo-telegraphy," by Mr. T. Thorne-Baker.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture and Demonstration, "Telearchics," by Mr. L. Hirschfield, B.Sc.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Test of Grid Leaks and L.F. Transformers.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Lecture: "Chemical Action Taking Place in Accumulators," by Mr. W. C. Forsyth.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Lecture: "Selectivity from a New Angle," by Mr. H. T. Winter.

Bristol and District Radio Society.—At 7.30 p.m. At Merchant Venturers' Technical College, Room 22. Special Lecture and Cinematograph Show.

THURSDAY, FEBRUARY 24th.

Stretford and District Radio Society.—At "The Cottage," Derbyshire Lane. Lecture: "The Peter Curtis 8-Valve Super-Het," by Mr. E. Woods (2UA).

FRIDAY, FEBRUARY 25th.

Sheffield and District Wireless Society.—At the Dept. of Applied Science, St. George's Square Lecture: "Detectors: Their Effect upon Quality in Reproduction," by Mr. E. A. Hannay, M.Eng., A.M.I.E.E.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Lecture: "Broadcasting in Central Europe," by Mr. E. N. Kent-Lemon.

Bristol and District Radio Society.—At 7.30 p.m. At the Physics Lecture Theatre, Bristol University. Lecture and Demonstration by Messrs. Electradines, Ltd.

MONDAY, FEBRUARY 28th.

Croydon Wireless and Physical Society.—At 8 p.m. At 128a, George Street. Lecture: "Thermionic Relays," by Capt. S. Arthur Huss.

Northampton and District Amateur Radio Society.—At 8 p.m. At the Cosmo Café, The Drapery. Lecture: "Ancient and Modern Ideas of the Constitution of Matter," by Prof. Beeby Thompson, F.G.S.

Hackney and District Radio Society.—At 8 p.m. At 18-24, Lower Clapton Road, E.5. Junk Sale.

Cinematograph Display.

At this evening's meeting of the Bristol and District Radio Society a special lecture is to be given with the aid of the cinematograph. The meeting begins at 7.30 p.m. and will be held at the Merchant Venturers' Technical College, Room 22.

Hon. Secretary, Mr. S. J. Hurley, 46, Cotswold Road, Bedminster, Bristol.

oooo

All About Accumulators.

Valuable hints on the care of accumulators were given by Mr. H. C. Mayer, of Joseph Lucas, Ltd., in his lecture before the Bristol and District Radio Society on February 4th. Mr. Mayer explained the chemical and physical changes involved in the processes of charge and discharge, and the causes of sulphating with its attendant troubles. Very full details were given of the processes of manufacture, special attention being given to the construction of plates, separators and containers. The lecturer concluded by emphasising the need for special care when giving an accumulator its first charge, and he outlined the precautions necessary when re-charging.

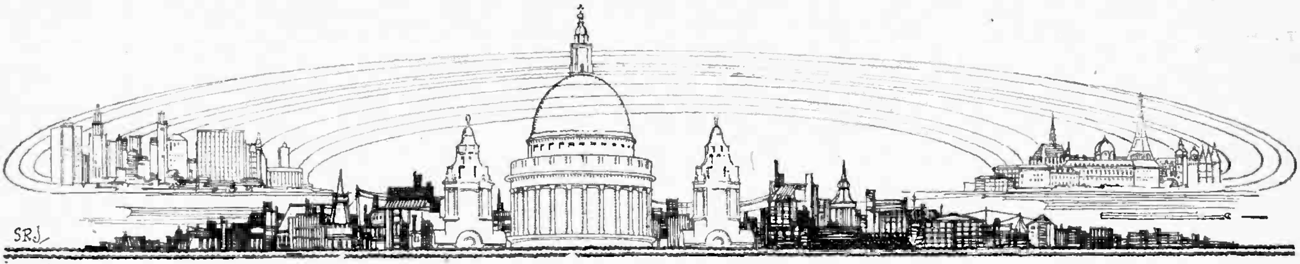
The subject of the weekly ballot among members present was a 60-volt high tension accumulator kindly presently by Messrs. Joseph Lucas, Ltd., the winner being Mr. T. C. Dee.

oooo

Co-axial Valve Mounting.

An informal talk on the co-axial method of valve mounting, given by Mr. J. M. Colbert, of Messrs. A. C. Cossor, Ltd., provided an interesting evening for members of the Ipswich and District Radio Society on Monday, February 7th. The speaker succeeded in being entertaining and instructive without resorting to "highbrow" technicalities. He explained how the Cossor principle of co-axial mounting of the three elements made for uniformity in different valves of the same type and was effective in eliminating microphonic noises. Mr. Colbert concluded with some useful hints on obtaining better all-round reception.

Hon. secretary, Mr. H. E. Barbrook, 22, Vernon Street, Ipswich.



CURRENT TOPICS

News of the Week in Brief Review.

708.

According to the Department of Commerce, Washington, the number of registered broadcasting stations in America on January 31st was 708.

o o o o

THE LADY "PIRATE."

Brighton's first wireless prosecution took place last week, when a woman was fined 10s. for operating a set without a licence. The defendant pleaded that the instrument was not working satisfactorily.

o o o o

A DUBLIN HAUL.

No fewer than 101 persons were prosecuted in Dublin District Court last week for having failed to take out wireless receiving licences. Defendants who had since paid the licence fee were fined 20s. each, while fines of £5 and costs were imposed on those who were still defaulters.

o o o o

LECTURE ON "PHOTO-TELEGRAPHY."

Mr. T. Thorne Baker will give a lecture and demonstration dealing with "Photo-Telegraphy" at an ordinary meeting of the Radio Society of Great Britain, to be held this evening (Wednesday) at 6 o'clock at the Institution of Electrical Engineers, Savoy Place, W.C.2.

o o o o

WORLD CONFERENCE IN THE AUTUMN.

The International Radio Conference will probably meet in Washington, D.C., on or about October 1st. Many striking proposals will probably be made regarding broadcasting regulations and wavelengths both in America and Europe, and it is understood that a book of proposals is being distributed among the countries involved.

o o o o

TRANSATLANTIC TELEPHONY EXTENSIONS.

During the past week the transatlantic telephony service has been extended to several States in America constituting the *Second* and *Third* American Zones. The charge for calls to the Second Zone is £15 12s. for the first three minutes, and £5 4s. for each additional minute or fraction thereof. Calls for the Third Zone are charged for at the rate of £16 14s. for the first three minutes, and £5 8s. for each additional minute.

A BAD CASE.

"When Tramcars Come Through the Loud-Speaker," runs a headline. In cases like this the victim should switch off immediately and try a double soda.

o o o o

WIRELESS FOR SICK SAILORS.

Naval men in Devonport are subscribing towards the cost of establishing a wireless receiver in the Plymouth Royal Naval Hospital.

A BRITISH WIRELESS PIONEER. The late Dr. James Erskine-Murray, whose death occurred on February 12th. Dr. Erskine-Murray was an assistant of Mr. Marconi in the early days of wireless. In 1921 he was President of the Wireless Society of London.

DEATH OF DR. ERSKINE-MURRAY.

With great regret we have to record the death, at Portsmouth, on Saturday, February 12th, of Dr. James Robert Erskine-Murray.

From 1898 to 1900 Dr. Erskine-Murray was an experimental assistant to Mr. Marconi. He was the author of several works on wireless telegraphy, and spent many years as lecturer and consulting engineer on the subject. During the war he served with the Royal Air Force, being in charge of wireless instrument design and experimental work. Afterwards he was appointed Experimental Engineer at H.M. Signal School, R.N. Barracks, Portsmouth.

Dr. Erskine-Murray will be remembered as a past President of the Wireless Society of London (now the Radio Society of Great Britain). He was also a Fellow of the Institute of Physics and of the Institute of Radio Engineers.

o o o o

THE "DEATH RAY" AGAIN.

Another "death ray," this time dispensing with wireless, is reported to have been discovered at Montpelier, France. The last sensational claim of this kind was that of Mr. Grindell-Matthews, whose invention was rejected by the Air Ministry in 1924.

o o o o

RADIO CORPORATION OF AMERICA.

It is confidently predicted in New York that the Radio Corporation of America will show a substantial increase in profits for 1926 as compared with the previous year. Gross earnings for the first nine months of 1926 totalled $38,941,743, against $27,165,529 in the same period of 1925.

o o o o

TO THE TUNE OF £150.

Mr. Horatio Nicholls, the song writer, telephoned a song from New York to his publishers in London last week at a cost of £150. The song took thirty minutes to transmit.

The words and notes were first dictated to Mr. Jack Hylton at an office in Denmark Street, W.C., and the song was then sung by the composer. Mr. Hylton orchestrated the melody, which was played at a London music-hall on the same evening.

o o o o

LAST WORD IN MARITIME WIRELESS.

The M.V. *Alcantara*, the latest addition to the fleet of the Royal Mail Steam Packet Company, has been equipped with the most up-to-date Marconi apparatus both for wireless communication and music reproduction.

Four microphones and six loud-speakers are included in the Marconi band repeater equipment by means of which music from the ship's band is reproduced in different parts of the vessel.

D.F. CAR FOR WINNIPEG.

An "interference car," for the purpose of locating the origins of interference to broadcast programmes in Winnipeg, has been commissioned by the Canadian Government. The car will be equipped with the latest D.F. devices.

oooo

TO PLEASE EVERYBODY.

In view of the scheme, recently advocated by *The Wireless World*, whereby all sections of the listening public could be catered for by allocating different evenings for different classes of broadcast programme, a recent recommendation by the Wireless Associations' Advisory Committee is of special interest. "Until an alternative programme is available," says the Committee's report, "it is urged that the British Broadcasting Corporation should adopt the policy of making the entertainment from 7.30 to 10 p.m. continuous. The entertainments each night should vary in character, so that all listeners could be sure of hearing two or three programmes a week definitely to their taste."

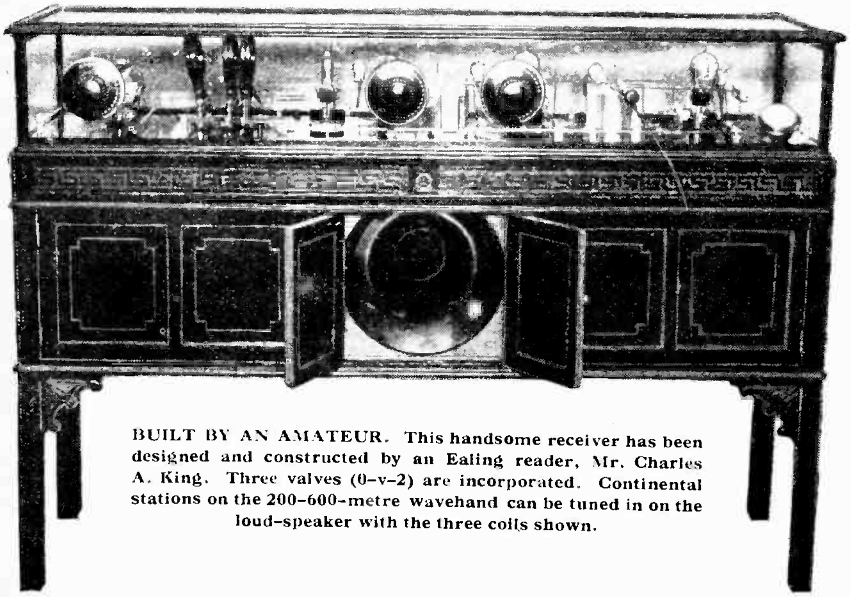
oooo

GENERAL FERRIÉ AS GUEST OF HONOUR.

General G. Ferrié, Inspector-General of Communications in the French Army, was the guest of honour at a luncheon of the Anglo-French Luncheon Club held on Wednesday last at the New Prince's Restaurant, London. Sir John Reith presided, and those present included Dr. W. H. Eccles, F.R.S., Mr. E. H. Shaughnessy, Capt. P. P. Eckersley, and Sir Frank Dyson, F.R.S.

Sir John Reith welcomed General Ferrié and paid a great tribute to his pioneer work in connection with wireless in military operations. In his reply the General spoke of his admiration for the profound impression created by the English, who in the early days of the science included such immortal names as those of Faraday, Maxwell, and Kelvin. Reviewing the work that had been done in the discovery of electro-magnetic rays, the French engineer showed how the scale of frequencies had been lengthened until the discovery of the rays of radium. Was this the limit of the ever-decreasing wavelengths? he asked. It was hardly probable. Already it seemed to be demonstrated that the sun, and perhaps certain other stars, gave out radiations which penetrated lead thicker than that which arrested all other known rays and which were designated "Ultra Penetrating Rays." Should their existence be ultimately confirmed, who knew whether it might not be possible to find others still shorter?

General Ferrié will best be remembered for his work in the construction of the Eiffel Tower station, which he began in 1903. In 1908 he commenced the establishment of wireless telegraphy in Morocco, and it was this system that he then set up which ensured the maintenance of communications for the French expeditionary force.



BUILT BY AN AMATEUR. This handsome receiver has been designed and constructed by an Ealing reader, Mr. Charles A. King. Three valves (0-v-2) are incorporated. Continental stations on the 200-600-metre waveband can be tuned in on the loud-speaker with the three coils shown.

oooo

THE U.S. RADIO BILL.

According to our Washington correspondent, there is little doubt that the composite radio Bill which is being placed before Congress this session will pass into law. The Bill provides for the appointment of five Federal Radio Commissioners, in whose hands will be placed the control of all radio communication in America.

The great question now exercising the minds of the radio public is with regard to the measures which the Commissioners will take to overcome the present chaos in the ether, caused by more than 700 broadcasting stations

As soon as the Bill is passed all these stations will, technically speaking, be infringing the law until they secure licences.

WIRELESS AT WESTMINSTER.

By Our Parliamentary Correspondent.

A Point About Licences.

Last week in the House of Commons Viscount Wolmer, the Assistant Postmaster-General, informed Colonel Applin that a wireless receiving licence entitled the licensee to use wireless apparatus in the premises occupied by him. One licence would cover any number of sets installed in the same premises for the use of the licensee, his family, or his servants, but any other person occupying a portion of the same house under a separate tenancy and desiring to install wireless receiving apparatus must take out a separate licence. When a licensee ran telephone leads from his set to the house of a neighbour or to any premises other than those in his own occupation for the purpose of conveying broadcast programmes there, a separate wireless licence was necessary for such premises.

Amateur Broadcasting in Manchester.

Major Ainsworth asked the Postmaster-General whether his attention had been called to the broadcasting of a regular entertainment by an amateur station at Manchester; and what action, if any, had been taken in the matter, in view of the terms of the licence issued to the British Broadcasting Corporation.

Sir W. Mitchell-Thomson said that his attention had recently been called to a case in which an experimental wireless station had been used for the transmission of concerts. The licensees claimed that these concerts were necessary for the purpose of scientific experiments which they were conducting; but he was not satisfied on that point, and he had asked them to discontinue the concerts until the matter had been considered in the light of certain information which he had requested them to furnish.

Licences for Crystal Users.

Mr. Geoffrey Peto asked the Postmaster-General whether he would consider the reduction of the licence for crystal wireless sets to 5s. per annum?

Sir W. Mitchell-Thomson: "No, sir."

The Regional Scheme.

Mr. Duckworth asked the Postmaster-General if he would give the attitude of his department towards the new regional broadcasting scheme; and whether there was any hostility to this development of alternative programmes on the part of either Government departments or commercial wireless services?

Sir W. Mitchell-Thomson said that he gave authority to the British Broadcasting Company last year to undertake experiments with a view to ascertaining whether a regional scheme could be adopted without causing interference between one broadcasting station and another or between broadcasting stations and other wireless stations. The Company conducted some experiments, and the Corporation were at present arranging to carry out further experiments. The answer to the latter part of the question was in the negative.

BROADCAST RECEIVERS

EDISWAN R.C. THREESOME

An Inexpensive Three-valve Receiver for Home Construction.

FOR some time past The Edison Swan Electric Co., Ltd., have made a speciality of the manufacture of high resistances for anode resistances and leaks in the system of resistance-capacity coupling developed by von Ardenne and Heinert. This principle was first described in *The Wireless World* in the issue of September 23rd, 1925, the principal feature being the use of anode resistances of the order of megohms in conjunction with small-capacity coupling condensers and high-resistance grid leaks. This arrangement gives exceptionally uniform amplification over the range of audible frequencies, and the amplification per stage is little less than the amplification factor of the valves. Further, the step-up of voltage is attained with an expenditure of power which is negligibly small. This results in economy of filament and anode current in the *amplifying* valves, and it is not until the power or output valve is reached that generous emission from the filament is required.

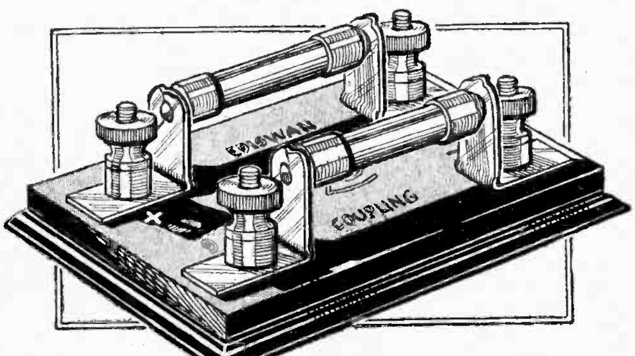
The Ediswan R.C.2 valve has been specially developed for use in amplifiers of this type. It has an amplification factor of 30 and impedance of 150,000 ohms, the filament being rated at 2 volts and 0.1 amp. A power valve, the P.V.2, for use in the final stage of an amplifier preceded by R.C.2 valves in the earlier stages is also available. This valve has a slightly heavier filament, taking 0.15 amp. at 2 volts, the amplification factor and impedance being 6 and 9,000 ohms respectively.

Simple to Build.

Here, then, we have the essentials of an inexpensive set—specially designed valves of low current consumption and reliable non-inductive resistances. The Ediswan organisation has not been slow to appreciate this, and the result is the "R.C. Threesome" design. Complete instructions for building this set, together with a full size blue print showing the layout and wiring are issued free by the company. The booklet, besides giving detailed instructions for assembling and wiring, also contains a chapter on the theory of resistance coupling for those whom it may interest, and characteristics of the R.C.2 and P.V.2 valves. The circuit of the receiver indicates that it will be best suited to high-quality reception of the local station. No reaction is employed, the two-coil holder being used as a coupled tuner, which provides an excellent volume control. In addition to the use of resistance coupling, high-quality reproduction is ensured by anode bend rectification, the first valve operating under these conditions with a separate H.T. voltage of 60. The second valve—a pure amplifier—and the power valve are both supplied with H.T. at 120 volts. The anode resistances have a value of 3 megohms, and the grid leaks 4 megohms.

Coupling Units.

Complete resistance coupling units incorporating two resistance elements and a mica dielectric coupling condenser have been produced. These are mounted on ebonite bases complete with terminals, and are engraved so that the novice should have no difficulty when wiring the set. These units, together with the valves, are the foundation of the set, and, while a certain amount of freedom in the choice of other components is permissible, the reader cannot be said to have built the "R.C. Threesome" unless he makes use of the correct valves and coupling units.



Complete coupling unit, comprising anode resistance, grid leak and coupling condenser mounted inside base.

Through the courtesy of the manufacturers we recently had an opportunity of testing one of these sets constructed with Ediswan components. The results from 2LO at a distance of three miles were excellent. The aerial coupling had to be

Broadcast Receivers.—
considerably reduced to avoid overloading the amplifying valves, and tests with various types of loud-speaker indicated that the limitations of the quality of reproduction are determined by the loud-speaker characteristic rather than by the receiver itself. The published characteristics of the power valve indicate that a medium or small-sized loud-speaker is best suited to its output.

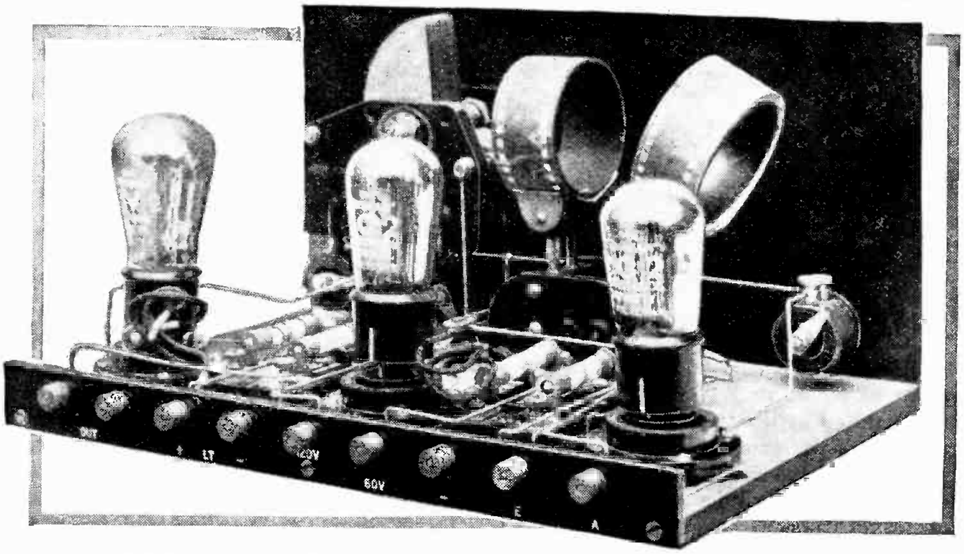
The aerial and earth leads were then removed from the set to determine whether any of the background noise could be attributed to the set. Under these conditions no trace of sound could be heard from the loud-speaker even with the ear placed quite close to the flare. The test was made with accumulator H.T. batteries, and it can be stated with certainty that the Ediswan resistances were perfectly constant and silent in operation. They have all the advantages of wire-wound resistances without detrimental self-capacity.

There is a discrepancy in the instruction book regarding grid bias. According to the valve curves on page 9 a grid bias for the P.V.2 valve of − 4 volts is indicated for an anode potential of 120 volts; on page 11 the reader is instructed to apply − 9 volts. In a circuit of this type, insulation resistance can play an important part in determining the grid bias required, and it is safer to find the correct value for each valve by trial than to rely on predetermined figures. The anode voltage on the detector should also be varied a few volts at a time to find the value corresponding to the grid bias in use at the time.

There is one other minor criticism. Unless great care is exercised when inserting or removing valves and coils there is a possibility that some of the longer connections in the wiring may be depressed and make contact with wires lower down. Short-circuits through this cause will not be possible if covered wire is used instead of the bare tinned copper wire originally specified.

The total filament current is 0.35 amp. at 2 volts, and the 40-ampere-hour accumulator cell recommended would give approximately 110 hours' service on a single charge. The drain on the H.T. battery is correspondingly light. The first two valves take only a few microamperes between them, while the anode current to the output valve is only about 5 milliamperes. Consequently, H.T. batteries constructed with the smallest type of cells will give satisfactory service—another instance of the all-round economy of this system of amplification.

The cost of accessories, such as valves, batteries and loud-speaker would be about £6, so that the total cost of the whole installation works out in the neighbourhood of £9.



The simplicity of the R.C. Threesome is at once apparent from this view taken from the back of the set with valves and coils in position. The fixed vertical coil is the aerial coil, the secondary coil being movable.

The instruction book and blue print can be obtained free of charge from The Edison Swan Electric Co., Ltd., 123-125, Queen Victoria Street, London, E.C.4. A supplementary instruction book and blue print is also issued showing a modification of the standard circuit to give increased range and selectivity. The difference between the two circuits is centred round the tuning circuit; the coils in the two-coil holder are used as tuned aerial coil and reaction coil instead of untuned aerial and tuned secondary coil respectively. With this circuit a by-pass condenser across the first anode resistance is essential, and a resistance as high as 3 megohms (the normal value) cannot be used. Special anode resistances for the reaction circuit, distinguished by a green label, are available at all Ediswan depots.

THE "EVERYMAN FOUR."

The following is an interesting extract from a letter received from a firm of electrical engineers in Liverpool :—

"We are pleased to note that you are publishing a special booklet dealing with the "Everyman Four" receiver.*

"We enclose herewith our official order for 36 copies, and shall be pleased to receive them at your earliest convenience.

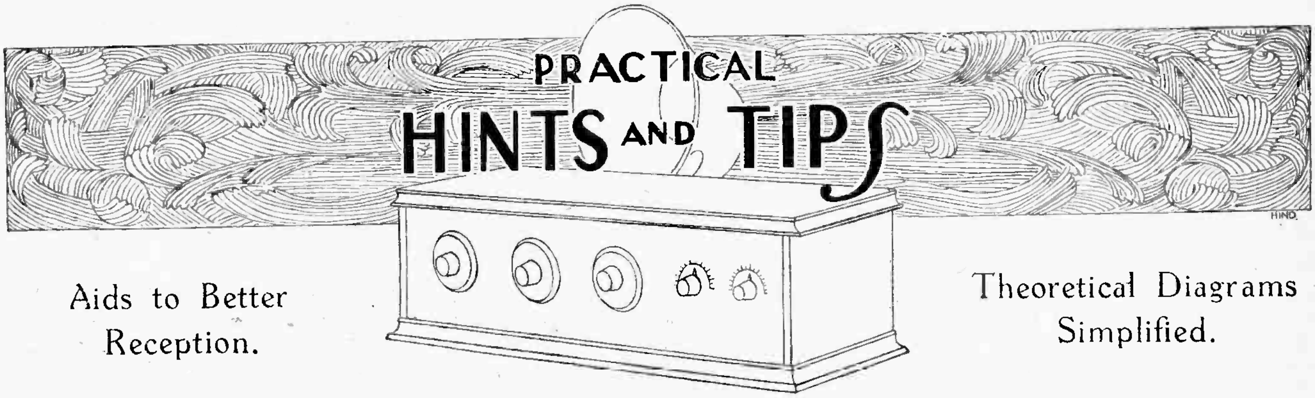
"The writer would just like to mention that he himself constructed an "Everyman Four" receiver some three months ago and he has received excellent results.

"Immediately the set was finished and put on test, 45 stations were received on the headphones and loud-speaker.

"This reception was carried out on a Sunday afternoon in broad daylight using an inside aerial.

"Needless to say, the writer became very enthusiastic over this set and as a result has been able to recommend it to a number of local experimenters, all of whom have received similar results to his own."

* *Price 1s. 2d. post free from the publishers of* "The Wireless World."



PRACTICAL HINTS AND TIPS

Aids to Better Reception.

Theoretical Diagrams Simplified.

"DISSECTED DIAGRAMS."

In this issue is printed the first of a new series of diagrams in which an attempt will be made to present concisely the principal points to be considered in the design of typical wireless receivers. The majority of those treated will represent modern practice, but a few well-tried and standard circuits, which still have a distinct field of usefulness, will also be given.

While these diagrams will primarily deal with the strictly practical aspect of the subject, they should serve another useful purpose. Many newer readers of this journal are unable to read circuit diagrams—mainly because they have ignored the fact that such diagrams should be considered in stages, and not as a whole. Without this knowledge, it is safe to say that no one can go very far in wireless, and every reader should make an attempt to acquire this essentially simple art. It is admitted that the circuit diagram of a multi-valve set may at first sight appear to be alarmingly complex; but the subject, viewed from the right aspect, soon loses its terrors.

The set builder who acquires the art of reading theoretical diagrams will find that his efforts are amply repaid, as, armed with this knowledge, he will be able to ignore practical wiring plans. There can be no doubt that a complete reliance on such plans is dangerous, as no real insight into the working of the receiver is gained when following them, and the amateur will not be in a good position to make any slight departures from the original design which may be desired, and, moreover, he will find it difficult to trace any faults which may arise.

THE "EVERYMAN'S FOUR" WITH AN H.T. ELIMINATOR.

When supplying a receiver with H.T. from D.C. mains it is always advisable to insert a large fixed condenser in series with the earth lead. This is, of course, essential when the positive main is earthed, and is generally necessary even with the more usual arrangement of an earthed negative, as there is often some slight difference of potential between the "set earth" and the "mains earth." This is occasionally responsible for a certain amount of "hum" in the loud-speaker, which may generally be eliminated, in the case of the "Everyman's Four" and "Everyman's Three" receivers, by arranging to earth the filaments of the valves and the L.T. battery at only one point.

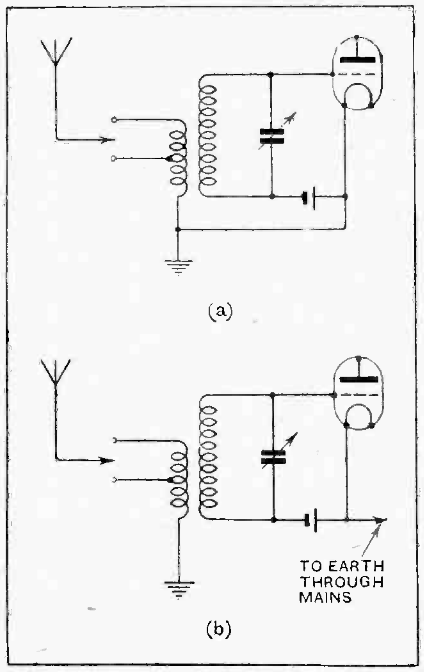


Fig. 1.—A conventional "untuned" aerial coupler; and, below, the same circuit with battery earth removed for operating from an H.T. battery eliminator.

In Fig. 1 (a) is shown the usual connection of the aerial-grid coil, which is suitable when batteries are used for both filament lighting and H.T. supply, with a lead between the common negative L.T. and H.T. bus-bar and the earth terminal. If the circuit is slightly modified, as shown in Fig. 1 (b) the filaments are in metallic connection with earth only through the mains, so a series condenser is no longer necessary.

This arrangement may reduce the efficiency of the receiver on the long-wave (Daventry) adjustment, but in spite of this it is well worth trying, especially when receiving conditions are such that there is an ample margin of signal strength from this station.

oooo

RE-CALIBRATING A MILLIAMMETER.

For use with the majority of valves obtainable a year or two ago, a milliammeter with a reading of up to five or six milliamperes was generally considered suitable. Such an instrument is now, however, quite useless for measuring the anode current passed by the modern "super-power" valve, which, under working conditions, may consume as much as 10 milliamps., or even more.

It is useful to know that the range of these instruments may be doubled in a very simple manner by connecting a resistance, or shunt, in parallel. The windings of a potentiometer, a rheostat, or a semi-fixed filament rheostat will serve the purpose, if of sufficiently high ohmic value. The latter is particularly convenient. To make the necessary adjustment, the meter may be connected in the anode circuit of a valve in the usual manner. The current indicated by it should now be reduced by altering the H.T. voltage, dimming the filament, or a combination of both methods, until a convenient reading (preferably an exact even number of milliamperes) is obtained. The shunt is now connected across the milliammeter, and its value is adjusted until the reading is exactly half of the original. The shunt should now be removed temporarily to make sure that the current flowing has not changed, on account of a possible fall in battery voltage. If it has, the operation must be repeated until conditions of stability have been reached, but if not, the shunt may be connected permanently. To obtain a correct estimate of the current flowing, the readings indicated on the scale must now be multiplied by two.

Needless to say, this method is only applicable to moving-coil instruments having a "straight-line" scale, on which equal variations in current are indicated by equal spacing of the graduations. A moving-iron meter cannot be calibrated in this manner.

It is possible to make a still greater reduction of the scale by fitting a shunt of smaller resistance; thus, a steady current of 4 milliamperes may be passed through a 0.5 meter, and the resistance adjusted till a reading of 1 milliamp. is obtained. With this shunt in position, the current as indicated must be divided by four to obtain the true value.

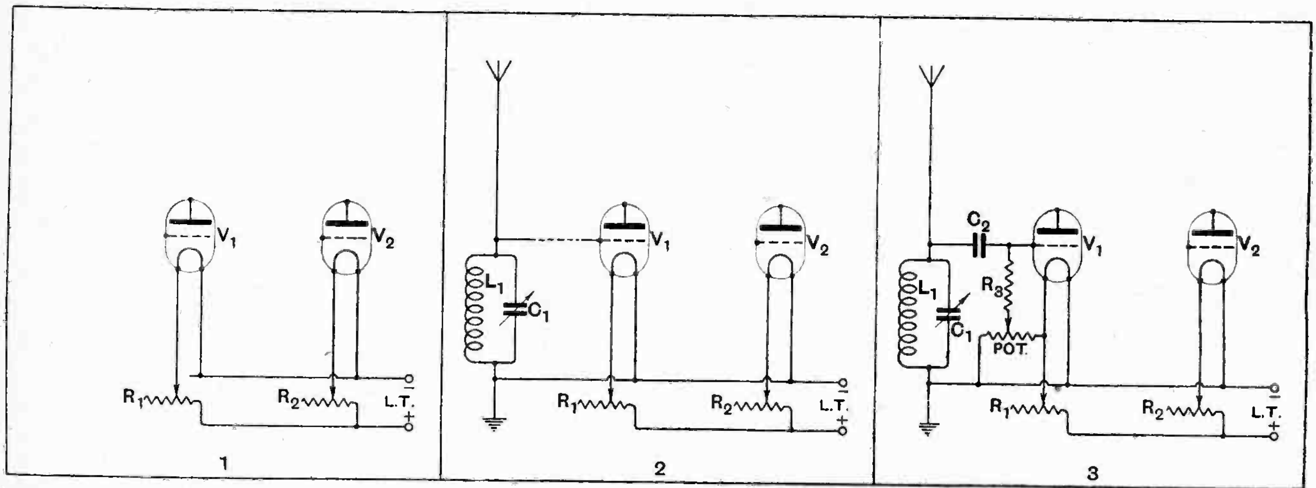
DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 61.—A Regenerative Detector–L.F. Receiver.

(To be continued in next week's issue.)

The simple circuit shown below is not highly selective, but, with careful operation, it is capable of receiving distant stations on headphones, and a near-by transmitter at loud-speaker strength. It is an arrangement which can be recommended to the beginner.



1. The filaments are connected in parallel across an L.T. battery, with controlling rheostat in series with each.

2. Aerial and earth are joined to a tuned circuit, which is connected across grid and filament.

3. To obtain rectification effects, a grid condenser is inserted. Its leak is connected to the filament through a potentiometer.

THE valve V_1 is to operate as a detector, and should have the highest amplification factor possible, with a working impedance not greatly in excess of 30,000 ohms. V_2 is the L.F. amplifier, which, if good quality reproduction is required, should be of the "power" type (impedance 10,000 ohms or less).

The resistance of the filament rheostats (R_1 and R_2) will depend entirely on the voltage of the L.F. battery and the rating of the valve, and may easily be calculated by dividing the voltage to be dropped (*i.e.*, the difference between the rated voltage of the valve and that of the battery) by the current consumed (in amperes). The result will be the required resistance in ohms.

In Fig. 2 the aerial tuning inductance (L_1) will have a value depending entirely on the wavelength to be received and the characteristics of the aerial. For the broadcast waveband coils No. 35, 40, and 50 are generally required, and for Daventry No. 150 or 200. A tuning condenser (C_1) of 0.0005 mfd. is convenient; as it is in a circuit already having a large amount of capacity (that of the aerial) in parallel, it matters little whether it is of the "semi-circular plate," square-law, or S.L.F. variety.

Referring to Fig. 3, the grid condenser C_2 may have the standard capacity of 0.0003 mfd. with a 2 megohm leak (R_3). The lower end of this leak may be connected to the positive side of the filament, but the interposition of a potentiometer as shown is recommended. By its use the operator can make an adjustment of grid voltage which is a compromise between that giving best detection efficiency and smoothest control of reaction.

Measurements on RADIO-FREQUENCY AMPLIFIERS.

IV.—Intermediate Amplifiers for Supersonic Heterodyne Receivers.

By R. L. SMITH ROSE, Ph.D., D.Sc., A.M.I.E.E., and H. A. THOMAS, M.Sc.

WHEN any demonstration or exhibition of wireless receiving apparatus is given, one of the most noticeable things attaching thereto is the entire lack of any method of judging the relative merits of the different sets. If one is fortunate, there may, of course, be the opportunity to try one set after another under the same conditions, but even this is not entirely satisfactory and is found to be rather crude, particularly when the development of an amplifier or receiver is being carried out. Those who have given any consideration to the matter will appreciate that our inability to give a "figure-of-merit" to receiving apparatus as a whole is due to the large experimental difficulties in the way of making reliable and accurate measurements of the various quantities concerned. In the previous articles the authors have described the lines along which an attempt is being made to investigate these difficulties, attention being devoted in the first place to the reduction of the ordinary cascade valve amplifier to measurable quantities. As an illustration of the method of applying the results obtained in such measurements, the case of the intermediate-frequency amplifier used in the supersonic heterodyne receiver may be discussed.

As most readers of *The Wireless World* are aware, this type of receiver utilises a local oscillator and a rectifying valve to transform the original high-frequency oscillations of the received waves into oscillations of a lower radio frequency at which a comparatively large amplification may be obtained in an efficient and stable manner. Although this type of amplifier is now in everyday use for the reception of broadcasting, it is doubtful if its somewhat unique advantages are yet fully realised, particularly in the large and growing field of short-wave communication, where amplification at the original radio frequency is very difficult to obtain. The supersonic heterodyne type of receiver is available for use on any band of wavelengths by a simple modification of the aerial tuning arrangements and the frequency range of the local oscillator. The large proportion of the effective operation of the instrument is thrown on the amplifier used at the intermediate frequency, and this may remain unchanged, whatever the actual wavelength being received.

For several years there has been a great struggle to design and construct an amplifier which would give a good performance over as wide a band of wavelengths as possible. In the supersonic heterodyne receiver, what we require is an amplifier which will operate very efficiently over a very small fixed band of frequencies, and we can therefore apply all the resources of our knowledge and experience to this end.

Selectivity of the Superheterodyne.

As is well known in the use of the heterodyne principle for reception, the frequency of the local oscillator may be either higher or lower than the frequency of the incoming signals, the only condition being that the *difference* between these frequencies should be equal to that at which the intermediate frequency amplifier operates. For this reason, unless special filtering arrangements are employed, a supersonic heterodyne receiver will be available for reception on two wavelengths simultaneously, and reliance must be placed on selectivity at some other point in the circuit if freedom from interference on the undesired wavelength is to be obtained. Following out this line of reasoning, it will be appreciated that the selectivity of the supersonic heterodyne receiver will increase as the wavelength at which the intermediate-frequency amplifier operates is reduced. For example, if this amplifier is most efficient at a wavelength of 10,000 metres, and a signal is being received on 400 metres, interference may be expected on wavelengths of 370 and 435 metres unless the tuning of the frame or aerial circuit

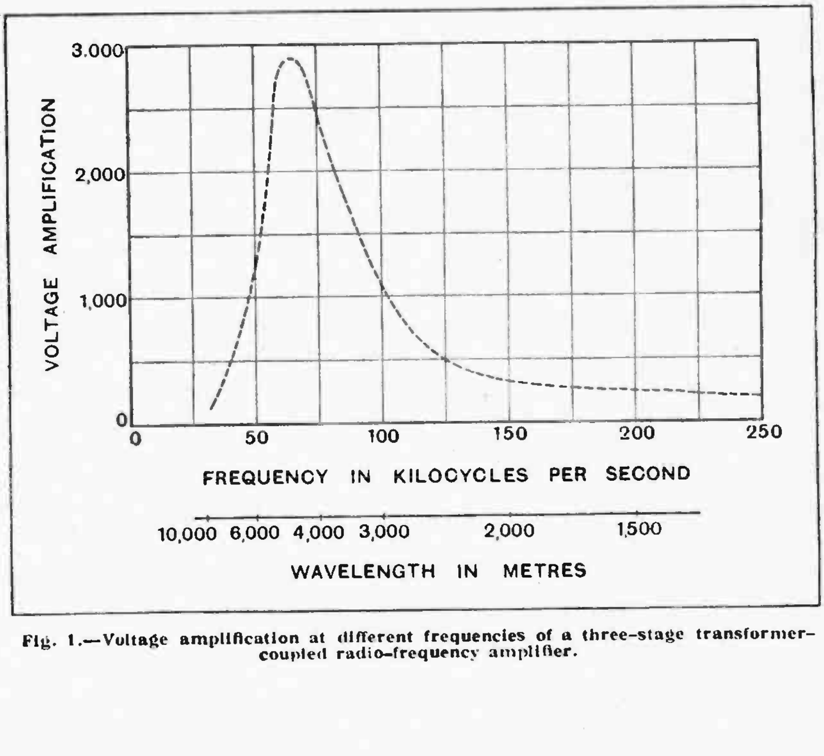


Fig. 1.—Voltage amplification at different frequencies of a three-stage transformer-coupled radio-frequency amplifier.

Measurements on Radio-frequency Amplifiers.—
is sufficiently sharp to distinguish between these and the desired wavelength. If, however, the intermediate amplifier operates on the wavelength of 3,000 metres, and the same wavelength of 400 metres is being received, the likely interfering wavelengths are 315 and 545 metres. It is thus evident that the tuning of the input circuit need not be nearly so sharp in this case in order to render the interference inoperative. The limit to which the operating wavelength of the intermediate amplifier may be reduced is set by the instability and difficulty of obtaining good overall amplification, which is encountered at the shorter wavelengths.

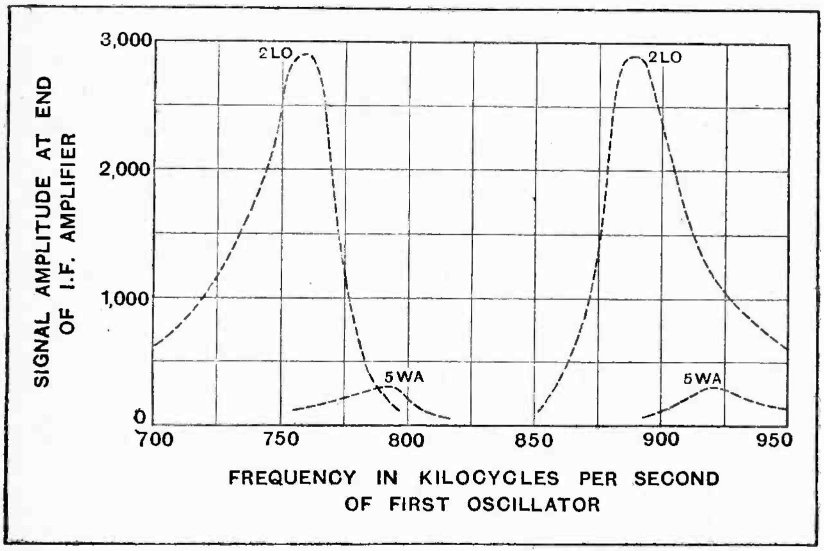


Fig. 2.—Relative amplitudes of signals from London and Cardiff for different settings of the first oscillator. The peak value of the signal from Cardiff is taken as one-tenth that from London.

When a supersonic heterodyne receiver is used in practice, however, it is soon found that it is not sufficient to assume that the intermediate amplifier operates over a very small band of wavelengths. With the aid of methods of measuring the overall voltage amplification, as already described, it is now possible to obtain the relation between amplication and wavelength or frequency, and to apply the results to a study of the performance of the whole receiver.

For example, in Fig. 1 is shown the voltage amplification at different frequencies or wavelengths of a three-stage transformer - coupled radio - frequency amplifier. The three transformers employed were identical in design and construction, but they were not provided with any external tuning capacity so that it was not possible to balance up the successive stages of the amplifier after assembly. It will be noticed that the peak of the amplification curve occurs at a wavelength between 4,000 and 5,000 metres, so that this instrument would appear to be suitable as an intermediate amplifier in a supersonic heterodyne receiver. At the peak, the voltage amplification is nearly 3,000. When the complete receiver was built up with this amplifier included it was found that while the overall sensitivity was very high, the selectivity was not all that could be desired. In particular, it was found that one of the two tuning positions on the first heterodyne oscillator made it much easier to separate two signals on neighbouring wavelengths than the other position. The cause of this effect, and the means by which it could be improved, were immediately evident on applying the curve in Fig. 1 to the case.

Alternative Oscillator Settings.

As is quite commonly the case, the receiver was first used with the tuned receiving loop connected directly to the first valve of the receiver. Suppose now that the receiver were so situated that when the receiving loop is tuned to the wavelength of Cardiff (353 metres), the actual potential difference applied to the first valve from the signals from Cardiff is only one-tenth of that arising from the signals from London. This is by no means an impossible case, especially if no retroaction is employed in the receiving loop to counteract the inherent damping effect resulting from its connection to the first valve. Employing the curve given in Fig. 1 we may then derive the curves in Fig. 2 showing, for different settings of the oscillator, the relative amplitudes of the signals from London and Cardiff after passage through the intermediate amplifier. These curves thus give the relative amplitudes of the current ultimately delivered to the telephones or loud-speaker. It

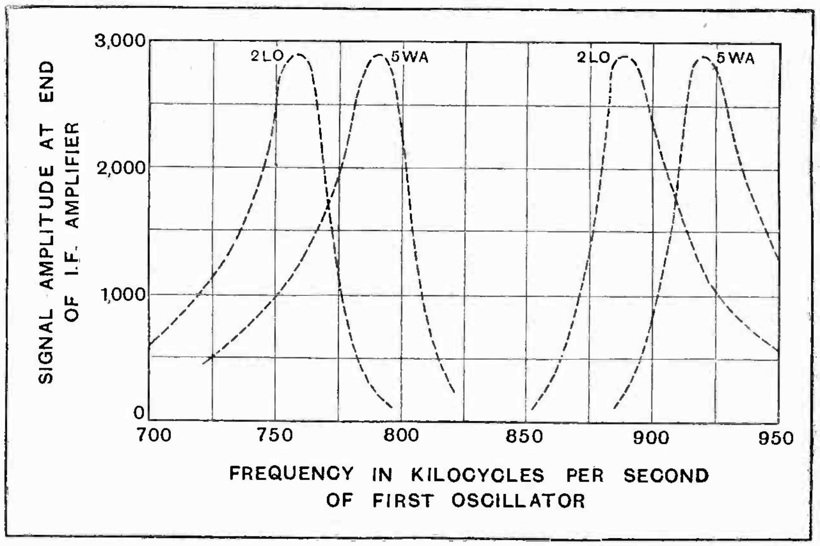


Fig. 3.—Relative amplitudes of signals from London and Cardiff when the two stations induce equal amplitudes in the receiving loop.

Measurements on Radio-frequency Amplifiers.— can be seen at once from these curves that if an attempt is made to receive Cardiff in this situation it is only possible to get the signals from Cardiff separated from those from London with the oscillator set at the lower frequency of the two positions available. At the other setting the London signals are about four times as strong as those from Cardiff, even though the oscillator is set well off its best position for London. In other words, under the conditions assumed above, the supersonic heterodyne principle used with an intermediate-frequency amplifier with a performance characteristic as given in Fig. 1 is not capable of sufficiently well separating the signals injected into the receiving loop by the radiation from London and Cardiff, when the loop is tuned to the latter station.

Local Interference.

Suppose, now, the receiver is moved to such a position, still fairly near London, that the signal P.D.'s applied to the first valve are equal for the two stations when the loop is tuned to Cardiff. The state of affairs at the end of the intermediate-frequency amplifier will then be as shown in Fig. 3. From these curves it is seen that while at the higher frequency position of the oscillator the conditions are quite good for the reception of Cardiff, at the lower position the conditions are still unsatisfactory, for London is still producing in the receiver a signal more than one-third of the strength of Cardiff, and so will cause considerable interference in the reception of a broadcast programme.

The corresponding curves for the reception of Bournemouth on a wavelength of 386 metres are given in Fig. 4.

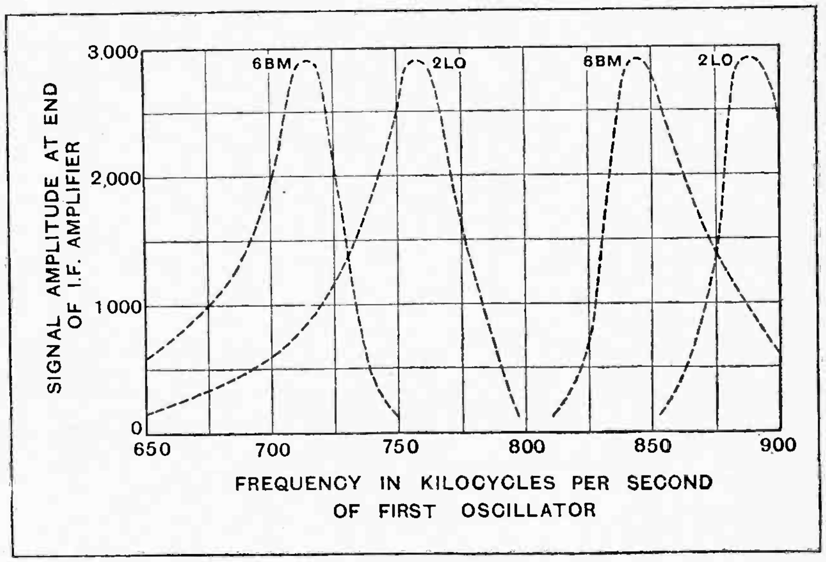
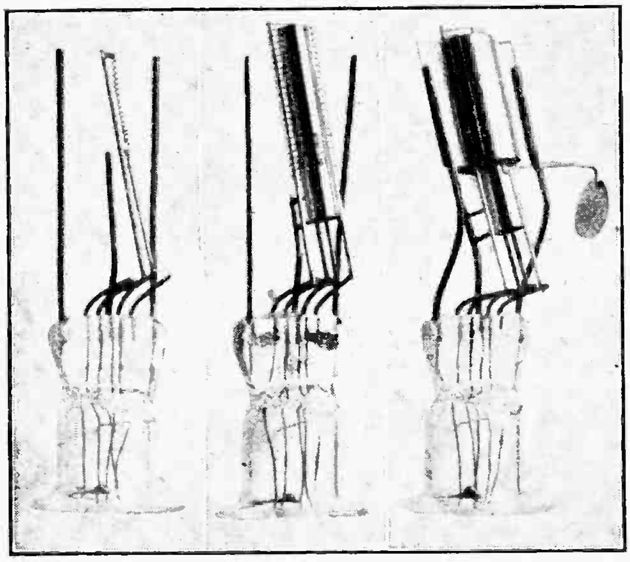


Fig. 4.—Relative amplitude of signals from London and Bournemouth. The signals are assumed to be of equal strength when the receiving frame is tuned to Bournemouth.

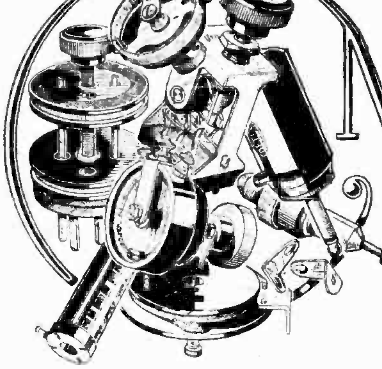
This diagram shows a similar state of affairs to prevail, although the settings of the first oscillator for best reception are reversed owing to the fact that the wavelength of Bournemouth is greater than that of London, whereas Cardiff's wavelength is less than that of London. Owing to the greater difference in wavelength of the two stations, also, the effect of London's interference when receiving signals from Bournemouth is not so great as when receiving Cardiff.

The state of affairs illustrated by these curves is exactly that which was experienced when the receiver was used for the reception of signals from various stations. A simple consideration of the case will show that there are two methods by which the selectivity of the receiver may be improved. First, by introducing a coupled circuit between the receiving loop and the first valve of the set the magnitude of the interfering signal potential difference applied to this valve is considerably reduced. Secondly, by improving the intermediate-frequency transformers and by providing some means of balancing them, after assembly in the amplifier, the width of the amplification-frequency curve of this amplifier can be considerably reduced. The adoption of the first method has the added advantage of reducing any interference which may arise from signals at the intermediate frequency being directly injected into the frame, while the provision of adjustable tuning to the intermediate-frequency amplifier enables the "peak" of its performance curve to be shifted away from the neighbourhood of such interfering signals

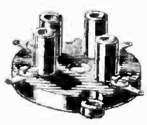
ELECTRODE CONSTRUCTION IN THE NEW K.L.1 VALVE FOR A.C. MAINS.



(Left) Spiral heater filament in position with supports for other electrodes. (Centre) Cylindrical cathode mounted over heater and surrounded by spiral grid. (Right) Complete assembly of electrodes including anode and disc for "getter" material.



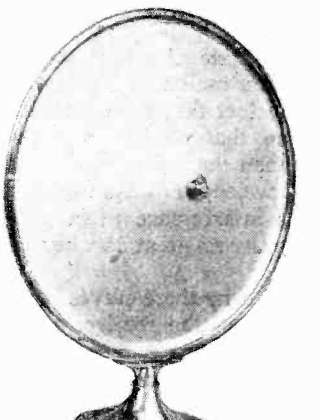
MANUFACTURERS' NEW APPARATUS



A Review of the Latest Products of the Manufacturers.

PARCHMENT DIAPHRAGM LOUD-SPEAKER.

Very many amateurs have undertaken the construction of loud-speakers of the parchment diaphragm type, and although with care and good workshop facilities a really good loud-speaker can be constructed at home and much knowledge gained on the principles of design, it is realised that as a rule a home constructed instrument is imperfect owing to constructional difficulties. A loud-speaker of this type is not just a paper cone and a telephone earpiece. The diaphragm must be suitably shaped and properly supported around its edge, whilst a rigid mounting is usually required for the driving mechanism.



The Sferavox Loud Speaker.

The Sferavox loud-speaker, a product of "Sferavox," 130, Fenchurch Street, London, E.C.3, is a really low priced loud-speaker of this type. Support is given to the stiffened diaphragm by clamping it between two nickel-plated brass rings, which in turn are bridged by a cross piece carrying the movement. It is obvious that every care has been taken to avoid resonances at frequencies falling in the audible scale, and with this object in view the cross piece which holds the movement is not only substantial, but is in the form of a channelled brass casting.

Instead of the usual form of construction in which the two poles act on the centre of the armature the pole winding is arranged to one side. The magnetic circuit is interesting, very thin stampings being employed for the pole ends, the polarising magnet consisting of the usual circular steel stampings. The armature is substantially mounted, and is over $\frac{1}{16}$in. in thickness, so that any resonance it may possess will almost be above the limit of audibility. The usual form of stiff reed drive is employed for linking the armature to the diaphragm, and provision is made for adjustment.

Rattling as marked by obvious resonances is entirely absent when the loud-speaker is driven with liberal input. It is, however, a sensitive instrument and gives good results. The metal parts are well finished and nickel-plated, and the cone is silvered.

oooo

CHARGING FROM D.C. MAINS.

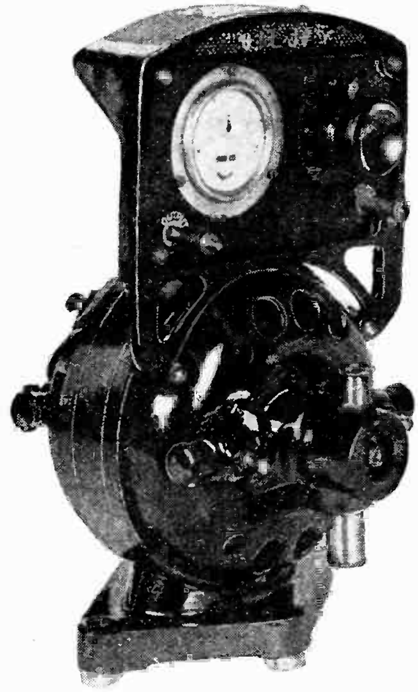
Many amateurs consider themselves fortunate when D.C. supply is available for battery charging, though when a bank of lamps is used for reducing the voltage charging from D.C. mains can be very costly. For example, when the voltage of the supply is 240 and it is desired to charge the battery at 5 amperes over a kilowatt is taken from the mains or more than one unit is consumed per hour. Thus to charge over a period of ten hours at a lighting rate of perhaps 6d. per unit means a cost of 5s. for charging a battery of average size. In the case of A.C. supply, however, using a step down transformer and arc rectifier gives a much better efficiency.

To improve the efficiency in the case of D.C. charging a machine has been developed by Giljay, Limited, King's Road, Hay Mills, Birmingham, which might be termed a rotary transformer.

It resembles a small motor, but is fitted with a commutator at each end of the shaft. The armature is double wound so as to run as a motor on the high voltage of the supply through one of the commutators, and to provide at the other a heavy current low voltage output suitable for battery charging.

Although the efficiency is low, as can only be expected from so small a machine, it will effect a very considerable saving in the cost of accumulator charging from D.C. supply as well as being perhaps a little more convenient than the fitting up of a bank of charging lamps. The output and hence the load on the machine is regulated by a variable resistance, and an ammeter with centre zero is fitted to show the charging rate.

Battery charging by means of a rotary transformer requires very little attention, though the machine should not be left running for long periods unattended. The noise from the high-speed revolving armature is a common criticism with regard to the use of this type of charger, though in this case the machine runs quite silently, and can be installed out of the way so that the hum will not prove a nuisance.



Giljay rotary transformer for accumulator charging from D.C. supply mains.

The machine shown in the accompanying illustration gives an output of 4 amperes at 9 volts and will charge a 6-volt accumulator at about 4 amperes. Spring-operated carbon brushes are fitted and the shaft runs in bronze bearings.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Welsh Hopes—Cardiff and Bristol—A Modern Caruso—Broadcasting Parliament—More About Warsaw—"Talk" Developments in France.

Hopes in Wales.

Whilst we can sympathise with the governors of the University College of South Wales and Monmouthshire in their efforts to persuade the B.B.C. to provide a new broadcasting station for Wales, it seems extremely doubtful if Wales will ever have such a benefit conferred upon her.

To all requests of this nature (Cornwall, I believe, is also pleading) the B.B.C. have the ready retort that all difficulties will be settled by the new regional scheme. If we share the optimistic hopes of the B.B.C. engineering department, we must regard the regional scheme as a panacea for all ills.

oooo

An Inland Station.

Be this as it may, nothing is less likely than the installation of a really powerful station west of the Severn. 5WA has itself been challenged in the past by the Admiralty and the Board of Trade on account of disturbance caused to ship signals. When 5WA's transmitter closes down in 1928 or 1929 in accordance with the provisions of the regional scheme, we may take it that the station or stations serving Wales will be situated much farther inland.

oooo

A Studio in Every Town?

Cardiff will retain its studio, and it is highly probable that a permanent microphone will be installed at Bristol, where local talent has so long been denied the privileges of broadcasting. "Fewer stations, more studios," will be the slogan of the B.B.C. in the next few years. The ideal would be a studio in every important town.

FUTURE FEATURES.

Sunday, February 27th.

LONDON.—A Programme of Favourite Wagner Excerpts.

GLASGOW.—Longfellow Anniversary Programme.

Monday, February 28th.

BOURNEMOUTH. — Schumann and Schubert Programme.

MANCHESTER. — A "Rag" Programme by Manchester University Students.

ABERDEEN.—"Love and the Washtub," one-act comedy.

BELFAST.—Traditional Irish Music.

Tuesday, March 1st.

LONDON, BIRMINGHAM, BOURNEMOUTH.—St. David's Day Programme.

Wednesday, March 2nd.

LONDON.—"I Pagliacci" performed by the B.N.O.C.

BIRMINGHAM.—An Eighteenth Century Hour.

NEWCASTLE, GLASGOW.—"I Pagliacci," from the Manchester Opera House.

Thursday. March 3rd.

LONDON.—B.B.C. National Concert relayed from Royal Albert Hall.

Friday, March 4th.

LONDON. — Variety. "My Programme," by the Chief Engineer.

CARDIFF.—"The Prodigal," a jest in one act by Anton Tchekov.

Saturday, March 5th.

NEWCASTLE.—"After the Trip," a Tyneside Comedy by E. A. Bryan.

GLASGOW.—The Glasgow (English) Concertina Band.

"The Modern Caruso."

According to Savoy Hill the B.B.C. has secured one of its biggest "scoops" in engaging Kiepura to sing at the Albert Hall National Concert on March 3rd. Jan Kiepura is a young Polish tenor who made his *début* as recently as 1924 in Warsaw, where, in open competition with 3,000 others, he won first prize. Since then he has sung in Vienna and other European cities, earning the title of "The Modern Caruso."

oooo

Albert Hall Attendances.

By the way, is it a tribute to the delightful efficiency of the modern broadcast receiver—or merely an indication of public indifference—that the National Concerts are so sparsely attended?

oooo

A Terrible Threat.

A broadcast listener at Long Beach, California, has sent out a circular letter to all American broadcasting stations giving notice that unless all jazz is immediately discontinued he will scrap his set.

oooo

The Most Active Relay Station.

Through one of those misapprehensions which perpetually lie in wait, ready to swoop upon and mislead the luckless seeker after information, I find that I owe an apology to the fairest city of the north.

On February 9th it was stated in these columns that the Edinburgh relay station had the lowest weekly average of all B.B.C. stations in the matter of hours worked. I take off my hat and sink down upon my knees. Not 51 hours 10 minutes, as stated, but 61 hours 10 minutes is 2EH's weekly average, a fact which places this indefatigable little station at the forefront of the relays, and next to Cardiff.

Nor is this a recent burst of activity on Edinburgh's part, for I find on investigation that during the first four months of 1926 2EH actually worked longer than any other B.B.C. station save London and Daventry.

oooo

Opera in the Spring.

The first of the B.N.O.C. spring series of operatic performances to be broadcast will be Acts 1 and 2 of "I Pagliacci" from the Opera House, Manchester, on March 2.

oooo

Broadcasting Parliament.

Captain Ian Fraser is again raising the question of broadcasting the proceedings of the House of Commons. He suggests that specially selected front bench speeches could be broadcast by arrangement between the parties at rare intervals when the importance and general interest of the subject is unquestioned.

Such a plan would offer no technical difficulties, but the same can hardly be said regarding the frequent proposals that debates should be broadcast in a similar manner. Being singularly tactless and indiscriminating, the microphones would pick up too much!

oooo

A Case of Chaos.

A possible solution would be to provide each member in the body of the House with his own small carbon microphone, which could be plugged into a socket opposite the member's seat. Even thus, I can imagine the worst possible confusion. What would happen if the honourable gentlemen all plugged in at once?

Probably we should then begin to sigh for a simple and homely talk on "Beetroot."

oooo

Question and Answer.

From the Zurich station the other day Prof. Dr. A. Pfister gave a psychological talk entitled "Do We Know Our Children?"

A few hours later an American dance band was sending out "Yes, Sir, That's My Baby!"

oooo

More About Warsaw.

The new station at Warsaw, photographs of which appeared in last week's *Wireless World*, has been built by Marconi's Wireless Telegraph Co., Ltd. It transmits at present with a power of 10 kW. on the main oscillator valve, and employs a wavelength of 1,013 metres, not 1,050 metres, as stated in our last issue. The latter wavelength was chosen provisionally while the station was under erection.

The Warsaw transmitter—a Marconi Q.D.8 set—was designed on the same lines as the Daventry station, the six main units being contained in aluminium frames. Four of these units are open, and contain the valves for the independent drive, main oscillator, modulator, and rectifier circuits, and the two enclosed units are the speech transformer and the coupling unit for the main oscillator grid circuit.

oooo

Warsaw's Range.

The Warsaw aerial is carried on two self-supporting lattice steel masts, 75 metres high, and the aerial current is 30 amperes. The range of reception in Poland, from reports received, indicate 75 miles with a crystal receiver and 375 miles with a two-valve receiver. The station has been received in this country, when the B.B.C. stations were closed down, on a two-valve receiver.

EASTWARD BOUND. Mr. C. C. N. Wallich, the popular director of the Plymouth B.B.C. station, who will sail for India on March 4th, to take up the position of director of the Calcutta broadcasting station. Mr. L. B. Page, formerly director of the Hull station, has been appointed director of the Indian Broadcasting Company's station at Bombay.

P.M.G. and the Regional Scheme.

At its second meeting, held on February 14th, the Wireless Organisations Committee decided to ask the Postmaster-General to take an early opportunity to assure listeners that a system of high-power regional distribution effective for the transmission of alternative programmes will be fully expedited so far as his department is concerned.

The next meeting of the Committee will be held next Monday, February 28th.

oooo

Cecil Lewis as Playwright.

Mr. Cecil A. Lewis, who shone in the broadcasting firmament first as "Uncle Caractacus," and subsequently as director of programmes at Savoy Hill, recently retired from the rigours of official routine to devote himself entirely to the craft of literature.

One of the first fruits of his retirement is *Jazz Patterns*, described as "A Comedy of Bad Manners," which is to be produced at the Everyman Theatre, Hampstead, on March 1st. Loyal to the atmosphere in which he has worked so ardently, Mr. Lewis has introduced a loud-speaker into one of the acts.

I hear that Mr. Bernard Shaw has retouched the whole of the first act of *Jazz Patterns*. This was done when he and Mr. Lewis were on holiday together in Italy last summer.

oooo

Where is the Super Ear?

How many listeners whose ears are considered to be of the super-sensitive variety can point with any certainty to the dates on which the new 2LO studio has already been used?

The first official use of this studio, which has the highest ceiling in Europe, was on the last Sunday in January, when the evening service was broadcast from it and the new pipe organ was played for the first time.

The engineers seem delighted with the improved echo effect, which is reported to be much more natural than that produced in the so-called echo room.

oooo

Broadcasting a Boxing Match.

The cult of the "running commentary" is finding favour in Germany. On a recent Sunday the Dortmund station relayed a graphic description of the German Heavyweight Boxing Championship match in the Westphalian Hall in that town. Langenburg and Muenster listeners also enjoyed the privilege of listening to the blows.

oooo

"Running" Commentary in a Theatre.

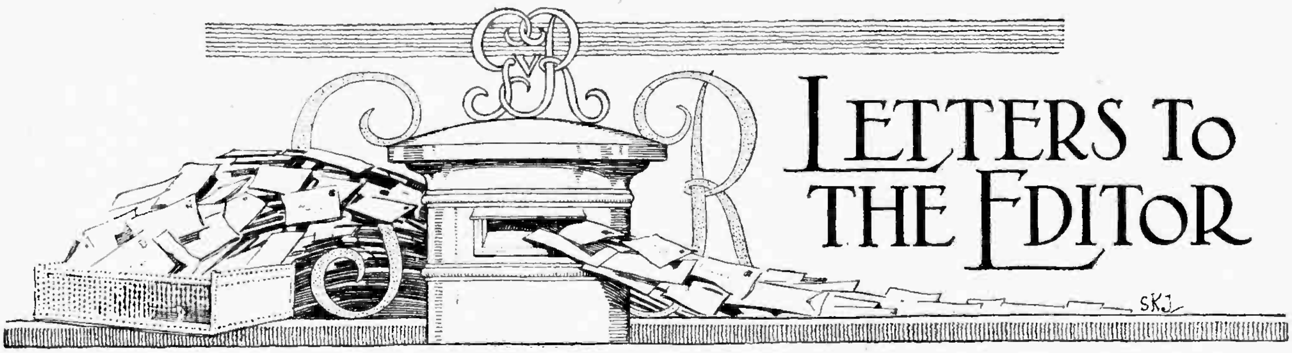
To-morrow evening (Thursday) will be the occasion of the Royal Command performance in aid of the Variety Artists' Benevolent Fund which, will be broadcast in its entirety from all stations of the B.B.C. Some of the turns in this programme rely largely on visual effects for their success. In order to help listeners to understand what is going on at such moments, Tommy Handley, the well-known broadcasting comedian, will give a brief running description of these turns.

oooo

"Talks" in France.

Although broadcast education has many opponents in this country, it does not appear that the French authorities are meeting with similar criticism in connection with their very comprehensive educational scheme. At the present time the Ecole Supérieure (PTT) station in Paris is co-operating with the Eiffel Tower station in the dissemination of lectures from the "Collège de France" and the Sorbonne. While L'Ecole Supérieure is broadcasting a talk from the Sorbonne, the Eiffel Tower supplies an alternative item—in the form of another talk!—from the Collège de France.

The Ecole Supérieure station has recently increased its power, and is now busy on technical improvements, so that listeners over here may expect to pick up these transmissions at greater strength in the near future.



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.

MODERN AMPLIFIER PERFORMANCE.

Sir,—I have observed in your Correspondence page of February 9th issue a letter by Mr. Lancelot W. Wild, and I feel a comment upon his letter is necessary.

I would point out that anyone conversant with the technicalities of alternating current circuits would refrain from stating that $\frac{L}{R}$ has anything to do with the current in a loud-speaker circuit. He has apparently got ωL and L very mixed. In the case cited L is about 2 henries for an average "Kone" loud-speaker, and this makes $\frac{L}{R} = \frac{2}{20,000}$ or $\frac{1}{10,000}$ of a second.

It is important to get as large an inductance with as low a resistance as possible to obtain large outputs, since the current through the speaker is given by $\frac{\mu e}{\sqrt{\{(R_A+R)^2+(\omega L)^2\}}}$ where e is the applied grid voltage, μ is the amplification factor of the valve, R_A is the valve A.C. resistance, R and L are the effective resistance and inductance respectively of the loud-speaking mechanism. $\frac{L}{R}$ has no bearing on the operation of such a mechanism and gives the conditions arising in transient phenomena only.

Manufacturers of power valves are working along excellent lines of development in attempting to get a low impedance valve with a large voltage factor. H. A. THOMAS.

Teddington,
February 11th, 1927.

Sir,—I am very interested in the replies to my letter on the above subject in your issue of February 9th, and am specially grateful to Mr. Turner for giving such valuable authoritative information regarding the "Kone" loud-speaker.

I may say that I certainly did not think that the impedance of a L.S. acted as a simple inductance, but I did not imagine that it was modified to the extent that he indicates. From his figures the 750 ohm "Kone" should be quite suitable for a 3,000 ohm valve.

At the same time it would seem that there is no sort of agreement as to what is required of L.S. mechanism. Messrs. D. Kingsbury and L. W. Wild put forward a theory that is quite contrary to modern practice. The swamp resistance they advocate, while it would seemingly level out frequency variations, would, to my thinking, also level out variations of input volume; this point is also noted by Mr. Axten.

This gentleman, however, does not seem to have read my previous letter correctly. I am certainly not mixing A.C. and D.C., and I definitely stated that I did not know the A.C. particulars of the "Kone" L.S.; the provision of these considerably clears the air. His suggestion, however, that the reason for the 750 ohm D.C. resistance is to decrease the voltage drop across the L.S. windings does not seem very reasonable. Surely no one should put the output from a 3,000 ohm valve working at 150 volts directly through the L.S. windings. I quite agree with him that such an output is only just sufficient to give normal volume with high quality reproduction. C. M. KEILLER.

Cookham Dean.
February 10th, 1927.

ARRANGEMENT OF PROGRAMMES.

Sir,—In reference to a letter in the February 9th issue of your journal from A. T. Reynolds, London, I wish to express my agreement with his views.

I feel quite sure that I am only one of the many Daventry listeners in Ireland who consider the complete programme system of the old B.B.C. much preferable to that adopted by the new Corporation. The average nightly programme is, at least, very scrappy; and the excellence of the musical items renders the introduction of news and lectures, etc., all the more undesirable. I notice that the picture-house music which, I believe, is generally considered a very welcome feature, is mutilated every evening by various bulletins or news which the old company gave out at more appropriate times.

And, of course, gone are the days when one could enjoy an uninterrupted musical programme from 8 p.m. to 10 p.m.

If the B.B.C. were to revert to the old system of unbroken musical programmes they would give great satisfaction to the majority of their listeners who, like myself, consider that the medicine is O.K. but wrongly administered.

Dublin. T. L. NATHAN.
February 13th, 1927.

Sir,—As a solution to the arrangement of programmes difficulty, I suggest that there should be four or five high-power stations in the British Isles, each station broadcasting a complete programme suitable for a different section of the public on different days.

Thus on January 1st A would broadcast dance music, B classical music, C talks, and D music and entertainment essentially of a light character.

On January 2nd A would broadcast B's type of programme, B C's, C D's, and D A's, and so on.

It would probably be most convenient to have weather and news always from the same station, and it would be most satisfactory if the fifth station were kept essentially for this purpose, broadcasting other items as occasion demanded.

This arrangement would give relief from the present system of chopping hither and thither, from Bach to dance and from dance to talk all in one hour, while those who like chopping will merely tune in another station.

Given four or five stations of the Langenburg type, the great majority of listeners will be able to switch on to each at will.

Reading. KYRLE LENG.
February 8th, 1927.

Readers' Problems

"The Wireless World" Information Department Conducts a Free Service of Replies to Readers' Queries.

Questions should be concisely worded, and headed "Information Department." Each separate question must be accompanied by a stamped addressed envelope for postal reply.

Volume Control.

I have a powerful four-valve set which brings in several stations at too great a strength for the loud-speaker. I should much appreciate details of where to insert a volume control in the set and what form this should take, and should also like to know if it is possible to have a volume control at the loud-speaker when the latter is in a different room to the set.

B. S. A.

One of the simplest forms of volume control when an anode bend type of detector is used is given by adjusting the temperature of the detector valve filament by means of a filament resistance of, perhaps, some 30 ohms. If this resistance is suitably constructed so that it has a very smooth action, quite noiseless variations in signal strength may be made, but if at all jerky, loud, scratchy noises will be apparent in the loud-speaker when this filament resistance is adjusted.

Another method of obtaining volume control is to use a very high resistance potentiometer of about half a megohm—such as the Modulator or the Dubilier potentiometer—across one of the L.F. transformers or chokes, and to pass on only a part of the output to the next valve, as shown in Fig. 1 (a) and (b). If resistance coupling be used, one of the anode resistances may be replaced by one of the new Varley tapped anode resistances and a small switch arranged for conveniently tapping off part of the output, as is shown in Fig. 1 (c).

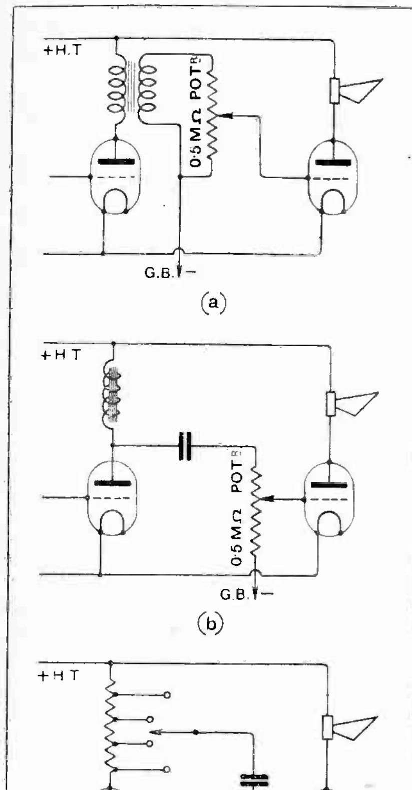


Fig. 1.—Showing various arrangements for obtaining volume control (a) with transformer coupling, (b) with choke coupling, and (c) with resistance coupling.

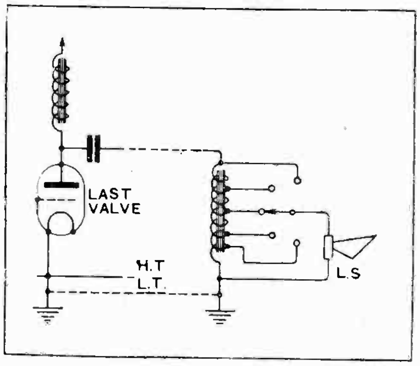


Fig. 2.—Showing a scheme for obtaining volume control from the loud-speaker end. Note that if a local earth is available near the loud-speaker, only one wire between the set and the loud-speaker is necessary.

For obtaining auxiliary volume control from a distant loud-speaker, one of the simplest things to do is to use a tapped choke, such as that manufactured by Messrs. Pye & Co., at the loud-speaker end, and to use a small switch for the control, as shown in Fig. 2. Failing this, a Varley tapped anode resistance could be used instead, but it is probable that a thinness of tone would be noticed on the weaker outputs. A choke-condenser output should be used to couple the last valve to the loud-speaker, both from the point of view of cutting out the D.C. current from the latter, and incidentally eliminating H.T. leakage through faulty insulation, and for quality purposes. A local earth should be used where possible, as indicated in Fig. 2, so that only one wire is necessary between set and loud-speaker.

If this one wire is kept about one inch away from all walls, then quite long distances are possible between the set and the loud-speaker without any alteration in quality of reproduction.

oooo

Determining the Value of Amplifier Grid Leaks.

Will you kindly explain what determines the value of the grid leaks in a choke or resistance coupled L.F. amplifier, and also why the value of grid bias used for a given valve with a given high tension voltage should be independent of the value of the grid leak used?

H. C. P.

The function of the grid leak in a choke or resistance coupled amplifier is simply to fix the mean potential of the grid to which it is connected without interfering with the L.F. alternating potentials due to the signal being amplified.

Consider the case of two L.F. valves V_1 and V_2 coupled by a 100 henry L.F. choke and a 0.1 mfd. condenser, for example. The grid leak of V_2 is effectively in parallel, from the alternating current point of view, with the choke, since the grid end of the leak is connected to the plate end of the choke through a low impedance condenser, while the other ends of the choke and leak, although connected to opposite ends of the H.T. battery, are at the same *A.C.* potential owing to the low resistance of the latter.

In order to prevent the grid leak from reducing the *effective* impedance in the plate circuit of V_1 and thereby reducing the amplification, the grid leak resistance must be several times the *actual* impedance in the plate circuit, and since the latter will be of the order of 100,000 ohms the leak should have a value of about one megohm or over.

The grid bias value is, of course, determined for a given valve by the H.T. voltage used on the plate, and since there is no current flowing through the grid leak there will be no "voltage drop" across it, and therefore the voltage on the grid will be the full grid bias value whatever the value of the leak, so long as there is a conducting circuit between the grid and the grid bias battery.

oooo

ERRATA.

In last week's "Readers' Problems," col. 1, bottom line, the H.T. power should be 2.88 watts and the cost 17.5 pence instead of 0.288 watts and 1.75 pence as stated (col. 2, line 6). This, of course, makes no difference to the solution offered.