The Wireless World

AND RADIO REVIEW

(15th Year of Publication)

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CHRISTMAS 1927.

THE influence of Christmas is felt in every sphere of life, and as we draw near to Christmas, 1927, our thoughts may quite naturally turn to questions of how to use wireless to assist in celebrating this festival. There are many ways in which wireless can be applied to providing Christmas entertainment, and in this issue we have endeavoured to put forward a number of suggestions which we hope will be helpful to our readers when called upon to contribute their share of providing entertainment. No doubt many of our readers, with these suggestions to assist them, will find ways and means of developing the ideas so that they form the basis of competitions which are still so popular at Christmas parties.

Wireless for Christmas Presents.

With the Christmas season, too, comes the inevitable question of what to give as Christmas presents, and probably wireless provides the simplest possible solution to the problem. We can select a wireless present from a complete set costing many pounds down to a useful component or accessory at the price of only a few shillings. There is such a wide variety of possibilities for wireless Christmas presents that it would be quite impossible to enumerate them, but one word of advice we would give those who desire that wireless is to provide Christmas presents this year : do not delay in making your selection and ordering what you need. Wireless is not like the industries which have been established for a great number of years. With wireless there has been a constant change in the types of apparatus, due to the progress which has been made, and consequently, unless orders are placed early for Christmas delivery, one cannot be sure that the manufacturers will be able to supply to time. We understand that special efforts are being made to cope with the volume of Christmas business, but if those who are ordering will see to it that they do not leave things too late they will help very effectively to avoid the risk of delay.

AN INTERESTING AMALGAMATION.

IN this week's issue a detailed announcement is made of the recent amalgamation of the two important Listener organisations, the Wireless League and the Wireless Association, under the new title of the "Wireless League, incorporating the Wireless Association of Great Britain." For some time it has been felt that these two organisations were overlapping in their activities, and that the best interests of the listener would be served if the two bodies could unite. There were minor difficulties to be overcome before the amalgamation could go through, but it was found it was possible to make the necessary changes without disturbing the constitution of the Wireless League.

The Hon. Sir Arthur Stanley, G.B.E., will continue to act as Chairman of the joint body, whilst Lord Drogheda, formerly Chairman of the Wireless Association of Great Britain, has consented to act on the Committee.

An important new line of activity of the joint body is connected with the furtherance of an Empire broadcasting service. A representative of the League is shortly leaving for Africa and Australia with the object of consolidating the overseas interest in the establishment of a service, and in doing so the League is extending its influence so that it will no doubt come to be regarded as the Imperial Listeners' organisation.

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IDENTIFYING STATIONS.

IN our editorial of last week the suggestion was put forward for a new system of identifying stations, which we believe would solve the problem with a minimum of difficulty and modification of existing broadcasting arrangements. We have already received a number of letters strongly supporting our proposal, and we hope to include some of these letters under Correspondence in our next issue. We would welcome the views of readers on this suggestion, particularly opinions from those who may see objections to the scheme, because such views are of even greater value in assisting us to put forward a constructive proposal.

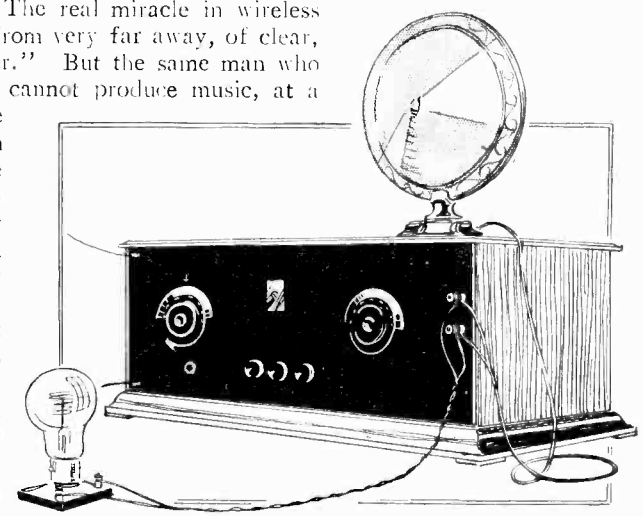
IDEAS for XMAS ENTERTAINMENT

Some Novel Wireless Experiments.

AT the approach of the Christmas season, with all its gaieties and festivities, the enthusiastic experimenter feels that there must be, lying dormant in his wireless apparatus, the germs of entertainment of all kinds. Providing he has, in addition to his wireless receiver, a small collection of odd parts, the experimenter is in possession, though he may not realise it, of quite a presentable electrical laboratory, which can be drawn upon for the material for a number of different "stunts" of an entertaining nature.

To the initiated, the various tricks that can be played with wireless apparatus are mostly simple enough, though they may very frequently be regarded as surprising, and even almost magical, by one's non-technical friends. After all, it is *novelty* that counts in entertaining, rather than scientific attainment. The real miracle in wireless is the reception, sometimes from very far away, of clear, undistorted music "*via* ether." But the same man who feels positively hurt if you cannot produce music, at a moment's notice, from the ends of the earth will often be mightily impressed to see the pointer of a meter dancing merrily over a scale, or a neon lamp flickering in time with the music or speech.

It is proposed to suggest a few simple experiments that can be performed either with a wireless set or with a few wireless components specially put together for a particular demonstration. Where possible, special mention will be made of any opportunity to develop a game or competition in connection with any experiment, but any who have that keen eye for the possibility of building up entertainment on a trifling basis that marks out the born host or hostess will probably be able to make more of the material provided than can the writer.



Try this experiment during a programme of dance music. A neon lamp on the output terminals can be made to flash in rhythm with the music. It may he necessary to supplement the output potential by connecting an H.T. battery as well as a step-up ratio transformer between the lamp and the output terminals.

Turning Sound into Light.

This experiment is most easily performed by those who possess fairly powerful receivers, and is generally regarded as entertaining by one's non-technical friends. It consists in connecting an ordinary neon lamp in parallel with the loud-speaker, so that when the signal volts across the latter are greater than the minimum voltage (about 175 volts) required to light the lamp, it lights up momentarily. Since the highest voltages are produced by the strongest signals, it is usually only on these that the lamp lights, so that it will beat time very satisfactorily with the music.

When the set will not provide voltage enough to light the lamp, two alternatives are possible. If the extra voltage required is not large, an L.F. transformer may be used to step up the voltage, the primary being connected in parallel with the loud-speaker, and the secondary connected to the lamp. Alternatively, the neon lamp may be connected between L.T. – and the plate of the last valve (or "loud-speaker"), by which means the voltage of the H.T. battery is added to the voltage due to the signals, so that the lamp lights on much less loud music—at the cost, however, of a few extra milliamps. from the H.T. battery.

Competitions, on the lines of guessing the number of times the lamp will flick per fox-trot, are possible here also.

A Simple Stroboscope.

Only those with alternating current mains can try this particular experiment. It is, however, one that seldom fails to appeal. A neon lamp when connected to an

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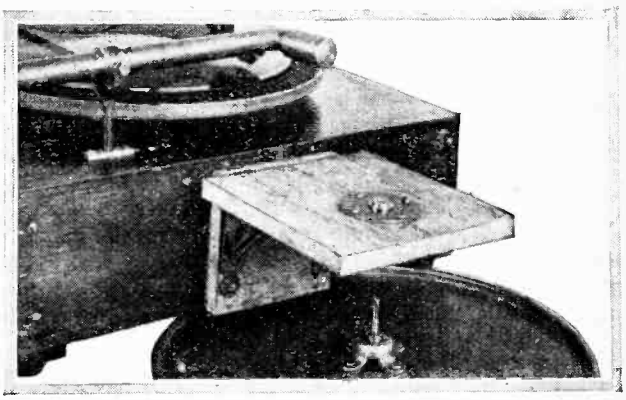
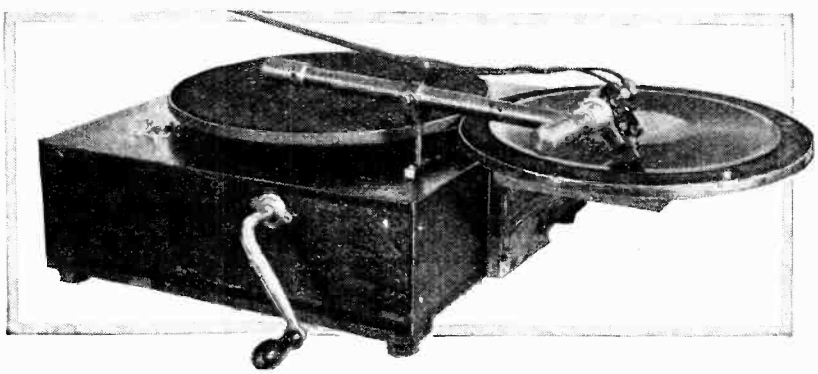
alternating current supply will flicker at the rate of the frequency of the supply—usually 50 cycles, or 50 times a second. Although the flashes are sufficiently rapid to give the illusion of continuous light, a disc revolving at exactly 50 times a second would appear to be stationary. The reason for this is obviously that the disc is illuminated in precisely the same position on each revolution, and cannot be seen during the period of making a revolution. If the revolving disc is

The Stroboscope. Where the electric supply is alternating a neon lamp can be used to check gramophone turntable speed. With a careful adjustment of the speed regulator the disc will appear to be stationary when illuminated by a neon lamp connected to alternating current mains.

arranged in the form of a white card upon which is clearly marked in black some figure, image, or design, and is made to revolve 50 times a second, the card with its image will appear to be at rest. Should the rate of revolution be 51 times a second, the image will appear to be revolving slowly in one direction (the direction of actual rotation), while if it rotates 49 times a second it will appear to be slowly revolving in the opposite direction. As there are two voltage peaks in each cycle, it may be thought that the neon lamp will flash 100 times a second on 50 cycle supply. Actually, a much lower voltage is required in one direction than in the other to cause the lamp to flash. The main voltage, therefore, must be carefully regulated so that the lamp is just capable of flashing. It should be so inserted in the holder that the glow takes place on the larger electrode. In order suitably to reduce the voltage of the supply a potential divider consisting of two series connected lamps, each of the voltage of the supply and mounted in batten holders, may be used. The neon lamp is fed between one of the main wires and the junction between two lamps. Obviously, it will be necessary to augment the voltage obtained in this way by connecting a high-tension battery in one of the leads to the neon lamp. It is interesting to note that, in such an arrangement as this, which includes a battery in series with A.C. mains, the voltage on the lamp, instead of varying from zero up to, say, 140 volts in either direction, varies between the sum and the difference of the battery and mains voltages. By this means one can be quite sure that the lamp will only light once per cycle, so that the number of flashes per second will be the same as the frequency of the mains. In the case of low voltage supply, say, of 100 volts, the potential divider will not be required, and a 240-volt lamp should be procured and operated with the assistance of a high-tension battery.



Constructional details for setting up the bearings of a turntable to reverse the rotation so as to examine the curious effects produced when a record is played backwards. A rubber band is placed round the rim of the driving turntable so that the edges, by making only light contact, will not retard the speed of the gramophone motor.



Can you identify a gramophone record when played backwards? A simple method of mounting an auxiliary turntable.

A hand drill, Meccano winder, sewing machine or toy electric motor may be adapted for driving the disc according to convenience. If a gramophone is available, a 12in. white card should be made up and marked off with 1in. radial lines near the circumference, and equal in thickness to the space between them. It is easier to mark out the position of these lines, which must be done accurately, with the aid of a protractor, and therefore 90 lines, each 2° wide and 2° apart, will be found most convenient. With a 50-cycle supply the marks on the disc will appear to be stationary when the turntable is revolving at 33 (or 66) revolu-

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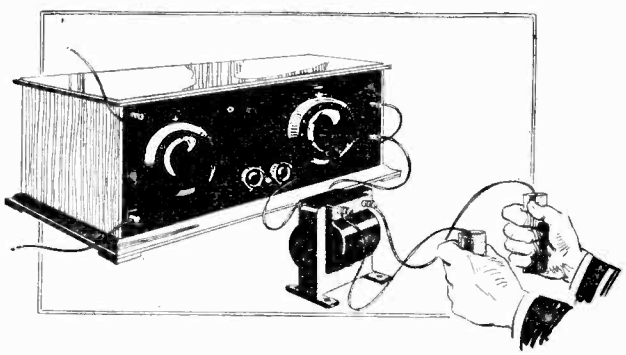
tions a minute. As the correct running speed of the gramophone is 80 revolutions a minute, with a little trouble a disc can be prepared for calibrating the motor.

In passing, it may be added that the Stroboscope finds a wide application where it is desired to investigate the behaviour of revolving machinery at high speeds.

Modern Music.

Thanks largely to the efforts of the B.B.C., the listener is getting quite accustomed to music which, to those who, perhaps, are old-fashioned, is not much more than a confusion of sounds which they are unable to interpret.

Many readers may not know that with the assistance of a gramophone music quite as remarkable can be produced, music which at least in some cases will be found not unpleasing to listen to. This is done by arranging to play gramophone records backwards, and it is not at all difficult to carry out, especially with an electrical pick-up. The first essential is to arrange that the direction of rotation of the gramophone record is reversed, and then the pick-up carrying the needle must be placed on the record at the centre instead of the edge. There are several ways in which the arrangements can be made for reversing the direction of rotation of the record, but probably the most convenient is to get a second turntable of the same diameter as the one already on the gramophone and fit it up on a bracket so that it can be brought against the existing turntable, so that the edges of the two come into contact. To ensure a satisfactory grip it will be advisable to put a large elastic band round the circumference of one of the turntables and to arrange that the bracket supporting the additional one is held in contact by a spring or tension applied by a strong elastic band. The other point which must be carefully watched is to see that, just as in the ordinary gramophone, the pivot of the tone arm is so placed that the distance from the universal joint to the needle brings the needle into the centre of the record, so when the additional turntable is set up it must be at the correct distance from the universal joint of the tone arm to bring the needle again in the centre of the turntable.



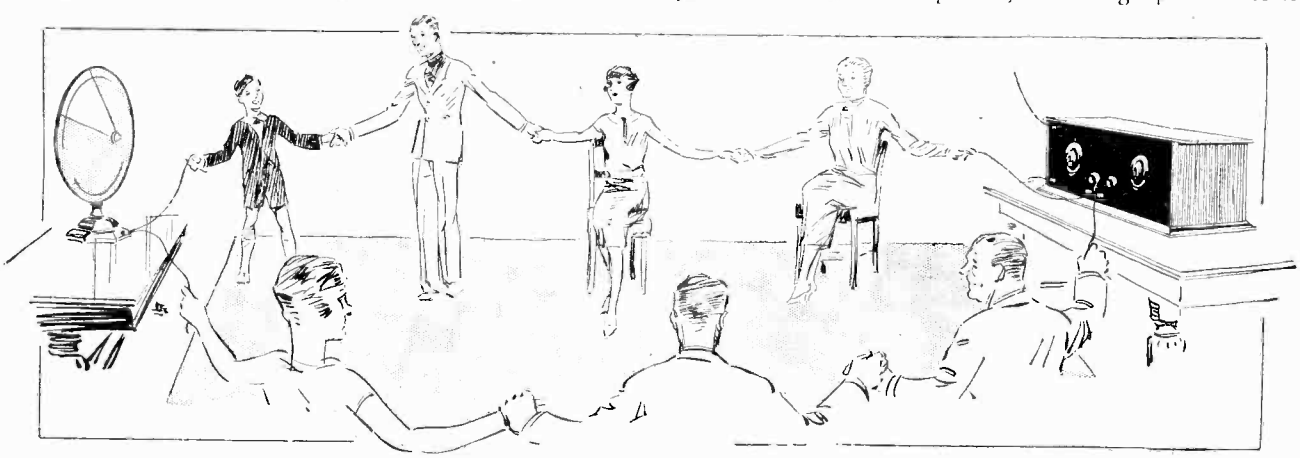
Feeling music. That a shock can be felt at the output terminals of a receiver may have already been accidentally discovered by many. A step-up ratio transformer will increase the effect and feeble shocks will be felt to the rhythm of the music.

Once the apparatus has been set up to reverse the records, all sorts of competitions can be devised which will entertain listeners. First, if the loud-speaker is in a separate room from the wireless set and the gramophone equipment, the set can be switched off during a programme, and a reversed gramophone put on as if it were part of the broadcast programme, and then see what effect it has on the listeners.

A simple way of devising a competition would be to supply the guests with a card with the names of, say, ten titles of gramophone records and then play these pieces over in some other order than is given on the card and invite the guests to put down the order in which they are played, guessing the pieces in turn. Of course, in a competition of this kind the records must not be very dissimilar in character, otherwise the guessing would be too easy.

The Dancing Guests.

If the foregoing is voted dull after a while, why not try to make the guests dance? Not by the obvious method of turning on the dance music and leaving the guests unentertained until, in sheer desperation, they dance for diversion, but in a much more unusual way. Produce two metal handles, made of sheet metal roughly rolled into a tube an inch or so in diameter and connected by pieces of flex to the secondary terminals of a step-up intervalve transformer. Join the primary terminals in parallel with the loud-speaker, and bring up music to its



A chain of persons linking hands in this way may form a substitute for the loud-speaker leads. Good contact should be made with the connections to both set and loud-speaker.

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maximum volume. Anyone holding the handles will receive quite energetic shocks in time with the music, and if your victim is either sensitive or unusually frivolous he may perhaps execute an impromptu grotesque dance.

If this experiment is presented under the guise of a new "marvel of science" it will be quite in order to introduce it with some pseudo-learned nonsense about "feeling music," suggesting that if only our sense of touch were sufficiently developed it would be every whit as possible to enjoy and appreciate a Beethoven Sonata (or a jazz band, according to taste) by feeling it in the form of "electrical impulses" as by hearing it from a loud-speaker. After all, are not the various frequencies and intensities of which the music is built up as fully represented in the electric currents flowing through the body as in the air-waves that strike the ear?

Music Without Telephones or Loud-speaker.

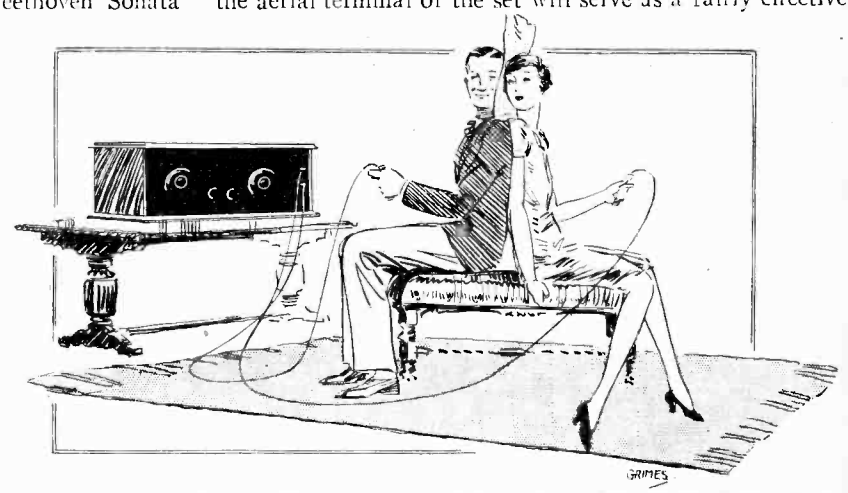
While the handles are still available in the output terminals of the receiver, with the output voltage stimulated probably by the use of a low-impedance power valve in the output stage and a 5 to 1 step-up output transformer, a very simple yet mystifying experiment can be undertaken. Two persons are seated side by side, each grasping one of the handles from the set. A third person places a dried piece of brown paper between the ears of the seated persons, and it is rather surprising that this simple arrangement gives "telephone reception." Being an electrostatic effect, improvement of signal strength will be found to result by connecting a 100-volt H.T. battery in one of the leads. The brown paper being dry, and consequently a good insulator, the possibility of feeling a "shock" need not be feared.

Human Telephone Leads.

The comparatively low electrical resistance of the human body is well illustrated by feeding the signals between the output terminals and the loud-speaker through a chain of persons. Good connection should be made at the terminals of both set and loud-speaker by increasing the area of contact with pieces of metal to serve as handles. This experiment is only successful with a loud-speaker of the high-resistance type, so that the value of the resistance introduced in this way will not become excessive compared with the total resistance in the circuit.

The Human Aerial.

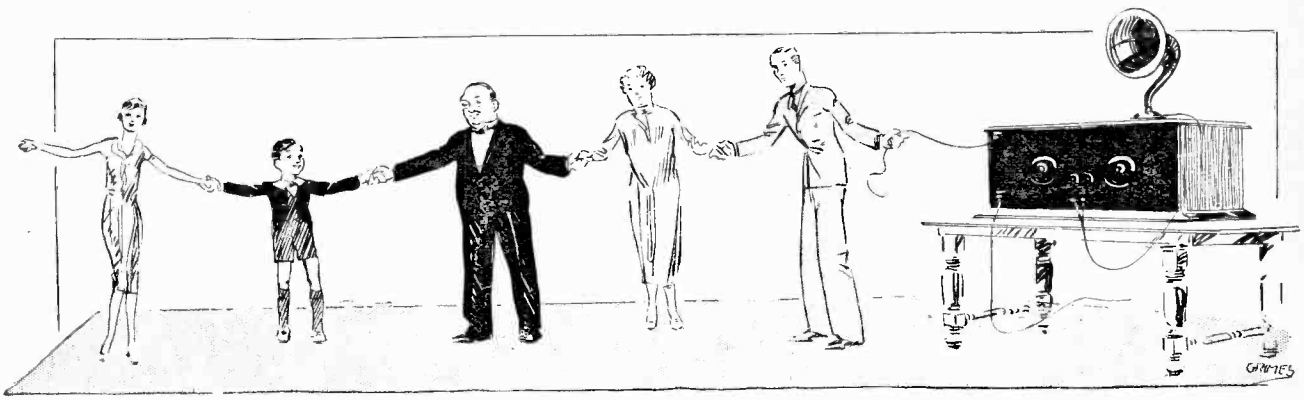
Again, a chain of people extending out in link from the aerial terminal of the set will serve as a fairly effective aerial, and good reception can be obtained with a set incorporating an efficient H.F. stage. It is assumed, of course, that the floor covering affords some degree of insulation, and a carpet covering an elevated boarded floor gives good results. The effect upon the tuning adjustments of a change in the length of this human aerial upon the aerial tuning adjustment is worth noting.



Listening in without telephones or loud-speaker. By an electrostatic effect a piece of dry brown paper placed between the ears of two listeners will feebly vibrate, emitting the music in the same way as the diaphragm of the telephone receiver. The introduction of a step-up ratio transformer at the output terminals will be found to increase the signal strength.

Local News.

Only a spare pair of telephones and a change-over switch are necessary to carry out this experiment. It will be first described as it would appear to the audience, and then it will be shown how it works. The broadcast programme is coming through on the loud-speaker in the



A human aerial. A good set fitted with an efficient high-frequency stage will receive the local programme with an aerial formed of several persons extended out in line as shown here. The effect on the tuning adjustment of changing the aerial constants by altering the length of the "aerial" can be readily observed.

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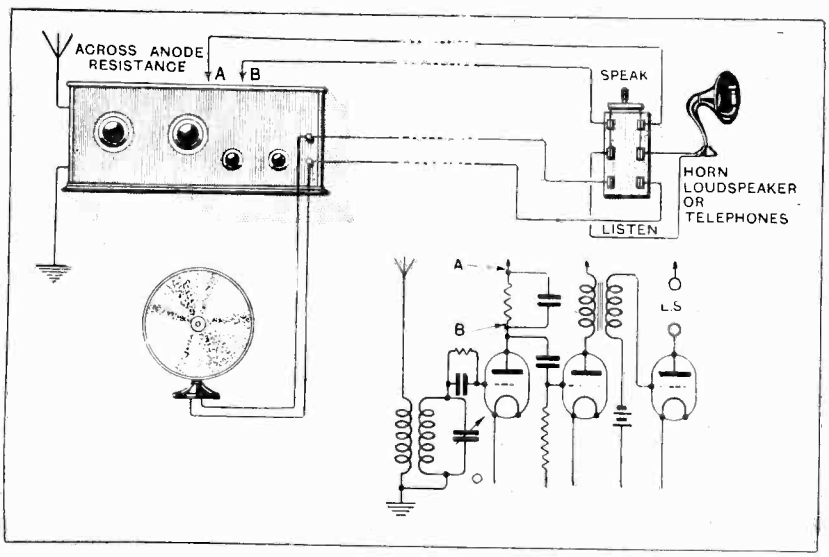
usual way, when it is announced at a suitable interval that "local news will follow." After dealing with items of particularly local and personal interest, it can be announced that a certain musical item will follow, having previously referred to the broadcast programme. A modification of the procedure consists of inviting the audience to ask questions when the "oracle" can make suitably framed replies.



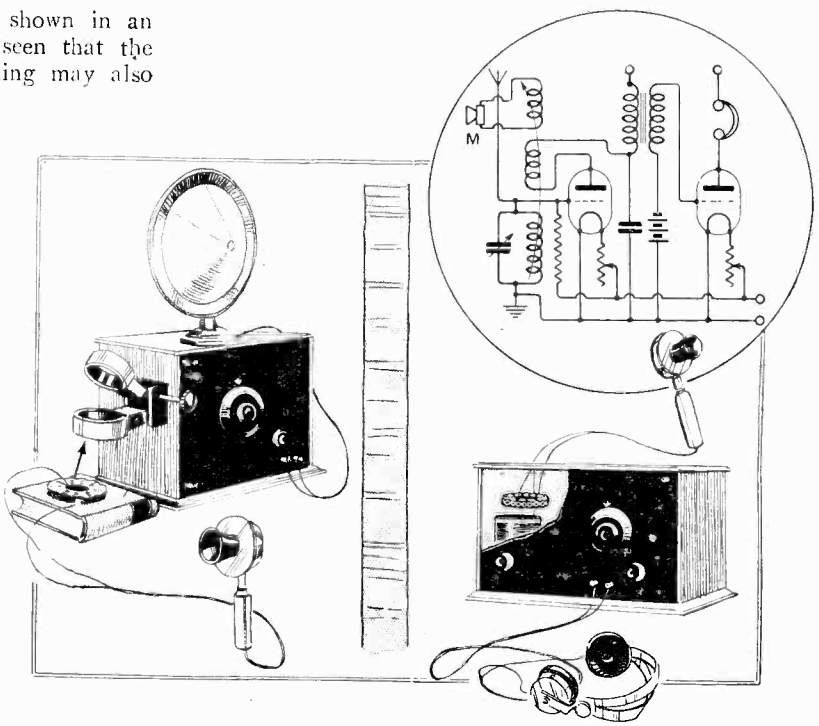
Local news. A news bulletin of personal interest to the listeners may be introduced without interrupting the transmission, by this simple switching arrangement. The change-over switch and loud-speaker, which is used as a microphone, are, of course, installed in another room to the receiving set.

The general scheme of connections is shown in an accompanying diagram, where it will be seen that the loud-speaker or telephones used for listening may also serve as a microphone for passing speech currents into the anode circuit of the detector valve. These leads should not be too long, and of light wire so as not to introduce unwanted capacity. It should be noted that words spoken into the loud-speaker directly connected with the receiving set can be faintly but clearly heard on the telephones or loud-speaker at the distant point. The additional leads to be fitted connecting with the detector valve are not only useful for the immediate needs of this "stunt," but will be valuable to those readers who might at any time wish to use a gramophone pick-up.

Wireless Telephony.

All listeners know how easy it is to cause interference by oscillating, and this experiment will serve to show how interference can be caused when a receiving set is not emitting the sound of heterodyning. Two simple receiving sets are required, preferably of the two-valve type, comprising reacting detector valve and note magnifier. The aim is to produce two-way speech communication, and although it is intended to provide only communication between two rooms in a house, it can be easily worked without modification between points many yards apart and through intervening walls. On standard elevated aerials the range may be several miles, though such an attempt would involve a breach of the regulations.

Each set is fitted with a few yards of aerial wire leading straight up to the picture rail, and a short earth wire should connect to gas or water pipe. One of the sets is brought into an oscillating condition, not so that it emits an audible whistle, but to a state where the set sounds "live" and with the reaction coupling taken to the point where further loosening results in cessation of the "breathing" sound. In this condition a loud click is heard in the telephones on touching the aerial. It is in this condition that the majority of two-valve sets are normally used for reception, and this experiment evidences, also, that it is this condition that causes interference. An inexpensive carbon microphone is connected across the ends of a basket coil roughly equal in size to the aerial or reaction coils. As it is moved nearer the aerial inductance it will be found that a point is reached where self-oscillation will just cease. When the diaphragm is now spoken on to, one's speech will be loudly heard in the telephones. With the microphone coil out of action, the second set is brought into operation by making use of



Two-way telephone transmission. It is quite easy by means of two receiving sets to establish short-distance telephone communication.

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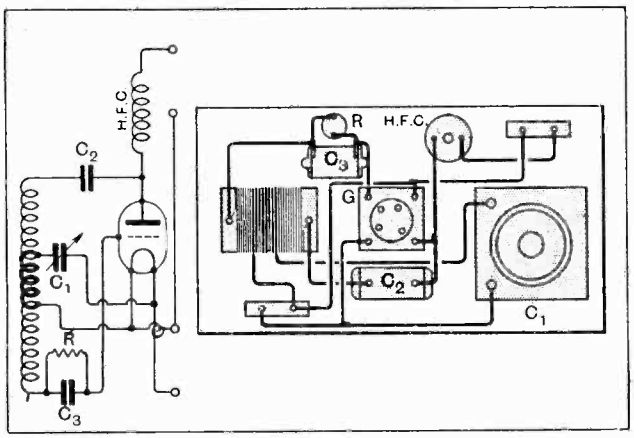
reaction and tuning round until a heterodyne note is heard from the first set. The condenser is then carefully adjusted to the silent point, so that a slight movement of the dial in either direction produces the whistle. A coil and microphone are then brought into operation, as in the case of the first station, and simultaneous two-way communication will readily be obtained.

Heating Filaments Without an L.T. Battery.

Every amateur understands the action by which a valve is caused to oscillate. A continuous process occurs by



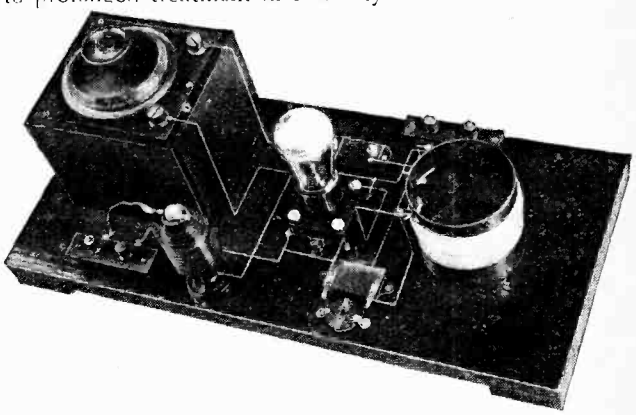
Lighting a valve filament without L.T. battery. The circuit arrangement of a valve oscillator in which the filament heating current is created by the oscillatory circuit. C_1, 0.0005 or 0.001: C_2, 0.001: C_3, 0.001; R, 10,000 ohms.

which potentials induced into the grid circuit control the anode current, which in turn again controls the potential of the grid. It is surprising that, although this fact has been known so long, yet it is probable that no single reader is aware that the filament heating current can be created as part of the process of self-oscillation, so that the valve may continue to regenerate merely by applying the constant anode potential.

If a single coil of wire is tapped somewhere near its centre and connected to the filament of a valve while the ends of the coil are connected to grid and anode, self-oscillation will occur, assuming that the anode current is fed through a suitable choke and "stopping" condenser and a battery is connected across the filament. Now if a portion of the winding in the anode circuit is tuned by bridging several turns with a variable condenser, a high-frequency current will circulate in this tuned circuit, its value depending upon the ratio of inductance to capacity. Thus by bridging only a few turns with a moderately large capacity condenser, a current of perhaps 2 or 3 amperes can be obtained, using an ordinary receiving valve as an oscillator and an anode potential of 200 volts. The experiment is carried out in this way. A 3in. cardboard tube is wound with 36 turns of No. 26 D.S.C. wire, then with 8 turns of No. 20 D.C.C., followed by 13 turns of No. 26 D.S.C. This coil is wired up to a valve as an oscillator, and a variable condenser having a maximum capacity of 0.0005 or even 0.001 mfd. is connected across the heavy winding, but in a manner such that the filament is in series with this tuned circuit. With the anode potential connected through a suitable choke coil to the plate and a momentary current applied to the filament, it will be found that the circuit in self-oscillating will cause the filament to glow brightly.

In carrying out the experiment for the first time, a battery should be connected across the filament, and the condenser adjusted to a position where the filament brightness is considerably increased. When this condition is reached, the filament supply may be withdrawn. It will be noted in the circuit given that a grid condenser is used for grid biassing in the place of cells. The condenser has a value of 0.001, and the leak consists of a spool of resistance wire having a value of 8,000 to 12,000 ohms. The "stopping" condenser in the anode circuit may be of any value between 0.01 and 0.0005 mfd.

If D.C. mains are available the H.T. can be conveniently obtained merely by joining directly to the supply voltage. A bright emitter valve, owing to the heavy filament-heated current which can be obtained, works exceedingly well for this experiment. It should be noted also that other valves may be connected in parallel on the terminals marked L.T., so that a receiving set can be operated without an L.T. battery. Valves with their filaments heated in this way appear to give a greater emission for a given filament brightness, and it is believed that the life of the filaments may be impaired if subjected to prolonged treatment in this way.



An L.T. battery eliminator. The oscillator with self-contained filament supply. A battery is momentarily connected across the filament, after which the current is maintained by oscillatory current in the tuned circuit.

The apparatus as shown in the accompanying illustrations forms a useful wavemeter and may be brought into operation by a key arranged momentarily to connect the filament to a small dry cell battery.

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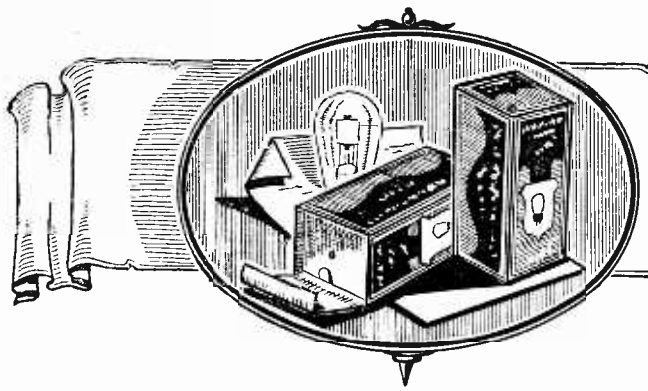
The ideas which have been described above are only some of many which might be put forward, but they will probably suffice to give the reader a sufficient basis on which to develop more schemes of his own and suggest the lines on which novel schemes for entertainment can be built up. With the apparatus available to the average wireless experimenter there are, of course, a great number of other experiments not directly connected with wireless but perhaps equally entertaining.



NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

OLD H.T. BATTERIES.

Before discarding an H.T. battery as useless, go over it from cell to cell either with a voltmeter or testing lamp, when it will generally be discovered that several of the cells are still in good condition. These may be utilised in various ways, such as running a small flash lamp bulb over tuning dials or the aerial ammeter in the case of a transmitting set.—A. H. R.

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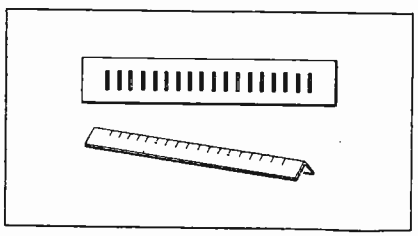
THE "REGIONAL RECEIVER."

Some difficulty may be experienced in cutting the slots in the ribbed formers for the long-wave coils in this receiver.

To overcome this difficulty a template was devised for marking the position of the slots.

A piece of sheet metal about No. 16 gauge was obtained and bent to an angle of approximately 45 deg.



Template for slotting ribbed ebonite formers.

so that it fitted over the ribs on the former. This angled metal was then slotted to the dimensions given in the issue of this journal for August 24th, 1927.

Instead of cutting the slots to the full depth with the template in position, it is advisable to start each slot with the hack-saw and then remove the template before finishing to the correct depth.—D. B.

INCREASING WET-CELL CAPACITY.

High-tension batteries are frequently constructed with wet cells containing the sac elements from run-down dry batteries. This is not a practice which can be recommended, but a certain degree of success is assured if, instead of using a single sac for each cell, two sacs are bound together with rubber bands and connected in parallel. If necessary the sacs may be carefully compressed in the vice to make them fit the containers available.—E. S.

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READERS' PROBLEMS.

For purposes of reference it will be found convenient to cut out the "Readers' Problems" pages and to file these by means of a spring binder such as is sold by philatelic dealers. It will then be a simple matter to find out whether any special point has been previously dealt with before writing in to the Information Department, and a considerable amount of repetition and overlapping will be avoided.—T. A. F.

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TESTING MOVING-COIL CONE.

In fixing the coil of a moving coil loud-speaker it is often difficult to get the coil truly square with the axis of the cone. This is easily and fairly accurately tested by laying the cone on the turntable of any gramophone which runs true; the slightest deviation from truth can be detected at once as the turntable revolves. If the coil is tested while the adhesive is still soft it can be adjusted very easily and quickly. It will be found best to place a few spots of adhesive round the circumference of the coil, adjusted with these when in a tacky state, allow to dry, and then finish with a thin line of adhesive round the coil at the junction of coil and cone.—J. B.

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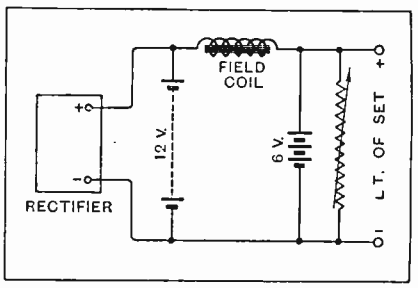
FIELD AND FILAMENT CURRENT FROM A.C. MAINS.

When the field current for a moving coil loud-speaker is obtained from an accumulator floated across a Philips rectifier, the filament current may be obtained in the same manner, but using the field coil as a choke



Smoothing circuit for field magnet and filament current supply.

which successfully removes all trace of ripple.

If the filament accumulator is six volts, then the floating accumulator must be increased by that amount, but as these cells may be ordinary H.T. accumulator units of, say, 3 amp. capacity, the cost will not be great.

A variable resistance should be used to balance the output to be slightly less than the input.—A. R. T

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."

REACTION AND SELECTIVITY.

Can the Effects of Circuit Resistance be Entirely Annulled by Reaction?

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

TOO often one hears the remark: "Why bother to go to the expense and trouble of making low-loss coils when any old coil with a bit more reaction will do as well?" And too often the fallacies underlying this argument are not even partially realised.

The present article has been written with a view to showing up these fallacies and to indicate both theoretically and by means of measurements what can and what cannot be done with reaction.

First, let us consider a simple tuned circuit (Fig. 1) consisting of an inductance L and a variable capacity C, and suppose the total resistance of the circuit to be R. If an E.M.F., E, at a fixed frequency, is induced in the circuit from some outside source—by means of an aerial coupled to the circuit, for example—a current, which we will call i, will flow round the circuit. The value of this current, for a fixed value of E and a given value of R, depends on the setting of the variable condenser C.

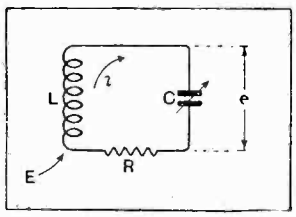


Fig. 1.—Simple tuned circuit with quantities involved in resonance curves.

If the value of current is plotted against the condenser setting, the curve obtained will be the familiar resonance curve. If the resistance of the circuit is increased and E kept constant, the maximum value of the current will be less, and the resonance curve will be generally flatter. However, if R is left unaltered, and E increased, the resonance curves obtained are as shown in Fig. 2 (a), with the vertical scale multiplied to correspond with the increase of E. Again, if the circuit resistance is increased and the induced E.M.F., E, increased in order to make the *maximum* values of the current the same in each case, the resonance curves will not be the same, but the curve corresponding to the increased resistance will be much flatter, as shown in Fig. 2 (b).

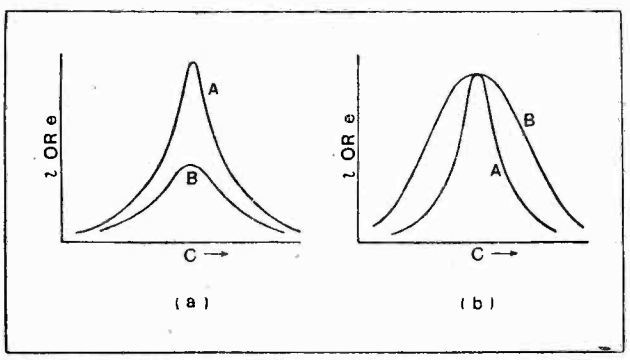


Fig. 2.—Resonance curves for two values of circuit resistance; (a) with E constant, (b) with E increased to bring maximum of curve B to same value as A.

The foregoing statements are very briefly summarised in the following equation:—

$$i = \frac{E}{Z} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (1)$$

where Z is the impedance of the circuit to the current flowing in it. At resonance—*i.e.*, when the circuit is tuned—the current is a maximum because Z is a minimum and equal to R. Thus the equation for the maximum current may be written:—

$$i_{max} = \frac{E}{R} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (2)$$

Now let us consider the circuit of Fig. 3, which represents the circuit of Fig. 1, with the addition of a valve

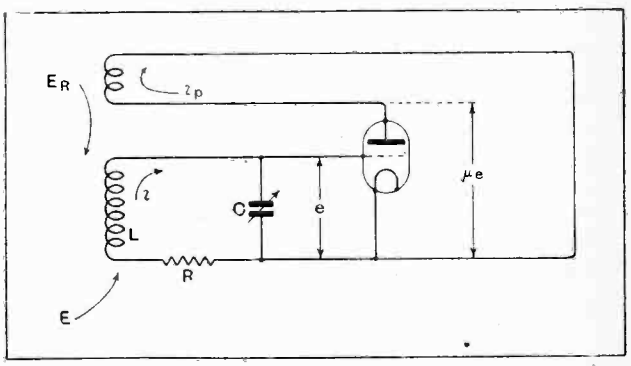


Fig. 3.—Schematic diagram showing the application of reaction to the circuit of Fig. 1.

with a reaction coil in its plate circuit coupled to the inductance L.

As before, an E.M.F., E, is assumed to be induced in the tuned circuit from some outside source, which produces a current in the circuit and a voltage, e, across the condenser, as before.

Owing to the presence of the valve, this voltage, e, connected between grid and filament, corresponds to a voltage, μe between plate and filament of the valve (where μ is the amplification factor of the valve), and this in turn corresponds to a current i_p through the reaction coil.

Extra E.M.F. Due to Reaction.

Since the reaction coil is coupled to the tuned circuit, there will be an E.M.F., which we will call E_r, induced in the latter, due to the current i_p in the reaction coil, and it should be noticed that the value of E_r depends on the value of i, the current in the tuned circuit.

We may therefore write for the maximum value of the latter current the following equation:—

$$i_{max} = \frac{E + E_r}{R} \quad \ldots\ldots\ldots\ldots\ldots \quad (3)$$

Now, from the point of view of the outside source, the only induced E.M.F. is E, so that from this point

Reaction and Selectivity.—

of view the increased value of current due to E_r might equally well be represented by a *decrease* of resistance by an amount x, so that i may be written as :—

$$i_{max} = \frac{E}{R - x} \quad \ldots\ldots\ldots\ldots\ldots\ldots \quad (4)$$

Equating (3) and (4) at resonance, $x = \frac{E_r}{E + E} R$

In other words, the effect of using reaction is to introduce an effective negative resistance into the tuned circuit, as regarded from the point of view that the total induced E.M.F. is the E.M.F., E, from the outside source.

Negative Resistance.

The point that must be noticed here is that the value of this effective negative resistance x depends on the value of the current in the simple circuit—that is, at points away from resonance, where the current is small, the value of x will be correspondingly small.

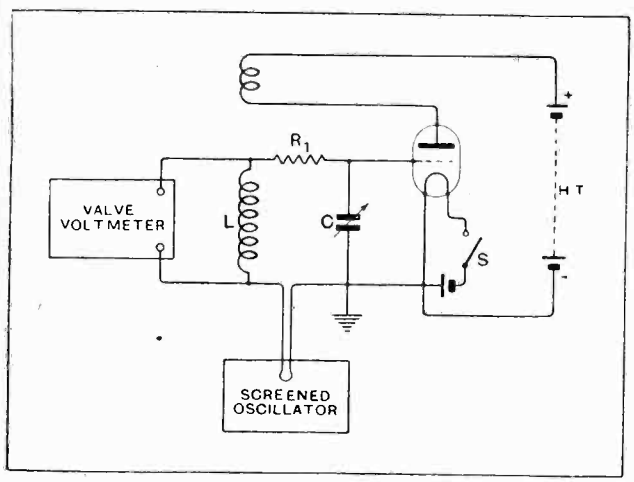


Fig. 4.—Apparatus used to obtain the curves of Fig. 5.

It would be expected, therefore, that the shape of a resonance curve obtained by using reaction on a tuned circuit should lie between the two shown in Fig. 2 (b), and that if the resonance curve for the circuit alone were fairly flat, due to high resistance, then the top of the resonance curve with reaction will also be flatter than the curve corresponding to a lower resistance circuit.

This means that a high-resistance circuit with reaction may be made as *sensitive* as a low-resistance circuit—or, similarly, a high-resistance circuit with more reaction as sensitive as a low-resistance circuit with less reaction—yet *it will not be as selective*, and the higher the resistance the less the selectivity, even with reaction. This shows the great fallacy underlying the remark at the commencement of this article.

Experimental Results.

In order to illustrate experimentally the foregoing reasoning, the arrangement of apparatus shown in Fig. 4 was adopted.

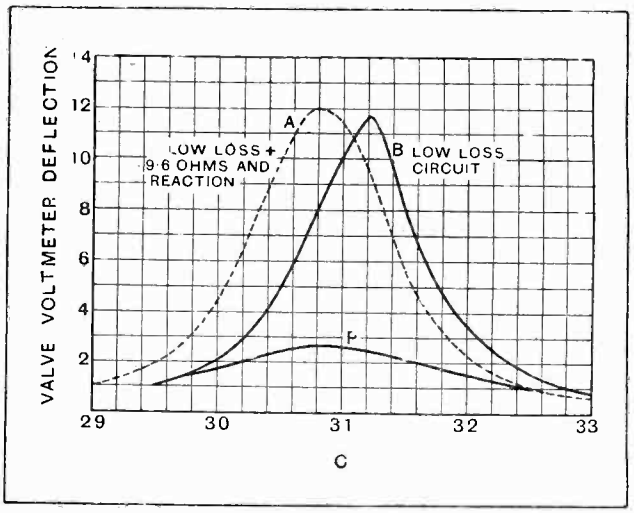


Fig. 5.—Curve A, 16½-ohm circuit with reaction; B, 7-ohm circuit without reaction; P, 16½-ohm circuit without reaction. The slight difference in the value of C for peak values of A and B is due to the fact that R is not quite non-inductive, but does not affect the general result.

The E.M.F., E, was obtained by very loose coupling with a suitably screened H.F. oscillator, and the voltage across the coil L measured by means of a valve voltmeter. Provision was made in the tuned circuit for the addition of a length of resistance wire of fine gauge to alter the resistance of the circuit.

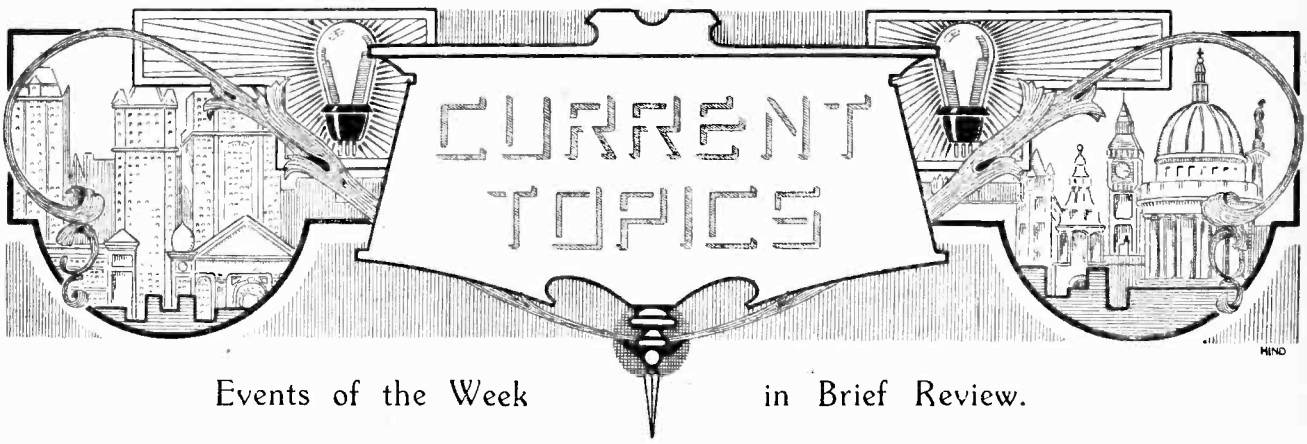
As a start, the maximum value of the voltage across L, without the added resistance R_1 and with the valve filament disconnected by means of the switch S, was noted. The resistance R_1 was then inserted, the valve switched on, and the reaction coil coupling varied until the maximum voltage was approximately the same as in the first case, after which complete resonance curves were taken for the above cases and also for the circuit alone with R_1 included (curve P).

These three curves are shown in Fig. 5. The difference in the shape of curves A and B is most marked, and clearly shows that the high-resistance circuit with reaction is not so selective as the low-resistance circuit without.

The latter circuit had a resistance of approximately 7 ohms at the frequency of the experiment ($\lambda = 500$ metres), and the added resistance was about 9½ ohms, so that the high-resistance circuit value was about 16½ ohms.

TECHNICAL QUERIES.

The attention of readers availing themselves of "The Wireless World" Free Information Service is specially directed to the Rules of this Department which are printed in the "Readers' Problems" section.



Events of the Week in Brief Review.

A GOOD TIP.

Make it a "wireless" Christmas, and solve the presents problem.

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CHRISTMAS IN THE WORKHOUSE.

The inhabitants of the Rye Institution stand a chance of enjoying a radio Yuletide if the plans of the Board of Guardians materialise in time. A wireless fund has been opened for the provision of a broadcast receiver.

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"MAYDAY."

"Mayday" is the new wireless telephony distress signal incorporated in the International Wireless Convention, signed at Washington, as the equivalent of the S.O.S. in telegraphy. The word is a corruption of the French "m'aidez," and has been used by cross-Channel pilots for some time.

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FIRE AT DITTON PARK.

A serious fire occurred last week at the Ditton Park experimental wireless station of the Radio Research Board. Part of the station building was gutted and one of the tall wooden masts was burnt down. Many wireless workers will be glad to know that, although the material damage was extensive, all the records were saved.

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DEAF OFFICIAL AND ALLEGED "PIRATE."

A deaf postal official who was sent to "test" the wireless set of an alleged "pirate" figured in a case at the West London Police Court on Friday, November 18th, when Mr. G. W. Robinson, a Fulham resident, was charged with installing and operating a receiver without a licence.

The official, who used an aural appliance in the witness box, was asked whether he had heard anything on the defendant's set. He replied: "I thought I could." (Laughter.)

The defendant told the magistrate that although he took out a licence on the day of the official's visit, he had never been able to use the set.

The magistrate (Mr. Cousins) dismissed the case under the Probation Act.

2LO AT POTTERS BAR?

We should not be surprised to hear that the B.B.C. had chosen a site at Potters Bar, Middlesex, for the erection of the London regional broadcasting station. Does this mean that the new station will carry the original call-sign, 2LO?

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CHINA SPEAKS OUT.

Chin Chung-wang, representative of the Peking Government, was responsible for a

BURNT DOWN. A general view of the Ditton Park Radio Research Station which suffered severe damage in a fire last week. The mast on the right was burnt to the ground.

spirited little declaration at the Washington Conference. He said that the Chinese Government would not, without its expressed consent, recognise the right of any foreign power or its nationals to install or operate any wireless station on any part of its territory. This applied to any station erected in Legation grounds, concessions, or leased territory.

WANTED: QUIET LOUD-SPEAKERS.

Steps to prevent public annoyance by loud-speakers and gramophones are being considered by the Bexhill Town Council. A draft by-law will probably be submitted to the Home Office for approval.

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AN EASY STARTER.

A New York firm of car manufacturers is stated to be exhibiting a car which can be started through a thermionic valve relay by a mere wave of the hand. Car thieves will consider this a very sensible invention.

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GO-AHEAD ALGIERS.

The town of Algiers is holding a wireless exhibition this week under the auspices of the Radio-Club d'Algerie. It is expected that a broadcasting station will be in operation before the end of the year.

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CABLES AND WIRELESS.

The Prime Minister, replying to a question in Parliament on November 28th, said that the Government did not intend to set up a Royal Commission to consider the possibility of practical co-operation between the State-owned systems of wireless and cable.

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WASHINGTON WAVELENGTH DECREES.

The International Radio-telegraph Convention was signed at Washington on November 25th by representatives of some eighty nations and territories. It is stated that the Convention will remain effective as from January 1st, 1929, and will "remain in force for an indeterminate period, and until one year from the day on which the denunciation thereof shall take place."

In regard to the wavebands available to amateurs, agreement was reached on the following basis: Amateurs will share with mobile and point-to-point users of radio the wavebands between 75 and 85 metres and between 150 and 175 metres. Another waveband available to amateurs will be that between 20.8 and 21.4 metres, together with the two experimental wavelengths of five and ten metres which are not considered of commercial value at the present time.

Perhaps the most important clause of the Convention is the fifth, which says: "The administrations of the contracting countries may assign any frequency or any type of wave to any radio station within their jurisdiction upon the sole condition that it will result in no interference with any service of another country."

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PRAISE FOR THE AMATEUR.

High praise has been meted out to the wireless amateurs of New England and Boston for their emergency work during the floods in New Hampshire. In a recent statement Major-General Charles McK. Saltzman, chief of the U.S. Army Signal Corps, said that for nearly a week radio amateurs in the signal corps emergency network and the American Radio Relay League carried a big share of the burden of communications, particularly to relatives and friends of those in the stricken area. The first news of the flood disaster at Montpelier was given by two amateur operators.

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LARGER BRITISH INDUSTRIES FAIR.

The British Industries Fair, to be held in London and Birmingham from February 22nd to March 2nd next, will be at least one-third as large again as this year's event, according to Mr. Douglas Hacking, M.P., new head of the Department of Overseas Trade. Many wireless firms were represented at the 1927 Fair.

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NO NEED FOR ALARM.

American radio manufacturers are said to be growing anxious over the pending exploitation of the "monophone," a device which can be plugged into the ordinary lighting system to receive music by "wired wireless." The monophone is now in operation at Freeport, Illinois, and there is talk of its being introduced into Chicago.

The telephone or lighting company provides the music, which is charged on a time basis.

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WIRELESS IN PARIS HOSPITALS.

"La T.S.F. à l'Hôpital" is the name of a new society founded in Paris for the provision of wireless sets in hospitals. Subscribers are made members of the society, and are asked to pay 20 francs per annum. State and local grants help to swell the funds.

A large membership has already been obtained and there is a confident hope that patients in all the Paris hospitals may soon be able to listen-in.

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 7th.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "The Attenuation of Wireless Waves over Land," by Mr. R. H. Barfield, M.Sc. (Eng.), A.M.I.E.E.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Informal Demonstration by Mr. Percy Marks, B.Sc.

Stretford and District Radio Society.—At 8 p.m. At 6A, Derbyshire Lane. Lecture by Mr. Burch.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Business Meeting.

North Middlesex Wireless Club.—At 8.30 p.m. Loud-speaker Competition.

THURSDAY, DECEMBER 8th.

Institute of Wireless Technology.—At 7 p.m. At the Engineers' Club, Coventry Street, W. Lecture: "Mains Operation of Receivers," by Mr. W. A. Chambers.

Leyton and Leytonstone Radio Society.—At 8 p.m. At "Hayda House," Fairlop Road, E.11. An Evening with the "Everyman Four," conducted by Mr. Anthoney.

FRIDAY, DECEMBER 9th.

South Manchester Radio Society. At the Co-operative Hall, Wilmslow Road, Didsbury. "Solodyne v. Superheterodyne," by Messrs F. Marlow and G. A. F. Mercer.

Leeds Radio Society.—At Leeds University. Lecture No. 2: "The Three-valve Set," by Mr. A. F. Carter, A.M.I.E.E.

MONDAY, DECEMBER 12th.

Southport and District Radio Society.—At St. John Hall, Scarisbrick Street. Lecture: "Superheterodyne Receivers," by Mr. P. K. Carmichael (of the Society).

NEWS FROM THE CLUBS.

New Birmingham Society.

A Wireless Society has been formed on the initiative of Dr. C. H. Harcourt at Erdington, Birmingham, and is known as the Slade Radio (Branch of the Wireless League), with the object of securing mutual co-operation between all those interested in the principles of wireless operation. An experimental station is being provided and a series of demonstrations and lectures arranged. Members of the Wireless League and others interested will be welcomed.

The Hon. Secretary is Mr. H. Clews, 52, St. Thomas Rd., Erdington, near Birmingham.

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Catering for the Beginner.

A Junior Section has been formed by the Wembley Wireless Society with the special object of appealing to boys and those whose knowledge of wireless practice has not yet reached an advanced stage. The section meets at 6.30 each Friday evening, and recent lectures have dealt with such topics as "The best way to erect an aerial" and "How to obtain loud-speaker results from the crystal set." The Senior Section is carrying out a busy and profitable programme. At a recent meeting, Mr. N. P. Vincer-Minter, of *The Wireless World*, demonstrated the well-known "Everyman Four."

All those interested in either section of the Society can obtain further particulars from the Hon. Treasurer, Mr. H. E. Comben, 24, Park Lane, Wembley.

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Varied Fare at Tottenham.

A varied fare of interesting things was provided by Messrs. K. Higginson and G. W. Hale, of Messrs. R.I. & Varley, Ltd., at the last meeting of the Tottenham Wireless Society. Mr. Higginson in a lantern lecture reviewed briefly and lucidly the whole subject of low-frequency amplification. Mr. Hale then described the well-known "Hale" reflex circuit. During the latter part of the evening both lecturers described the new Interdyne valve, and in a subsequent demonstration with a five-valve receiver the manner in which signals were received with Interdyne valves was very interesting. Hon. Secretary: Mr. F. E. R. Neale, 11, St. Loys Road, Tottenham, N.17.

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Past Year in South Woodford.

Speaking at the Annual General Meeting of the South Woodford and District Radio Society on November 21st, the president, Mr. J. E. Nickless, A.I.E.E. (2KT), said that considering the comparatively small population of that district the club had passed through a successful year.

All officers retired but were re-elected *en bloc*.

Hon. Secretary: Mr. E. J. Turbyfield, 42, Alexandra Road, South Woodford.

THAT CHRISTMAS FEELING. Members and friends of the Muswell Hill and District Radio Society photographed at the Society's recent annual dance.

PRACTICAL HINTS AND TIPS

Some Facts about Anode Rectifiers.—Over-amplification.—Using a Gramophone Pick-up.—The Advantages of "Super-super-power" Valves.

MOVING COIL LOUD-SPEAKERS.

THERE is no reason why an L.T. accumulator should not be used to supply current for the field winding of a moving coil loud-speaker in addition to performing its normal function of heating the valve filaments. It is probable, however, that the current passed by the pot magnet winding will exceed that taken by the set, and the cells will be discharged very much more quickly.

A word of warning should be added against using small accumulators at a greater discharge rate than that at which they are rated.

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FITTING A VOLTMETER.

IT is observed that the experimentally inclined amateur is, as a rule, unwilling to limit the usefulness of a voltmeter by wiring it permanently into his receiver. There is a good deal to be said in favour of this attitude, as the instrument is a valuable aid in the location of faults, and greater benefit will be derived from its use when it may readily be connected across any of the batteries or any part of the circuit. It cannot be denied, however, that it is extremely convenient to be able to read the more important voltages without the necessity for joining up temporary leads, and a two-range voltmeter might well be included as a part of every receiver where expense is not a first consideration.

In modern sets there is often available space on the panel, as a large proportion of the components are mounted on a baseboard, so there will be little difficulty in making the addition in question. The method of connection is shown in Fig. 1, from which it will be seen that the meter terminals are joined to convenient points on the battery leads through switches. These should be of the spring push type (as used for operating electric bells, but preferably much smaller), in order to preclude, or at any rate to minimise, the possibility of short circuits which might otherwise be introduced were two switches to be closed at the same time.

Several types of two-range instruments have the figures relating to the different scales inscribed on the dial in contrasting colours; in this case it

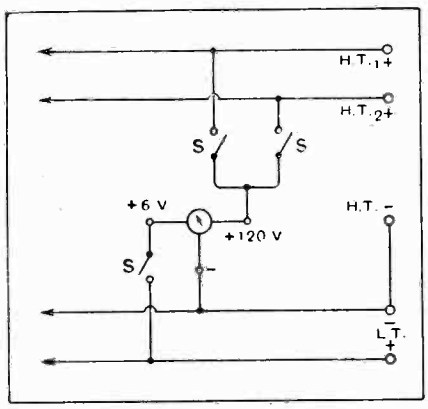

Fig. 1.—H.T. and L.T. voltages may be read at a glance by including a two-range voltmeter, wired to the battery bus-bars through push switches.

is a good idea to fit push buttons of corresponding colours for closing the L.T. and H.T. meter circuits.

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TWO-VOLT DETECTORS.

IT has been stated that two-volt valves (which have comparatively short filaments) make better anode bend detectors than those rated at four or six volts. This statement is correct enough as far as it goes, but requires some modification in certain cases. When the receiver includes two stages of low-frequency amplification it is undoubtedly wise, in the interests of long-range reception, to make every effort to obtain maximum rectification efficiency on a small input, as a very small rectified output will undergo sufficient magnification fully to load the ordinary output valve. There is, however, another aspect of the question which arises when a single L.F. stage following such a detector is used for loud-speaker reproduction. In a receiver of this kind it is important that the rectifier should contribute as much as possible towards the total amplification obtainable, and as a large H.F. voltage input is assumed, amplification efficiency is more important than pure detection efficiency. It will therefore be seen that, provided we intend to take advantage of the improved characteristics of high-voltage valves elsewhere in the set, there is no point in choosing a detector simply for its rectifying properties, the advantages of which are only apparent when dealing with weak signals.

A possible exception to this rule exists when the "single L.F." receiver is largely used for headphone reception of distant stations.

It may be added that the "large H.F. voltage input" mentioned above is obtained either on account of proximity to a transmitting station, or alternatively by efficient H.F. amplification preceding the detector; this addition may be required when the amount of energy collected by the aerial is small.

TWO-VOLT VALVES.

WHEN using two-volt valves throughout in a multi-stage receiver (with four or more valves) it is often advisable to omit all filament rheostats unless the design which is being followed specially calls for them—possibly as a volume control by dimming the H.F. amplifier. The reason for this is that a certain voltage is dropped in battery leads, both external and internal, and with the small surplus at our disposal it is quite possible that the residual resistance in a rheostat at minimum setting, in conjunction with the extra lengths of wire used in connecting it, may be sufficient to prevent the application of the full rated filament voltage.

This advice applies with greatest force when one or more of the valves consume a comparatively high current. It will be realised that, to obtain a wattage approximating to that consumed by six-volt valves, the tendency is to increase the heating current of those with two-volt filaments.

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SUPER-POWER VALVES.

THOSE who are considering the substitution of a valve having an extremely low impedance in the output stage should bear in mind that one of the greatest advantages of what may be called the super-super-power valve is its suitability for operation with extremely high anode voltages. The full benefit of such valves is only obtained when H.T. pressures of several hundred volts are applied; when the amateur is limited to 120 volts or so, they offer little advantage as compared with ordinary super-power valves, which are much more economical in filament current.

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THE "EVERYMAN THREE" ON THE GRAMOPHONE.

NO doubt many readers in possession of this popular receiver are desirous of adapting it for gramophone reproduction. As it includes only a single stage of low-frequency magnification, the detector must of necessity be converted into an amplifier; fortunately, there is no great difficulty in making the required alterations, which will be in the grid circuit of this latter valve, as shown in Fig. 2.

It will be observed that the grid leak must be connected in parallel with its condenser, and that a switch for short-circuiting the combination is fitted. This is, of course, opened when the valve is performing its normal function. In addition, the low potential end of the tuned circuit must be disconnected from the L.T. bus-bar and terminated in a plug for insertion into the socket of the bias battery. If the valve is to act as a gramophone amplifier, its grid will be made negative, while for detection a positive voltage must be applied. It will thus be necessary to connect the lead from L.T. negative to a positive tapping on the bias battery, in order that the grid circuit plug may be inserted at a point which is either positive or negative with respect to the fixed connecton.

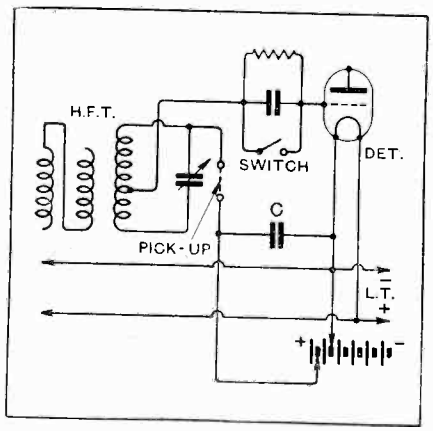

Fig. 2.—A method of modifying the grid circuit of the "Everyman Three" detector valve for optional use of a gramophone pick-up.

Two terminals (or sockets) are provided for connection to the pick-up; these are short-circuited when the set is used for wireless reception. It may be found more convenient to substitute a "single circuit closed" jack, which will automatically restore continuity in the circuit when the plug connected to the pick-up device is withdrawn.

A by-pass condenser of from 0.1 mfd. upwards may be added, generally with advantage; it is shown at C in the diagram.

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TOO MUCH AMPLIFICATION.

IT is generally assumed that L.F. coupling resistances will be used only in the anode circuits of valves having a comparatively high amplification factor. This practice is correct enough when maximum amplification is required, but it must not be forgotten that occasions often arise where this condition does not exist. For example, it may be found that a single L.F. amplifier gives signals which are definitely too weak, although an additional magnification of from 15 to 20 times, as obtainable from a stage with the conventional type of valve and associated value of resistance, would be altogether excessive. Under these conditions, it will generally be found that an ordinary power valve, with an impedance in the order of 7,000 ohms, and a coupling resistance of from 30,000 ohms upwards, will give all the extra intensity which is necessary. The amplification obtainable from a stage of this kind is not likely to exceed four or five, so the anode voltage supplied must be such that grid bias may be about one-fourth of that impressed on the last valve; otherwise there is risk of introducing distortion.

The above remarks apply essentially to receivers primarily designed for high-quality reproduction of signals from a nearby station, and not to long-distance reception, for which L.F. amplification cannot, as a rule, be sacrificed. It should be realised that the distribution of broadcast transmitters in this country is so arranged in respect to density of population that the majority of listeners should have little difficulty in obtaining a very considerable H.F. input from at least one station; if they do not, it will generally be found that the aerial-earth system and perhaps the tuning circuits are at fault. There are, of course, exceptions to this general statement, as certain districts are admittedly not too well served, but the fact remains that over-amplification is more common than the reverse condition.

The quality obtainable from a low-magnification resistance-coupled second stage is likely to be of a high order, partly because the tendency towards self-oscillation is small. Attention may be drawn to the fact that a high-impedance valve, as used for distant reception, may be replaced for local station work by a power valve without any real necessity for changing the anode resistance, the value of which is by no means critical.

CONSTRUCTING A GRAMOPHONE PICK-UP.

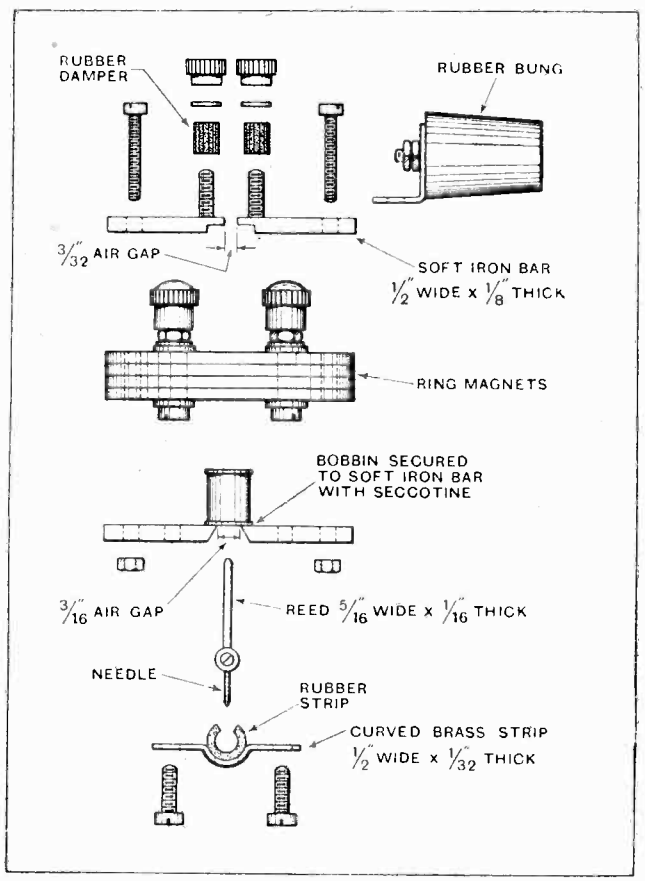
An Inexpensive Unit Built Up from Telephone Parts.

ELECTRICAL reproduction has brought the gramophone and radio set very close together, and many amateurs will now be considering the acquisition of a pick-up device. A visit to the recent Olympia exhibition would have shown that the choice is anything but limited for the man who has a few pounds to dispose of. There must, however, be many experimenters who would prefer to construct their own instrument, and the design described in this article is considered by the writer as being very suitable for their requirements.

The parts involved are both cheap and easily obtainable, while the constructional work is very straightforward.

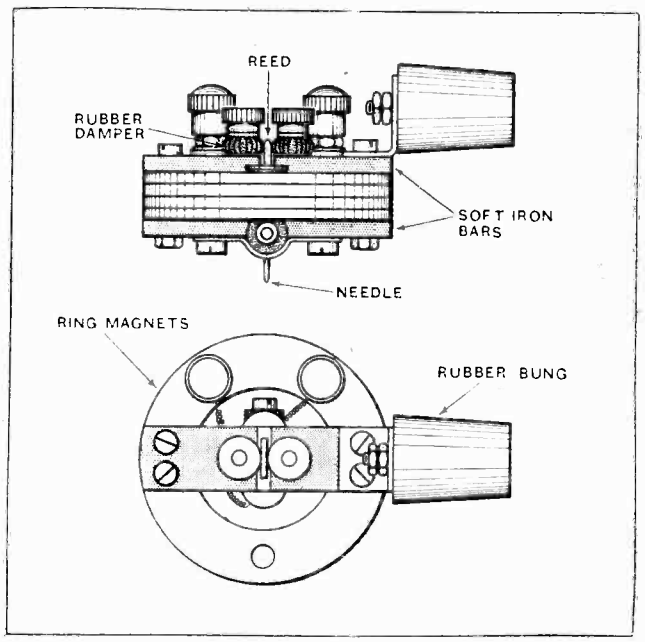
The following parts are required:

One set of telephone ring magnets; if those available are very ancient it will be advisable to have them remagnetised. One 1,000 ohm phone bobbin; one rubber bung, from the chemist; one latch key blank; short bar of $\frac{1}{2}$in. × $\frac{1}{8}$in. soft iron; brass strip; rubber tubing; screws; terminals, etc.



The pick-up device disassembled to show details of construction.

To commence with the phone magnets, two bars of the iron are cut to a length equal to the outside diameter of the rings, usually about 2in. These are to form the pole pieces, and after marking out and drilling to the existing holes in the magnets, they are sawn in halves and the faces piled up to the correct air gap ($\frac{3}{32}$in. between the top pair and $\frac{3}{16}$in. between the lower pair). The latter are bevelled at an angle of 45°, forming a "V" notch to receive the reed.



Plan and elevation of assembled unit.

The 1,000 ohm phone bobbins on sale at most wireless shops are wound on ebonite or fibre formers about $\frac{7}{16}$in. wide outside. If now a sufficient number of ring magnets are placed together to make a thickness slightly less than $\frac{7}{16}$in., and the upper pole pieces are recessed at the tips to fit round the bobbin, then the latter will be held securely in position if smeared with a touch of Seccotine.

Mounting the Reed.

The reed is quite easily shaped out of the key blank, a section $\frac{1}{2}$in. wide is sawn off, and the tongue portion filed down to $\frac{1}{16}$in. × $\frac{5}{16}$in. wide. The needle hole must now be drilled, and the tightening screw hole drilled and tapped 6B.A.

The circular portion is wrapped round with rubber strip and clamped into the "V" notch between the lower pole-pieces by means of a curved brass strip held up by

Constructing a Gramophone Pick-up.—

two No. 4 B.A. screws. A ¼in. hole is drilled through the centre of this bearing strip to clear the needle. On the upper pole-pieces is a centring and damping adjustment for the reed, consisting of a pair of No. 4 B.A. studs, on each of which a ¼in. length of rubber tube is compressed by two milled nuts until the rubber just presses on the top of the reed. It will be found that this damping may be left very free.

Attachment to the Tone Arm.

The rubber bung is utilised for attachment to the tone arm. It is bored through the centre and fastened to an angle bracket, which in turn is held by the No. 6 B.A. screws, which clamp the rings and pole-pieces. The leads from the coil are taken out to a pair of small terminals, insulated by fibre washers from the magnets. When all filing and drilling work has been finished, it is advisable to anneal the pole-pieces and reed by heating to a dull red and allowing them to cool in powdered chalk or similar substance.

The ideal metal for making the poles is, of course, Swedish iron, but it is not easy to obtain, and quite good results are possible without it.

The 1,000 ohm coil will be found to be about the right impedance for the primary of most good quality inter-valve transformers of about 5 to 1 or 6 to 1.

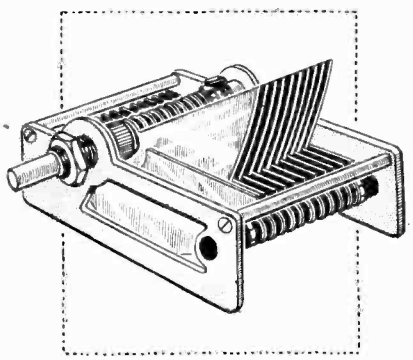
W. R. P.

NEW APPARATUS.

A Review of the Latest Products of the Manufacturers.

TRIX LOGARITHMIC CONDENSER.

Variable condensers conforming to the logarithmic law are extremely popular as they provide probably the most convenient scale between square law and straight line frequency. A particularly robust and well-finished 0.0005 mfd. log. condenser is



The Trix Logarithmic Condenser.

being sold at the moderate price of 7s. 9d. by Eric J. Lever, 39, Clerkenwell Green, London, E.C.1. The bearings have ample surface and end thrust is taken by ball bearings while a friction control is provided by adjustment of pressure on a leather washer. The rotor is connected to the metal fame of the condenser by a braided copper pigtail which ensures a positive contact. It is understood that future models will be arranged so that the stator contact and terminal are well air-spaced from the framework.

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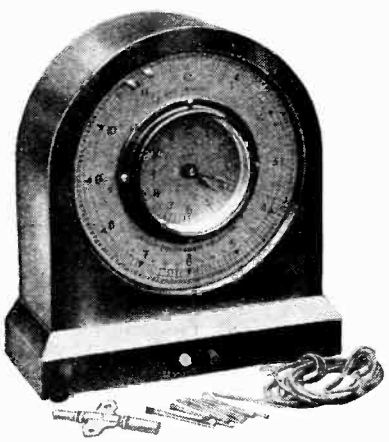
AXUEL PROGRAMME SELECTOR.

So varied are the musical tastes of broadcast listeners that seldom is a whole programme heard without deletion of one or two items. There may be some specially interesting sections in the programme which it is desired to hear to the exclusion of all others and to effect this, reliance must be placed on the memory and an accurate clock.

The Axuel programme selector made by Pelhams, Ltd., 5, Banner Street, London, E.C.1, provides a means of pre-selecting any number of items during the day and automatically switches the set off at the end of the programme. The selector consists of a 30-hour clock around the face of which are 144 holes, each hole corresponding with a five minute interval. The clock has two terminals and is interposed in the L.T. circuit of the receiver. A dozen metal plugs are included for insertion into the holes and serve alternately to make and break contact at any time or times desired.

This ingenious instrument is well finished in mottled brown or ebony and on being tested was found to be a good time-keeper and to give accurate selection of programme.



The Axuel programme selector provides a means of automatically switching on and off any number of items during the day.

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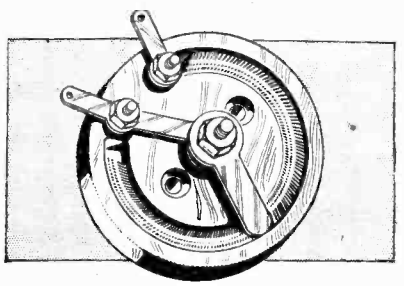
MATCHLESS ADJUSTABLE RESISTOR

Variable panel-mounting rheostats are not justified, on the score that a critical control of filament temperature is not required with modern valves; a panel rheostat, however, is useful for altering the ratio of internal to external anode impedance of a H.F. valve as a means of controlling volume. With this last exception the temperature of valve filaments is best controlled by a semi-fixed baseboard resistor which can be altered from time to time to suit the state of discharge of the L.T. accumulator. The Matchless adjustable resistor, a product of Thomas D. Young and Sons, 23, Noel St., Notting-



Matchless baseboard-mounting adjustable resistor.

ham, for baseboard mounting is a satisfactory means of controlling filament temperature and consists of a 1½in. circular porcelain disc grooved to take the resistance wire and having a finger-controlled contact arm. The price is 1s. 3d.

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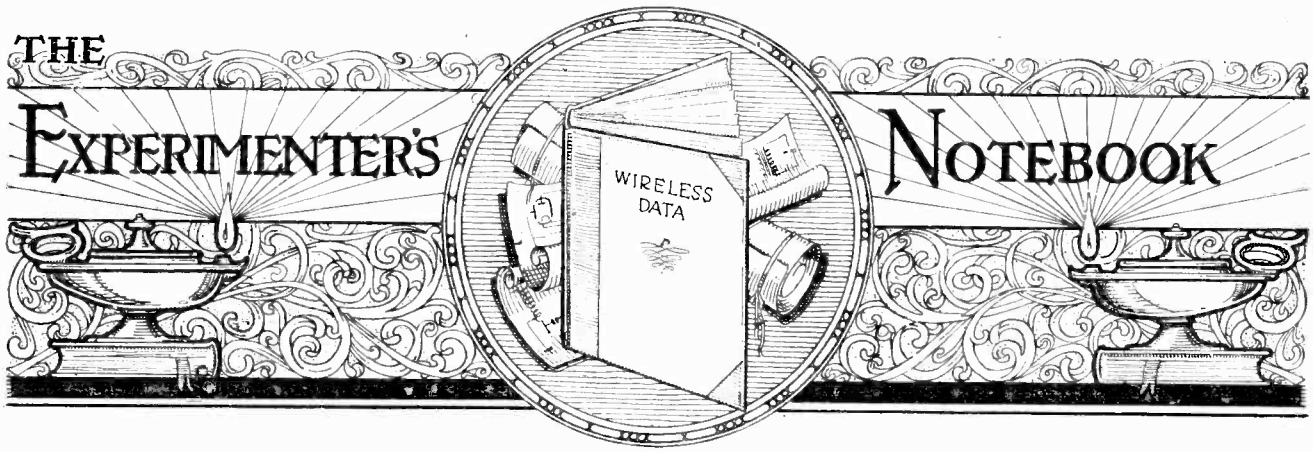
THE BUYERS' GUIDE.

Two Additional Portable Sets.

An omission from *The Wireless World* Buyers' Guide, published in our issue of November 16th, was that of the Qualitone Four Portable, manufactured by Messrs. The B. and J. Wireless Co., of 2, Athelstane Mews, Stroud Green Road, London, N.4. This receiver, which is totally enclosed in a black leatherette case, embodies four valves (1—v—2) transformer-coupled, and is priced at £22 10s.

Another portable set which should have been included is the Trix Portable Four, produced by Messrs. Eric J. Lever (Trix), Ltd., 33, Clerkenwell Green, London, E.C.1. The receiver is contained in a polished oak cabinet, and includes four valves (0—v—3), all stages being resistance coupled. The price is £21 8s.



Valve Characteristics and their Interpretation.

By "EMPIRICIST."

IN a previous article[1] dealing with the device of a valve for the purpose of wireless reception, the writer dealt in a general manner with the different kinds of valve at present on the market with a view to indicating the suitability of each to its specific purpose. In the present article it is intended to go into questions of elementary valve theory a little more deeply, with the intention of enabling the experimenter both to plot valve characteristics of a useful kind for himself and also to interpret the makers' published characteristics in such a manner that useful information can be obtained as to the performance of the corresponding valves in a practical circuit.

Grid and Anode Voltage Characteristics.

Valve characteristics are commonly plotted in the form of curves giving, for a specified plate voltage, the plate current corresponding to any grid voltage. The plate current is dependent upon the voltages applied both to the plate and to the grid, and the shape of the characteristic curve is very largely the same whether the latter is plotted so as to exhibit the variation of plate current with grid voltage keeping plate voltage constant, or with plate voltage keeping grid voltage constant. The main difference, in fact, lies in the proportionate effect of a change in the plate voltage and grid voltage respectively; it is well known, of course, that the grid exercises considerably more control than the plate, and on this fact depends the amplifying property of a valve.

In the article above referred to, mention was made of the effect of a valve in damping an oscillatory circuit to which it was connected. Let us see how it is possible to estimate the extent of this damping from plotted characteristics of the usual type. First of all, we must consider how the damping effect comes about at all, and for this purpose we must dismiss from our minds the idea of an ordinary ohmic resistance. In the case of the latter, if we apply a voltage to its terminals we obtain a proportionate current passing through it whatever the value of applied voltage may be, and by Ohm's law we know that the value of this resistance R in ohms is equal to $\frac{E}{I}$, where E is the applied electromotive force in volts and I the resultant current in amperes.

If we deal with a valve in a similar manner, we arrive at once at a difficulty, as Ohm's law does not hold good. In the first place, we know by experience that we obtain a curve and not a straight line when we plot plate current against plate voltage; secondly, although a part of

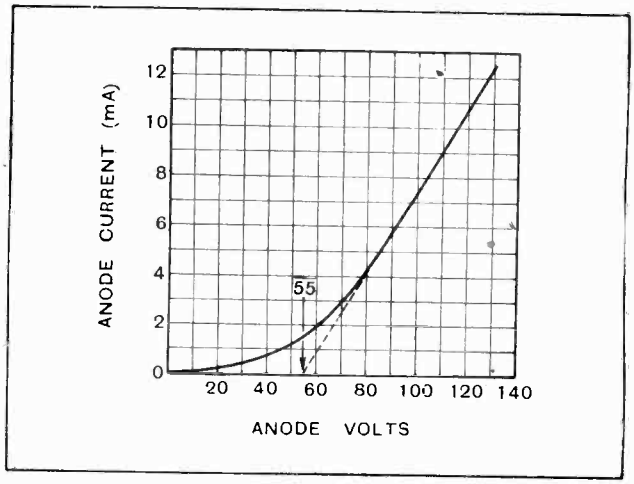


Fig. 1.—Anode voltage/anode current curve for B.T.H. B4 valve; grid bias −2 volts.

this curve may be regarded as straight for practical purposes, it does not, if produced, pass through the origin—that is to say, the point at which zero current would take place if the whole of the characteristic were like the straight part corresponds to a definite voltage, usually positive, and not to zero plate volts, as it should in the case of a resistance obeying Ohm's law. A characteristic corresponding to a case of this kind is shown in Fig. 1, which is taken from the makers' published data regarding a B.T.H. B4 valve. It will be seen that the straight part of the characteristic intersects the horizontal axis at a point corresponding to 55 volts.

If, however, we consider the effect of the valve on an associated A.C. circuit, it is plainly immaterial whether

[1] *The Wireless World*, Aug. 17th and 24th, 1927.

The Experimenter's Notebook.—

the straight part of the characteristic passes through the origin or not. Generally speaking, the voltage across the A.C. circuit is so small that the limits of the straight portion are never exceeded, and we are never concerned to know the actual value of the current passing through the valve, but only with the amount of its fluctuations for any given variation of the plate voltage from its steady value. Now, inasmuch as the characteristic is straight, we know that the variation i of the plate current from its steady value I is proportional to the variation of v from its steady value V, and we mean by the valve resistance the quotient $\frac{v}{i}$, which is in general quite different from $\frac{V}{I}$, the value based on the erroneous assumption that Ohm's law holds good.

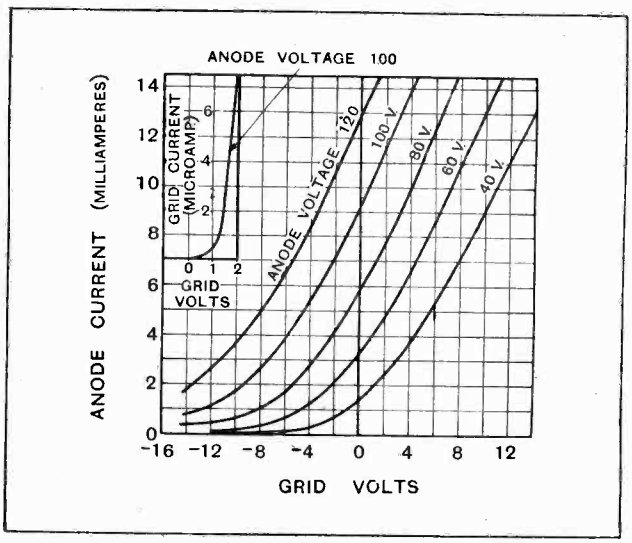


Fig. 2.—Grid voltage/anode current characteristics of the B.T.H. B4 valve.

In order, therefore, to evaluate R_a, the valve resistance, we must first of all note the value of I for any given voltage V, and then the change in this value corresponding to a known change of V. If we denote these changed values by I′ and V′, then the value of the valve resistance is $\frac{V' - V}{I' - I}$

It is legitimate to ask whether the answer will be the same whatever values are chosen for V and V′. Speaking generally, the answer is Yes, and upon this assumption are based the calculations commonly employed in practice. In Fig. 2 we show a family of characteristics (plate current against grid voltage) of a B.T.H. B4 valve, each of which corresponds to a given value of plate voltage. It will be seen that each curve has a straight portion, and that the straight portions of the family of curves are approximately parallel to and equidistant from each other. The plate voltages are taken at an interval of 20 volts, and on an average the vertical distance between the curves corresponds to a current change of 3·3 milliamperes. That is to say, if we increase the plate voltage by 20 volts, keeping the grid voltage constant, we increase the plate current by 3·3 milliamperes. The valve resistance is thus $\frac{20}{3{\cdot}3 \times 10^{-3}} = 6{,}000$ ohms.

If we consider the matter more closely, it is clear that the valve resistance is not strictly constant, but it is, nevertheless, possible to arrive at a definition of its value which has important practical utility. The first cause of variation is curvature of the plate current—plate voltage characteristic; this is clearly exhibited in the curve of Fig. 1 for values of H.T. below 80 volts. Equal increments of plate voltage will clearly give varying increments of plate current according to the point on the characteristic which is selected as the starting point. Secondly, supposing we have selected a starting point, we will arrive at different answers for our quotient, $\frac{V' - V}{I' - I}$, according to the amount of the increment of voltage and corresponding increment of current that we adopt as standard.

Definition of Valve Resistance.

To get round these difficulties we must first decide on a point on the characteristic at which we are to work, and then try to discover a meaning, if possible, for the term "valve resistance." Suppose we have an oscillatory circuit to which the valve of Fig. 1 is connected, then we know that this circuit will be damped by the valve. Now let us imagine oscillations of varying magnitude within this circuit; then it is clear that if the variation of plate voltage is considerable, it may extend over a part of the characteristic of Fig. 1, which is definitely curved. The result will be an effectively greater damping of the circuit than would be the case for small oscillations. On the other hand, as a progressively smaller variation of plate voltage is considered, the damping effect tends towards a constant limit, and since in practical cases their variations are extremely small, the effective resistance under these conditions has a definite and useful significance. We therefore define the valve resistance as the limit of $\frac{V' - V}{I' - I}$, when the respective changes of voltage and current are reduced to very small values.

In order, therefore, to measure the valve resistance more accurately, we must observe the change in plate current brought about by a small change in plate voltage. A simple method of doing this, due to Eccles, is shown in Fig. 3. Here a resistance R is cut in and out of the plate circuit and the corresponding currents I_1 (without R) and I_2 (with R) are noted. If S is the resistance of the milliammeter—by no means a negligible quantity in many present-day instruments—we obtain the result

$$R_a = \frac{R I_2}{I_1 - I_2} - S.$$

The measurement is thus carried out by means of a milliammeter and a variable resistance, and, with an instrument of reasonable sensitivity, it should be possible to observe a change of current as small as a quarter of a milliampere. For valves of very high resistance a more sensitive milliammeter would have to be used.

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The calculation of the amplification factor of a valve can be carried out in an equally satisfactory manner, but it will be as well in the first case to discuss the exact significance of this constant. Referring again to the curves of Fig. 2 it is noteworthy that they are substantially parallel throughout their entire length, even though they are curved at their lower extremity. The significance of this is that a change of plate voltage will shift the characteristic sideways in its entirety by an amount of grid voltage which is a definite fraction of the plate voltage change, and this proportion is found to be substantially the same for all characteristics and for all parts of the same characteristic. In order to define the amplification factor, let us consider that the plate voltage V_a and grid voltage V_g are changed to new values V_a' and V_g' in such a manner that the plate current remains constant. Then if the change of V_a is an increase, that of V_g will be a decrease, and we may define the amplification factor as the ratio $\frac{V_a' - V_a}{V_g - V_g'}$.

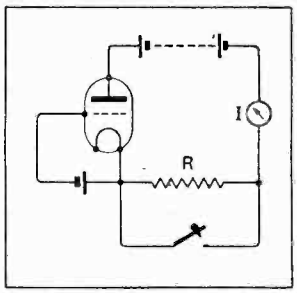

Fig. 3.—Circuit for measuring valve resistance; the milliammeter readings are taken with the key open and closed.

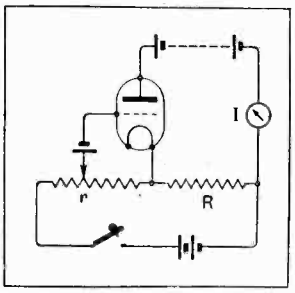

Fig. 4.—Method of measuring amplification factor; the relative values of R and r are adjusted until there is no change in I on opening or closing the key.

From the curves of Fig. 2 it will be noticed that, on an average, the horizontal distance between consecutive curves corresponds to a change of about 3.1 volts on the grid of the valve. The corresponding change of plate potential being 20 volts, the amplification factor is $\frac{20}{3.1} =$ about 6.5.

The above rough method may be replaced, as in the case of the measurement of internal resistance, by a more precise measurement, which will give the amplification factor for very small differences of plate and grid voltage. This method is illustrated in Fig. 4, and is due to Appleton. Referring to the figure, it will be noted that a resistance R is included in the plate circuit, and a resistance r in the grid circuit of the valve, and across these two resistances, which are connected in series, a battery and key are placed as shown in the figure. On closing the key, the battery voltage is divided between the plate and grid circuits in any desired ratio and in opposite senses, and the measurement is made by adjusting the value of one or other of the resistances until no change occurs in the anode current on making and breaking the key contact. When this result is achieved, the amplification factor of the valve is equal to the ratio $\frac{R}{r}$. It should be noted that the resistances R and r should be small, as otherwise the volt drop in R due to the plate current will have an appreciable value. In the arrangement employed by Appleton, R had a constant value of 10 ohms and r was a slide wire.

Definition of Mutual Conductance.

The term "mutual conductance" is in frequent use in connection with valves, but, as it is actually only the ratio of the amplification factor to the resistance, it does not introduce any new considerations. The term "conductance" is used to denote a quantity which is the reciprocal of a resistance, so that the lower the resistance of a conductor the greater will be its conductance. The unit of measurement is the "mho" or reciprocal ohm, and corresponding to a megohm we have a conductance of one micromhos. The conductances of valves are usually expressed in micromhos and the plate resistance is occasionally expressed in this form; thus, for the value of Fig. 2, corresponding to the resistance value of 6,000 ohms, we should have a plate conductance of 133 micromhos. The plate conductance may thus be defined as $\frac{I' - I}{V' - V}$, where I and I' are the two values of plate current corresponding to plate voltages V and V', when the grid voltage is constant, and $V' - V$ is as small as possible.

The mutual conductance may be defined more directly as the limiting value of $\frac{I' - I}{V_g' - V_g}$, where I' and I correspond to values of grid voltage V_g' and V_g, the plate voltage being kept constant and $V_g' - V_g$ being as small as possible. It is thus simply the slope of the characteristics of Fig. 2.

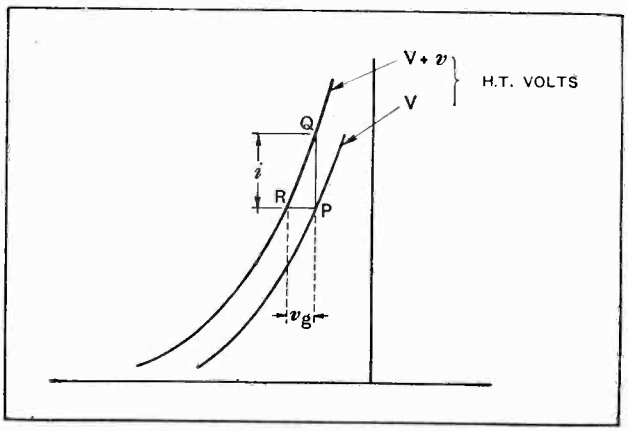

Fig. 5.—Diagram illustrating the calculation of the various valve constants.

The relations existing between these various magnitudes can, perhaps, best be seen from Fig. 5. Suppose that P be a point on a plate current/grid voltage characteristic, and that we draw another characteristic for a value of high-tension voltage which is slightly greater, the difference being v volts. If we draw horizontal and vertical lines through P which meet this second characteristic in R and Q respectively, PR will correspond on the horizontal scale to a certain variation of grid voltage which we will call v_g, and PQ will correspond to a variation of

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plate current which we will call i. Then we have immediately the folowing definitions :—

$$\text{Plate resistance} = \frac{v}{i}$$

$$\text{Plate conductance} = \frac{i}{v}$$

$$\text{Mutual conductance} = \frac{i}{v_g}$$

$$\text{Amplification factor} = \frac{v}{v_g}$$

so that mutual conductance $= \dfrac{\text{Amplification factor}}{\text{Plate resistance}}$.

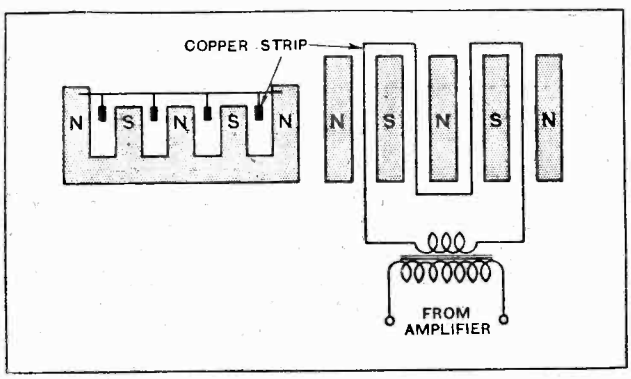
The term "mutual conductance" has value in considering the relative merits of valves having grids of different mesh, inasmuch as for a valve of given type but varying density of grid winding, the mutual conductance is constant up to a point and represents a figure of merit for the valve. Beyond a certain point, however, when the amplification factor is much increased the mutual conductance falls off rapidly and the performance of the valve as an amplifier does not improve as much as it should. In the case of a tuned anode circuit with reaction, the mutual conductance of the valve is strictly the figure of merit for performance, since by means of reaction the valve damping can be counteracted up to the limit of pure reproduction. On the whole, however, since the plate resistance and amplification factor constitute very definite and easily apprehended performance data for the valve, it would seem preferable to keep to these terms in interpreting characteristic curves.

THE BLATTHALLER LOUD-SPEAKER.

A High-power Reproducer Used in Germany for Addressing Large Gatherings.

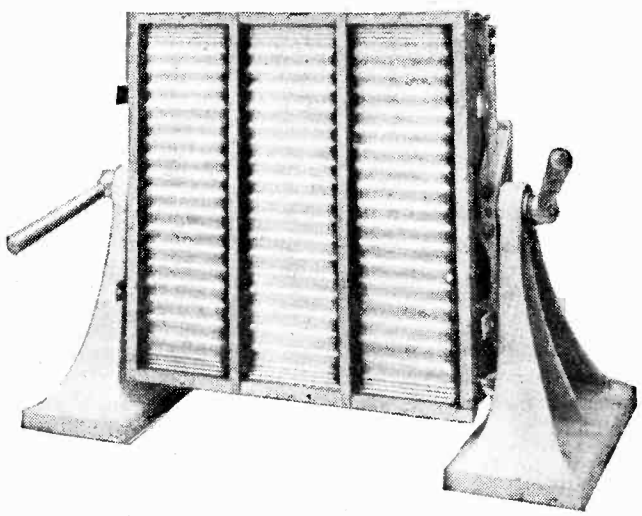
A DISADVANTAGE of cone loud-speakers in which the driving force is applied virtually at one point is that standing waves may be set up in the material of the diaphragm between the apex and the suspended edge. This phenomenon is responsible for some part of the resonance effects which are apparent to the ear when listening to the performance of the best loud-speakers, and although this trouble may be eliminated by suitable choice of materials there remains the possibility of lateral movement of the driving mechanism.

In the Blatthaller loud-speaker (made by Messrs. Siemens and Halske) the drive is distributed over the entire surface of the diaphragm, which is consequently impelled forward as a whole. This is accomplished, as shown in the diagrammatic sketch, by attaching edge on to the diaphragm a continuous metal band of zig-zag form. The fluctuating currents from the output transformer of the receiver-amplifier are made to traverse this "winding" and react with the field between the poles of an electromagnet, and since the current is the same in each part of the strip the force exerted is the same at each point, assuming the field to be uniform.



Diagrammatic representation of the principle of the Blatthaller loud-speaker.

In practice a rectangular "Pertinax" diaphragm is employed having an area of 400 sq. cm., and an electromagnet absorbing about 600 watts maintains the permanent field surrounding the strip winding. Owing to the small area of the diaphragm the use of a baffle is essential to ensure the radiation of low frequencies.



Heavy construction is essential in the Blatthaller loud-speaker on account of the large amplitudes which it is called upon to reproduce. In the instrument illustrated a pleated form of diaphragm is used.

It will be appreciated that the power required to operate this loud-speaker limits its use to public demonstration work, and it is in this capacity that it has attracted so much attention in Germany. Making its first public appearance at the opening of the German Museum in Munich, it has since been used at every important congress and sports meeting to broadcast speech and music over a wide area.

By Our Special Correspondent.

Christmas Programmes.—Wavelength Tests at Chelmsford.—Short Waves from Paris.—The Manchester Land-line.—Defects of the Wireless Link.—Gale Episode at Daventry.

Special Programmes at Christmas.

Christmas week will see a decidedly "Yule-y" flavour in the B.B.C. programmes. As a set-off listeners to 2LO and 5XX will on Monday, December 19th, have their holiday anticipations heightened by hearing the "end-of-the-term" concert given by the boys of Shrewsbury School at Alington Hall. A feature will be the school song, "Carmen Salopienae."

A Nativity Play will be given on the following day from St. Hilary's Church, Marazion, Cornwall, from which a similar play was broadcast last year.

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Carols by Carillon.

A Carillon of carols will be broadcast from a belfry in Bond Street, London, on the evening of Thursday, December 22nd, to be followed the same evening by Christmas hymns relayed from Cardiff by 5XX, while London will take a Bizet programme.

Humperdinck's Fairy Opera, "Hansel and Gretel," will be heard on December 23rd, and on the following evening Mrs. Gubbins, in the person of Mabel Constanduros, will give a Christmas party. Carols will be relayed on the same evening from Whitechapel.

On Christmas Day the afternoon programme from 2LO and 5XX will consist of Bach's "Christmas Oratorio," given by the Wireless Symphony Orchestra and Chorus under the direction of Stanford Robinson.

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Pantomimicry.

A peculiar feature of Boxing Day will be the transmission of what is described as "Pantomimicry," written and produced by Gordon McConnel. A principal boy and principal girl will duly appear, but an unusual item in the advance notice is the guarantee that most of the songs will be out of date and some of them out of print!

o o o o

5GB at Christmas.

5GB's programmes will also exude an aroma of Yuletide. The Manchester Cathedral choir will broadcast carols on December 20th, while on the following day the choir of Gloucester Cathedral will be heard singing carols in the cathedral chapter house.

A transmission on December 22nd will help to perpetuate that good old Christmas institution—Charades, while a Pickwick Picnic Party from Birmingham on December 23rd promises to be in the best Christmas tradition.

No Christmas would be complete without a legend or two. This will be provided from 5GB on Christmas Day, when Albert E. Drinkwater will recount "The Legend of Vandale."

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Next National Concert.

For the next National Symphony Concert to be given at the People's Palace, Mile End Road, on December 16th, the orchestra will be conducted by Geoffrey Toye, the soloist being Roy Henderson (baritone).

A Daily Religious Service?

The demand for the daily broadcast of a short religious service appears to be growing to judge from the Savoy Hill correspondence bag, which also shows that the Sunday services and the Epilogue were never more appreciated than they are to-day.

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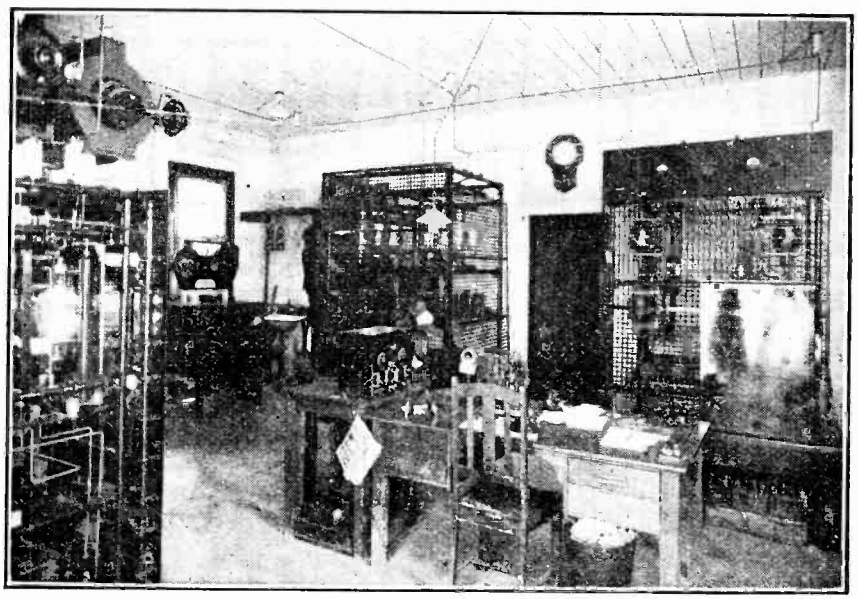
Empire Broadcast Tests.

Disappointment awaits those readers who have asked for a regular schedule of transmissions from 5SW, the short-wave broadcasting station at Chelmsford. The B.B.C. states that no special time-table is being observed at present, but that intensive experiments are being conducted. I gather that these relate principally to changes in wavelength, and that the original wavelength of 24 metres has been discarded in favour of 14 metres.

But the whole question of 5SW's wave-



EMPIRE BROADCASTING FROM AUSTRALIA. A recent photograph of the transmitting room at 3LO Melbourne, showing the oscillator, modulator and rectifier panels. The Melbourne station is regularly transmitting a short wave programme on 36 metres every Tuesday between 2.30 and 4.30 a.m. (G.M.T.).

length depends very largely upon the clock. A wavelength that may serve Australia very successfully during the wee sma' hours may be grossly unsuitable in the evening. A wavelength schedule as well as a time schedule seems to be indicated.

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Short-wave Broadcasting from Paris.

I believe that the Montmartre station, *Radio Vitus*, Paris, is the first French broadcasting station to launch a regular programme on short waves. The station has now begun the regular transmission of its evening concerts on a wavelength of 37 metres in addition to the ordinary wavelength of 302 metres. The station directors will welcome reports from British amateurs.

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Katowitze, the New Polish Station.

The inauguration of Poland's new 10kW. station at Katowitze took place on Sunday last, December 4th. The station, which transmits on a wavelength of 422 metres, operates daily from 2 10.30 p.m. (G.M.T.) with a varied programme of talks and music.

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Wireless Gifts for Swedish Blind.

Three hundred Swedish blind people in different parts of the country will receive brand new radio sets as Christmas presents this year, thanks to a nation-wide drive started on "The Day of the Blind," a special day devoted to welfare work for the benefit of Sweden's indigenous blind. Special broadcast appeals have met with generous response, says a correspondent, and 31,000 kronor have already been sent in to the committee. Dr. G. Dahlen, called "Sweden's blind Edison," who has been awarded the Nobel prize for his inventions, and who himself was blinded by an explosion during experiments with his automatic beacon lights, has contributed with his subordinates by sending forty broadcast receivers.

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The Manchester Land-line.

A Manchester reader, prompted by my recent paragraph on the shortcomings of the Manchester-London land-line in regard to the transmission of the Hallé concerts, asks, "What happens the other way round?" He adds that during a special week, such as Birthday week, Manchester listeners get practically the whole of the London programme relayed over the underground land-lines.

What happens the other way round is that Manchester listeners hearing London endure the same land-line defects as do Londoners when a Hallé concert is relayed from Manchester.

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Faults of the Wireless Link.

The London-Manchester line, one of the longest in the country, is excellent for speech, as it comprises some 600 circuits, and is equipped with valve repeaters at intervals of about 50 or 60 miles. But the Post Office never originally intended it for the wide range of frequencies necessary for good musical reproduction. Whether earthing conditions have anything to do with its deficiencies in this respect is a point which has not been settled.

Overhead wires are not, I believe, available on this route, the only alternative being the wireless link. But experience has shown that even underground cables are preferable to the wireless link, which is subject to atmospheric vagaries, Morse disturbance and fading.

Before five o'clock in the evening, however, frequent use is made of the wireless link, as the Post Office lines are occupied with commercial traffic. Up to that time, in accordance with the contract between the B.B.C. and the Post Office, the lines are not open for the purpose of broadcasting.

FUTURE FEATURES.

London and Daventry (5XX).

Dec. 11th.—Orchestral and Vocal Concert.
Dec. 12th.—Chamber Music.
Dec. 13th.—"The Grand Duchess of Gerolstein," a comic opera in three acts.
Dec. 14th.—Austrian National Programme.
Dec. 15th.—"Dropped from Heaven," a sketch in one act by Dion Titheradge. "Shadows," a radio scene in one act by Valerie Harwood.
Dec. 16th.—National Symphony Concert, conducted by Geoffrey Toye.
Dec. 17th.—"Daily Express" Carol Concert from the Albert Hall.

Daventry Exp. (5GB).

Dec. 11th.—Oratorio from Birmingham.
Dec. 12th.—Military Band Concert.
Dec. 13th.—Liverpool Philharmonic Society's Sixth Concert.
Dec. 14th.—Variety Programme.
Dec. 15th.—Symphony Concert.
Dec. 16th.—Salon Music with Gerda Nette (Pianoforte).
Dec. 17th.—"Dancing Time."

Bournemouth.

Dec. 13th.—"On the Wings of Song."
Dec. 14th.—"Sea Silence," by G. E. Lewis. "The Defective Detective," by H. S. Tinniswood, presented by the Station Players.
Dec. 15th.—"La Serva Padrona," an operetta by Pergolesi.

Cardiff.

Dec. 13th.—"Crowd Law," a radio play in one act by Charles Bateman.

Manchester.

Dec. 12th.—Arthur Sullivan and Edward German Programme.

Glasgow.

Dec. 12th.—"The Man, the Maid and the Muddlehead," a cameo by Gordon McConnell.

Aberdeen.

Dec. 15th.—"My Programme," by the Lord Provost of Aberdeen.

Belfast.

Dec. 15th.—Concert by the Londonderry Philharmonic Society.

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A Daventry Gale Episode.

A break in the land-line between 5NX and the Daventry telephone exchange during the recent gales shed light upon the resourcefulness of the B.B.C. staff in time of emergency. Very appropriately 5XX was relaying the weather forecast from London at the time.

Rather than deny listeners the pleasure of hearing that the gale was likely to continue, the people at Savoy Hill decided to 'phone the weather bulletin to Daventry by the ordinary telephone service. This was done, and the forecast was read by an engineer from the little disused studio adjoining the transmitting hall. I wonder how many listeners noticed the innovation?

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"The Visitors' Book."

A. J. Alan will broadcast another short story—"The Visitors' Book"—from 2LO on December 21st.

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A W. W. Jacobs' Tale.

A reading from W. W. Jacobs' "The Lost Ship" will be broadcast by Mr. Michael Sadleir from 5GB on December 16th.

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Band Judging by Wireless.

A brass band contest arranged by Newcastle station will be relayed from the Town Hall on December 17th. It will be adjudicated by wireless, the judge (Mr. Tom Morgan) listening to the contestants on a wireless receiver at a point remote from the hall. The test piece is "The White Rider," composed by Denis Wright.

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Microphones at Marriages.

What's wrong with the broadcasting of wedding ceremonies? 2FC, Sydney, has just transmitted a marriage service, and the innovation appears to have given pleasure all round. If the practice became general it might at least keep people at their receivers instead of scrambling round the church door and providing unnecessary work for cleaners-up.

And why stop at marriages? Couldn't the microphone do justice to a divorce?

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Broadcasting in the Dark.

While the Maxwell House Orchestra was broadcasting through WJZ and the Blue Chain of the American National Broadcasting Co. recently, the lights throughout the entire building were suddenly extinguished. A flashlight is kept in each studio for just such emergencies, and, using it as a baton, the director of the orchestra continued to conduct, while the orchestra carried on playing in the dark. Listeners declared that they were unable to detect any variation in the smoothness of the performance.

COILS FOR THE "STANDARD FOUR."

Constructional Details of the H.F. Transformers.

By H. F. SMITH.

IN last week's issue it was stated that the set of coils designed for the Regional Receiver are suitable for the new set, as are the "All-Wave Four" high-frequency transformers. The first-mentioned are slightly more effective, and are also mechanically stronger, due to the fact that the fine wire primary and neutralising windings are protected by the projecting ebonite ring on which the contact pins are mounted. As already stated, it is quite permissible when economy is necessary to abandon the Litz winding of the long-wave coils; if this is done, two alternative grid windings may be adopted. These are detailed below: the information given should be considered in conjunction with the reprinted description of the "Regional" coils which follows. The first modification was discussed on page 728 of last week's issue; this consists of a 250-turn winding of No. 30 D.C.C. wire in 10 slots (instead of 16), with $\frac{3}{16}$in. spacing between centres. The primary and neutralising sections each comprise 45 turns of No. 38 D.C.C. on spacing strips as described: these windings will occupy a space of nearly $\frac{3}{4}$in. (which is sufficient) if no attempt is made to wind in such a way that adjacent turns are firmly pressed against each other.

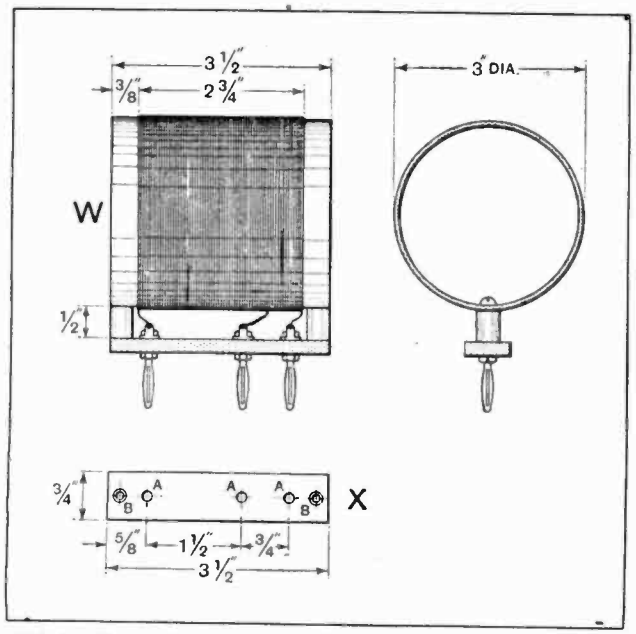


Fig. 1.—W, constructional details of "Regional" short-wave aerial-grid coil and below, X, the ebonite block forming its base. The holes marked A are drilled for sockets, and those marked B are for the holding-down screws.

The second suggestion is that the windings of the "All-Wave Four" long-wave transformer should be transferred to a "Regional" Paxolin tube former, which is illustrated in Fig. 2. This provides a moderately robust transformer, giving sufficient amplification for all ordinary requirements.

It should be pointed out that as the circuit is essentially a "straight" one, practically any reasonably good type of transformer may be used; the results obtainable, as far as sensitivity and selectivity are concerned, however, will be governed largely by the effectiveness (or otherwise) of the coupling device, which is certainly the most im-

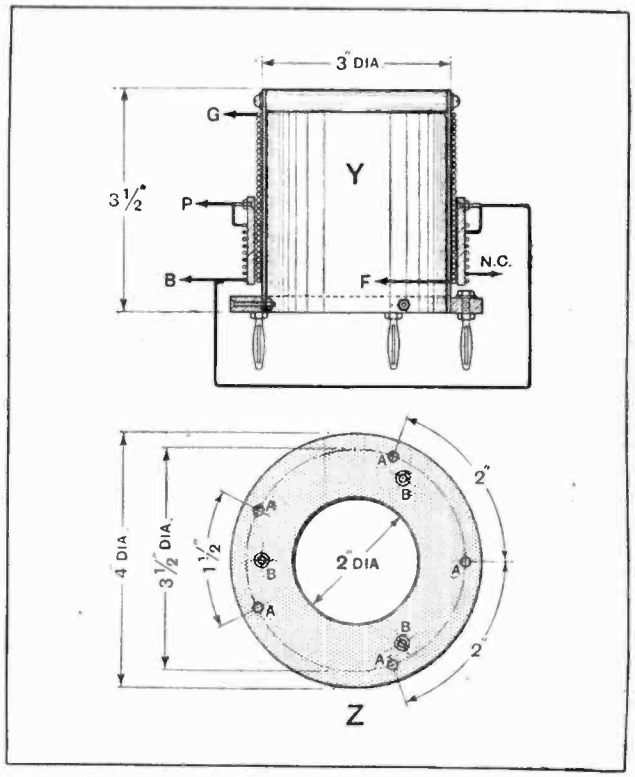


Fig. 2.—Y, details of the "Regional" short-wave H.F. transformer. Z, transformer base. Positions of holes for sockets are shown at A, and those for the holding-down screws at B.

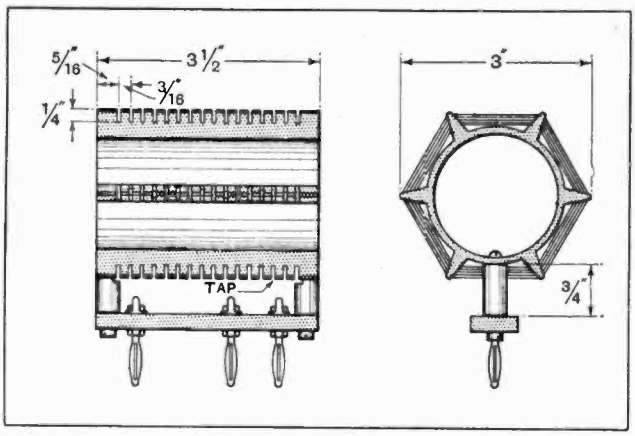


Fig. 3.—Details of the "Regional" long-wave aerial-grid coil former.

Coils for the "Standard Four."—

portant component in an H.F. amplifier, always assuming that the valve has suitable characteristics, and is a good specimen of its kind.

"Regional" Short-wave Aerial-grid Coil.—Construction is shown in Fig. 1. A Paxolin former of 3in. diameter, 3½in. long, is mounted on an ebonite strip by screws and distance pieces. Wound with 70 turns of No. 27/42 Litz, S.S.C. and D.S.C. overall, tapped at the 12th turn from the earthed end.

"Regional" Short-wave H.F. Transformer. — (See Fig 2.) Paxolin former, 3in. by 3½in., secured to ebonite ring measuring 4in. and 3in. in external and internal diameters respectively. Pins are mounted on this ring to coincide with sockets fitted to an ebonite base. Secondary winding same as aerial-grid coil. Primary has 15 turns of No. 40 D.S.C., spaced $\frac{1}{16}$in. between turns, and separated by 8 ebonite strips $\frac{1}{8}$in. in thickness. Neutralising section, also with 15 turns of the same wire, is interwound with the primary. All windings are in the same direction. The lettering on the ends of the windings indicates their connections. G to grid, P to plate, F to filament, NC to neutralising condenser, and B to H.T. +.

"Regional" Long-wave Aerial-grid Coil.—Wound on "Becol" ribbed former with 16 slots, each slightly over 3-64in. wide and ¼in. deep: 18 turns of No. 9/40 S.S.C. and D.S.C. overall Litz cable in each slot. Tapped for connection to aerial at junction between 3rd and 4th slots.

"Regional" Long-wave H.F. Transformer.—On similar former, mounted on ebonite ring with internal and external diameters of 2in. and 4in., carrying pins arranged as in short-wave transformer. Secondary as in aerial-grid coil. Primary has 45 turns No. 38 D.C.C. wire wound to occupy space of one inch, and separated from secondary by six strips of Paxolin or Pertinax measuring 1⅜in. long, ⅜in. wide, and $\frac{1}{32}$in. thick. These are scored longitudinally, and bent to have a cross-section in form of an open "V." Neutralising winding is similar, and separated from primary by spacers of same dimensions. All windings are in the same direction.

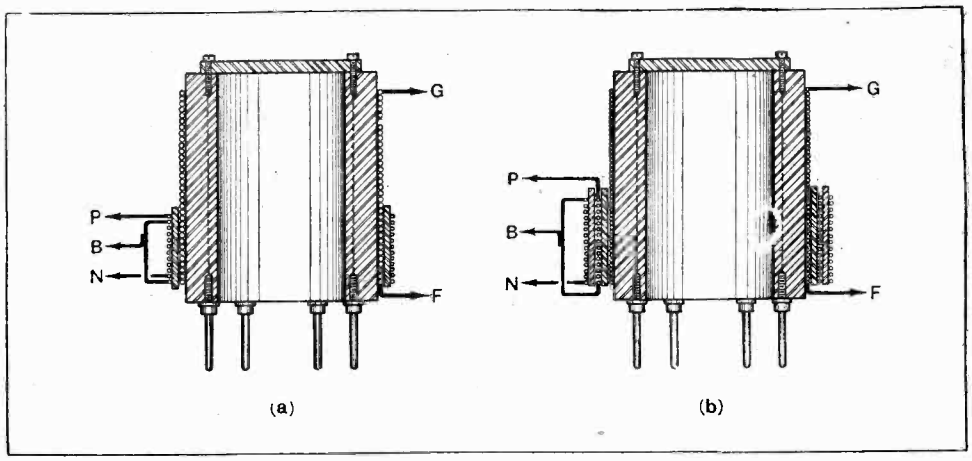


Fig. 5.—The "All Wave Four" coils. Long- and short-wave transformers are shown at (a) and (b) respectively.

"All-Wave Four" Short-wave Transformer.—Wound on "Radiax" ribbed former. Same windings as "Regional" transformer, but spacers have longitudinal V-shaped depression filed on undersides so that spacing between windings may be about $\frac{1}{16}$in. Six spacers are required.

"All-Wave Four" Long-wave Transformer.—Also wound on "Radiax" former. Secondary has 265 turns of No. 36 D.S.C. wire, wound as single-layer coil. Primary and neutralising windings may be as in "Regional" long-wave transformer

A few additional notes on the receiver may be of interest to prospective constructors. In the first place, the all-important question of valves may well have further treatment. In the original article a list of representative types with 6-volt filaments was given; this must not be taken as inferring that four-and two-volt valves are ruled out, although the amateur must face the fact that valve efficiency is decided to a certain extent by filament wattage. As manufacturers adopt a more or less uniform amperage for their various ranges, in the very nature of things the six-volt valves are bound to give better results in *any* receiver. However, modern two- and four-volt valves are only very slightly inferior, and the performance of the receiver when they are used is such that most ordinary requirements will be satisfied. Most of the 6-volt valves specified have counterparts in the two- and four-volt ranges.

There is no reason why an ordinary terminal strip should not be used, although in the set as described the various flexible leads are plaited together after their ends have been soldered permanently to the appropriate tags. The seven-way cable is securely anchored to the baseboard by means of a brass saddle.

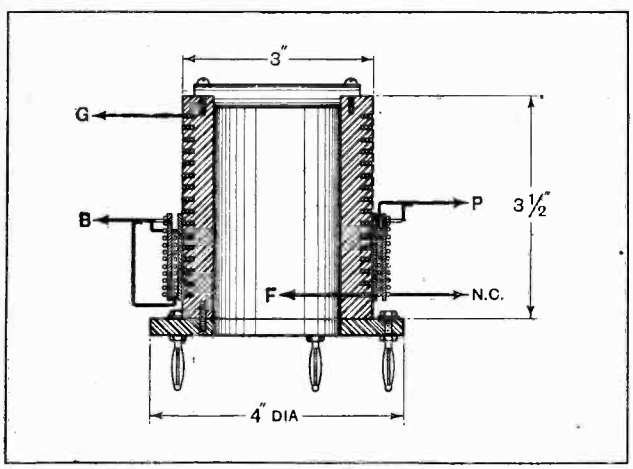
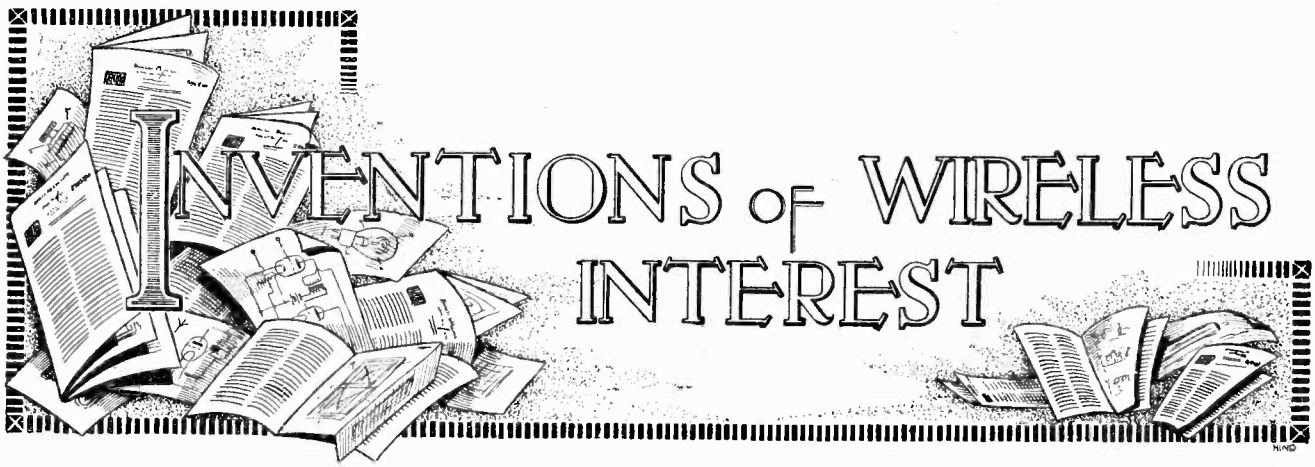


Fig. 4.—Section through the long-wave "Regional" H.F. transformer, showing arrangement of the windings. A cross-bar of ¼in. ebonite tube is fitted.

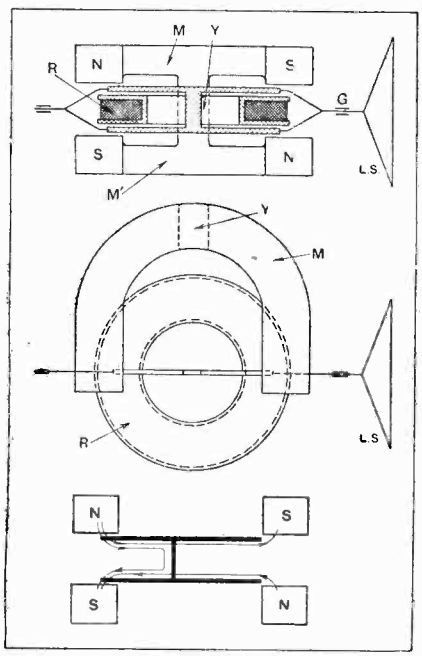


The following abstracts are prepared, with the permission of the Controller of H.M. Stationery Office, from Specifications obtainable at the Patent Office, 25, Southampton Buildings, London, W.C.2, price 1s. each.

An Ingenious Loud-speaker.

Application date: May 7th, 1926.

The magnetic armature of a loud-speaker is arranged to move longitudinally to and fro inside an extremely narrow air-gap, so that comparatively small currents produce large displacements of the armature which are not



Electromagnetic loud-speaker movement. (No. 277,052.)

limited mechanically by the width of the air gap. The diagram shows a plan and elevation of the magnetic unit, and also indicates the lines of force at a particular moment of operation.

Two permanent magnets M, M' are arranged with their respective North and South poles in opposition, a central yoke Y closing the magnetic circuit. A thin H-shaped armature, shown shaded, constitutes the moving element and is provided at one end with connecting rods which pass through a guide piece G to transmit the vibrations to a cone diaphragm loud-speaker L.S. A ring-shaped winding R is immovably mounted inside the free legs of the armature and at a sufficient distance from the centre leg to allow the armature to slide to and fro freely for a distance of several millimetres.

When low-frequency current passes through the windings R the armature is polarised in accordance with the direction of the current flow. For example, at one moment one leg of the armature is a North pole and the other a South pole, whilst at the next moment, as the current changes direction, the polarity reverses. The resultant magnetic flux is indicated by the arrows in the lower diagram, the net result at this moment being to move the armature to the left.

Patent issued to Harold Wade.

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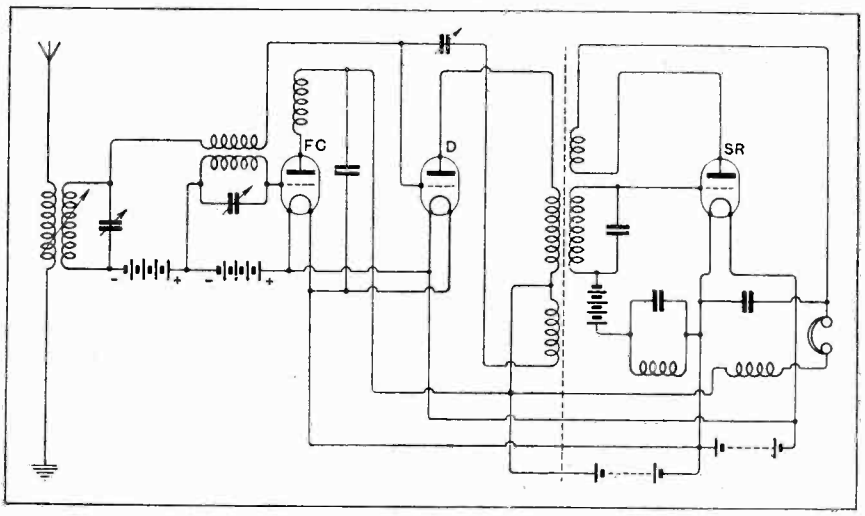
A Super-regenerative Amplifier.

Convention date (U.S.A.): April 12th, 1926.

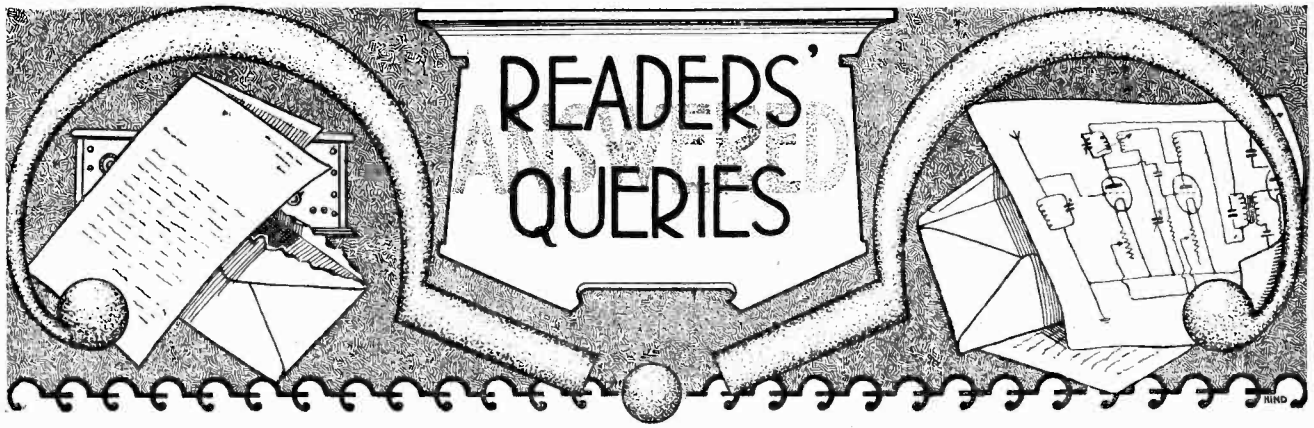
The standard super-regenerator circuit is admittedly difficult to tune and maintain in a stable operative condition. Another characteristic is that the amplification obtained varies in proportion to the difference between the local "quenching" frequency and that of the incoming signal. In practice short-wave signals in the neighbourhood of 100 metres are amplified to a greater degree than longer waves.

According to the present invention a frequency changer F C is interposed between the aerial and the super-regenerative circuit S R for the purpose of increasing the frequency of the incoming signals to a definite value, which corresponds to that at which super-regeneration takes place with maximum efficiency. In operation the circuits of S R are set permanently to this value, and the only tuning control then necessary is that of the local oscillator F C, which is adjusted to produce the predetermined beat frequency with the incoming signals. These are rectified by the valve D before being applied to the super-regenerator.

Patent issued to Metropolitan Vickers Co.



Super-regenerative circuit with frequency changer. (No. 269,207.)



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

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

Coil Values for Daventry.

I am using a No. 150 coil in the aerial circuit of my two-valve set to get Daventry 5XX, and wish to insert in the aerial lead-in a 0.0001 mfd. fixed condenser to improve selectivity. Will this necessitate my changing the value of the coil? T. R.

Yes. You will probably have to change the coil to a No. 200. You must remember that the aerial capacity, which is on an average about 0.0003 mfd., is added in parallel to the tuning coil, and when you insert a series 0.0001 mfd. condenser you effectively decrease this capacity below 0.0001 mfd., and should, therefore, compensate by adding extra inductance; this is done by using a larger coil.

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"Push-pull" with Ordinary Components.

I wish to incorporate in the last stage of my receiver the push-pull amplification, and understand that I can do this by means of two ordinary transformers. Is this correct? K. D. R. M.

It is possible to obtain the push-pull effect by the use of ordinary components, and you would require two intervalve transformers and two output transformers. You would, however, get more satisfactory results at less expense by investing in proper push-pull transformers rather than by purchasing four other transformers for this purpose.

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Transmitter Grid Leak.

In "The Wireless World" of June 29th last there appeared a description of a short-wave transmitter, and on page 819 the wire recommended for the grid leak is No. 44 D.S.C. Eureka. The "List of Parts" on page 822 states that No. 47 Eureka will be required. Will you please advise me which is the correct gauge of wire to use? A. T. D.

The gauge of wire to use is No. 44 S.W.G., D.S.C. Eureka resistance wire. Unfortunately, a slight error occurred in the list of parts, where the gauge was incorrectly stated as No. 47.

RULES.

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

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

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

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

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

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

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

Lighting Valve Filaments from Primary Cells.

I wish, if possible, to make use of wet primary batteries for lighting the filaments of my valves. The valves used are the Mullard 0.075 ampere type, the set being a three-valve set. Can you advise me if ordinary Leclanché cells would do? C. B.

The ordinary Leclanché cell used for operating electric bells, etc., which employs the usual porous pot and zinc rod, is not suitable. It is necessary to use the special type of cell known as a "sac" Leclanché cell. Such a cell employs a special depolariser, and has a circular zinc completely surrounding the positive element.

We advise you to write to the Wet H.T. Battery Co., 12, Brownlow Street, Holborn, W.C., whom, we understand, make special primary batteries for L.T. supply as well as for H.T. supply.

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Energising a Moving-coil Loud-speaker from A.C. Mains.

I wish to construct a moving-coil loud-speaker and to supply the magnet windings with energy from my A.C. mains in the manner recommended in your September 28th issue. Can you tell me if the device, of which full constructional details are given on page 468 of your October 5th issue, will serve my purpose? H. S. D. E.

It will be quite in order to use this instrument for the purpose named, provided that the pot magnet windings on your loud-speaker do not require a greater current than 1¼ amperes. If they do require a greater current than this, naturally a larger type of instrument must be used. In any case, an ordinary accumulator should be floated across the output terminals of the instrument.

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Is Reflex Worth While?

I have a two-valve reflex receiver constructed to a design which appeared in July 10th issue of "The Wireless World," published in 1925, and I now wish to increase the range of this receiver by the addition of an extra valve. Can you provide me with a circuit diagram showing the best position for the extra valve? A. T.

We do not think that the addition of an extra valve to your present receiver is to be recommended. Reflex circuits came into prominence in the days when valves required a high filament current, and their popularity was due to the slight economy possible with this arrangement. Now that economical valves are obtainable at very reasonable prices the advantages of reflexing cease to exist, and, in addition, big voltage amplification valves with high impedances enable greater sensitivity and selectivity to be gained than could be possible with a reflex circuit.

The Wireless World AND RADIO REVIEW

(15th Year of Publication)

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IDENTIFYING STATIONS.

THE suggestion put forward in our editorial under the above title in our issue of November 30th has already attracted a large amount of interest, and in this issue we publish a selection from amongst the letters received from our readers. It is quite apparent that the problem of identifying stations is one that has been troubling most listeners to distant programmes for a long while past, and we are glad to have had this opportunity of bringing the matter again to the fore, so that it can be discussed with a view to arriving at some practical solution.

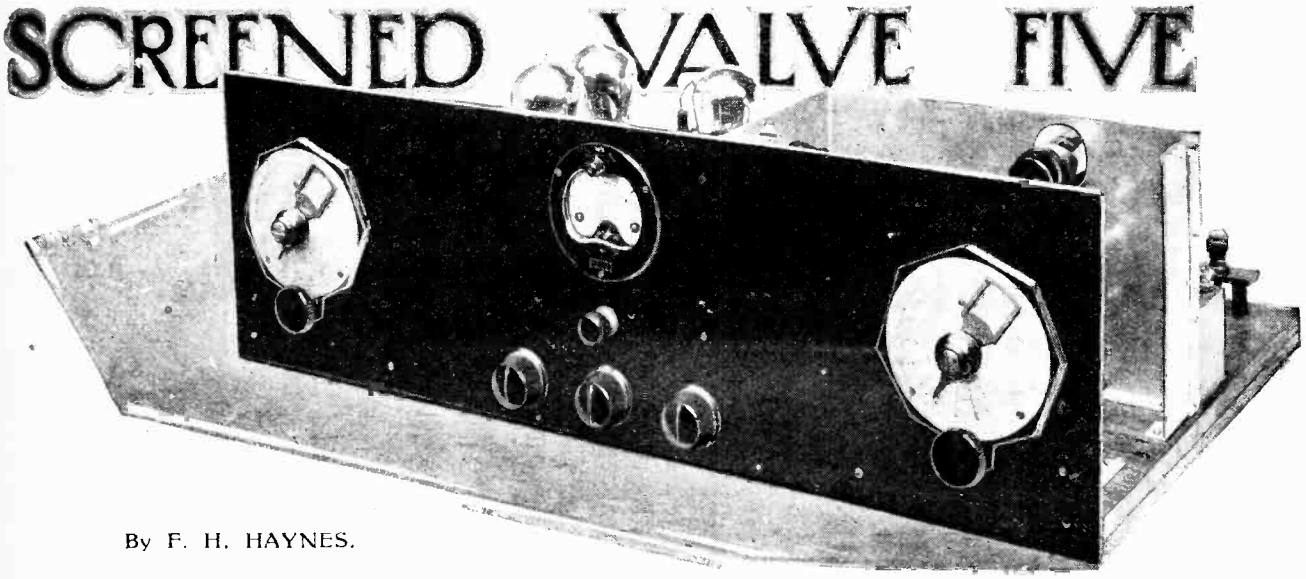
Amongst the letters received is one from Mr. A. A. Schaschke, of Glasgow, whose name will probably be familiar to a large number of our readers, since he has already done some pioneer work in the endeavour to bring about the introduction of some system of identifying signals. In the issue of March 17th, 1926, he contributed a letter on the subject, and when in the issue of October 27th of the same year we emphasised editorially the growing need for some such system, considerable correspondence followed, in which Mr. Schaschke took a prominent part, and forwarded to us for publication correspondence which he had had with the Geneva International Union.

Many suggestions for identifying signals might be put forward. Of course, the language difficulty is a serious one, for even if, as some of our correspondents suggest, we confined the identifying call to the bare announcement of the name of the station, this, pronounced in a foreign language, might be by no means easy to identify because, to one unacquainted with the language, the pronunciation of the name may bear no resemblance to the name as written. It would seem, therefore, that the ideal identifying signal would be one where difficulties resulting from language differences and pronunciations were not introduced. It is probably on this account that so many stations have adopted identifying signals other than the spoken word, such, for instance, as bells, chimes, strokes on a gong, tuning notes, etc. Now it would be comparatively easy for every station to be allotted a number, as in Mr. Schaschke's original proposal, and a list of stations with corresponding numbers could easily be published in order of wavelength, as previously recommended by ourselves, and this list could be available to everyone interested in distant reception. But if we followed the suggestion of H. A. B. in this issue, that each station should announce its number in some such form as "Radio Station No. 25," we should be back again with the difficulty of language.

This suggestion of the allocation of numbers does, however, seem to provide the basis on which to develop an international system. Thus numbers from one to nine could be broadcast as notes corresponding to, say, middle C of the piano, station No. 5 transmitting a series of five notes on that frequency; each series of notes corresponding to the number being divided by a suitable pause. When we get into the tens and wish to transmit, say, station No. 22, we would transmit two notes corresponding to middle C and two notes, say, an octave higher, and for station 124 we should have one note on middle C, two an octave higher, and three an octave still higher, and so on for any combination of figures.

This is the suggestion, slightly amplified, which was originally put forward by Mr. Schaschke and turned down by the Union in a letter to him dated October 2nd, 1926. The reason given for turning down the suggestion was that "it was felt confusion would follow through persons not hearing the entire signals," and that "the introduction of non-musical signals would be against the artistic composition of a programme." In our opinion, these objections are extremely feeble, and in view of the importance of the matter, and since no more serious reasons for rejecting the scheme were put forward by the Union, we think it is fully time that the matter should be reconsidered in a more sympathetic spirit.

THE WIRELESS WORLD SCREENED VALVE FIVE



By F. H. HAYNES.

Points on the Design of Receiving Sets for Using the New Screened Valve.

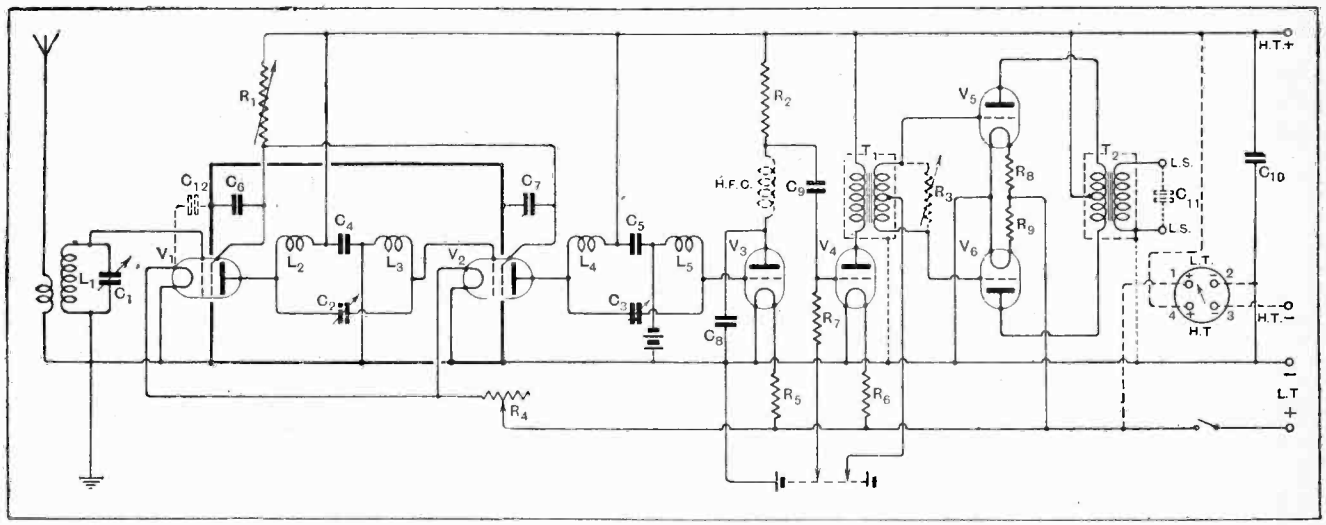
TWO months ago the screened valve made its appearance as the panacea of H.F. troubles. It promised to provide a high degree of amplification without regeneration. Many readers have shown a keen interest in this type of valve, but have hesitated to buy and experiment with the valve until there was more detailed and reliable published information to go upon dealing with its practical application. At the time the valve appeared we were in possession of a particularly good form of H.F. intervalve coupling, giving a high degree of amplification with perfect stability, and a number of receivers employing this form of coupling had attained considerable popularity. Possessors of these sets imagined that a simple modification by the substitution of a screened valve in their H.F. stages would still further enhance the operation of their sets. Tests have, however, revealed that the gain is small, while it was found that some of the early valves were not of uniform characteristic. A single stage of screened H.F. amplification, followed by a detector valve and resistance and transformer-coupled L.F. stages, makes a very good set, yet the principal application of the screened valve is the convenience of construction possible in two H.F. stages, as compared with a two-stage neutralised amplifier. Good selectivity can be obtained, an essential where considerable H.F. amplification is involved, while the overall magnification, when working in a stable condition, is probably greater than that which can be obtained by any other method. A multi-stage H.F. amplifier is usually difficult to build, involving, as it does, the fitting and wiring of components in screening boxes so that the connecting points are inaccessible. As far as home construction is concerned, designs embodying complete screening boxes are, as a rule, far too troublesome to pursue, though the use of sectional screening boxes is the safest way of avoiding stray interstage coupling.

The features of this set are: (1) Two-dial tuning over a wave range of 200 to 2,600 metres. (2) Two H.F. stages giving good reception with a poor aerial. (3) An anode bend detector valve. (4) Resistance L.F. coupling followed by a push-pull intervalve coupling and a push-pull output transformer. (5) Provision of a battery meter showing L.T. and H.T. volts and anode current. (6) A single H.T. potential

Screened Valve Circuits.

The circuit principle involves a loose-coupled aerial. It is obvious, with such great amplification, that the aerial circuit must be sharply tuned to eliminate flatly tuned transmitters. The aerial coil is a 70-turn winding of No. 26 S.S.C. occupying a space of 2¼in. on a six-ribbed former having a mean diameter of 2⅛in. The turns are wound very slightly spaced. Three layers of empire cloth at the earth end of the coil support the aerial winding, which may consist of between 4 and 11 turns of similar wire put on so that the direction of winding is continuous. In order that the transformer may suit aerials varying in dimensions, it is essential that the number of aerial turns should be actually adjusted by test. A cutting down of signal strength results as the number of aerial turns is reduced, but, obviously, 11 turns with a large aerial will render the reception of any one individual station impossible. This coil is mounted with its axis pointing towards the screen, though at some distance from it. It is tuned with a 0.0005-mfd. variable condenser.

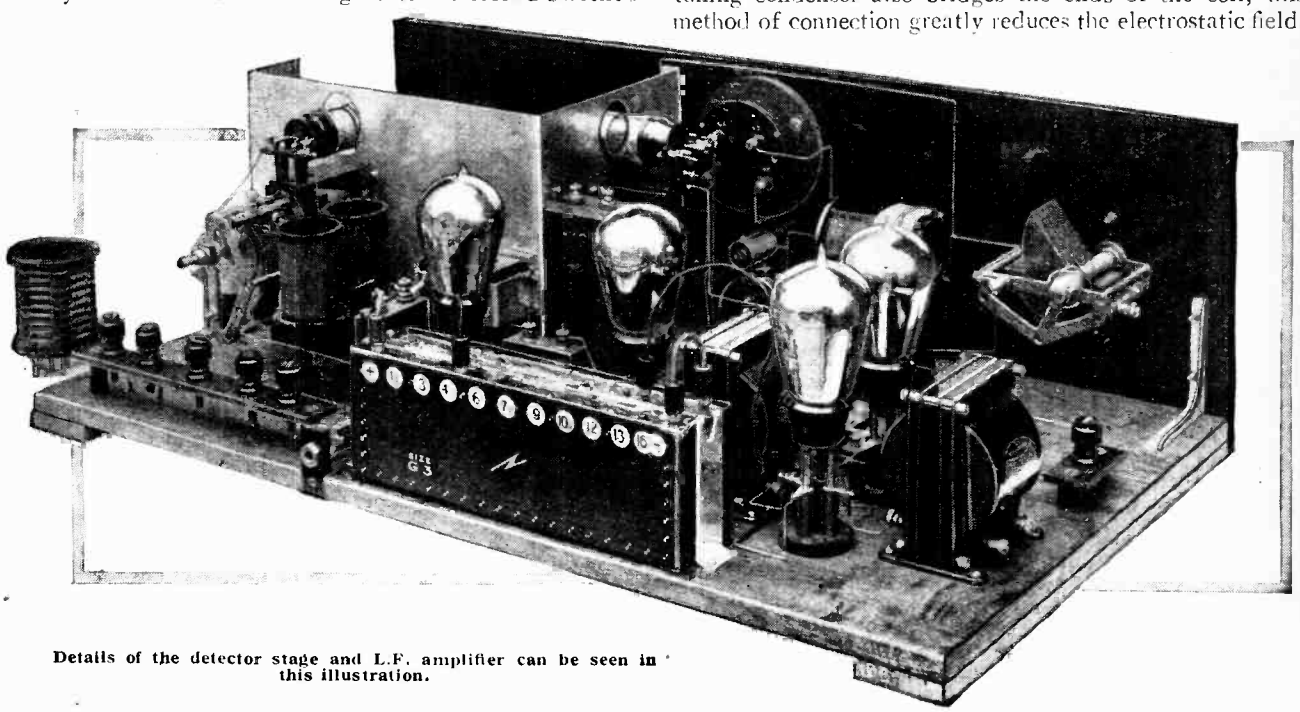
As recommended by the manufacturers, the H.F. valve is mounted through an aperture in the screen, the grid wire from the H.F. transformer passing straight to the grid pin. To prevent interstage coupling occurring in the filament circuit leads, the negative filament pin connects by a short wire directly to the screen. To avoid entirely



Circuit of 2 H.F. screened valve receiver combined with a push-pull output L.F. amplifier. The screened grid potential is controlled by a variable resistance (R_1). C_1, 0.0005 mfd.; C_2, C_3, 0.0003 mfd.; C_4, C_5, C_6, C_7, 1 mfd.; C_8, 0.0003 mfd.; C_9, 0.1 mfd. mica; C_{10}, 4 mfd.; C_{11}, 0.005 mfd.; C_{12}, 1 mfd. L_1, plug-in single layer solenoid coil. L_2, L_3, and L_4, L_5, plug-in binocular coil. R_1, variable resistance 25,000 ohms; R_2, 100,000 ohms; R_3, 25,000 ohms; R_4, 6 ohms; R_5, R_6, R_8, R_9, filament resistances to suit valves used; R_7, 0.5 megohms.

the possibility of radio frequency currents being induced into the filament circuit, the lead to the positive filament pin should follow down closely to the negative lead and be bound in against the screen. As this is not conveniently possible if the meter is fitted the provision of a shunt 1-mfd. condenser immediately beneath the filament pins and connected up by a thin twisted insulated pair of leads may be found desirable. Two additional tags should be inserted under the terminals of the valve holder for this purpose, so as to separate the shunt condenser circuit from the rest of the wiring. In this connection it may be mentioned that in regard to the second screened valve it is only necessary to run the positive filament lead close down near the screen.

In the anode circuit of the valve and within the screen is a two-section coil of the binocular type having a minimum of stray field and pick-up. Valve damping in a screened valve stage increases as the anode voltage is reduced, owing to a falling off in the valve impedance, and it will be seen that the coil is centre-tapped so limiting this damping effect. The centre point of the two series-connected sections is thus at earth potential, so halving the voltage above earth of the ends of the coil. As the tuning condenser also bridges the ends of the coil, this method of connection greatly reduces the electrostatic field.



Details of the detector stage and L.F. amplifier can be seen in this illustration.

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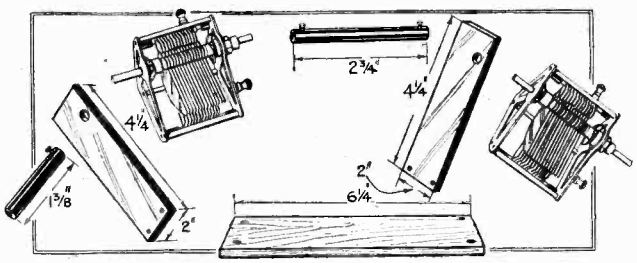
Were one end of the pair of coils to be earth-connected instead of the centre, the potential rise above earth of one set of the condenser plates and one end of the coil would be doubled. Coils of this type are reasonably efficient, though inferior to a good single layer solenoid. They have an H.F. resistance at 400 metres of something like 16 ohms. Although the tuned circuit is excited by including only half of its turns in the anode of V_1, a voltage step-up is not aimed at, and it will be seen that the H.F. potential set up only across half the tuned circuit is passed on to the grid of the second H.F. valve (V_2). Binocular coils possess only a small stray magnetic field, and this method of connection appreciably limits the stray electric field. In addition, the use of a coupling condenser and the grid potential controlling leak resistance is avoided. The latter would, of course, be a shunt across the tuned circuit, though its relative resistance is high. There is the danger, also, of the leak resistance and its leads picking up a stray H.F. voltage, necessitating the use of a special shunt condenser.



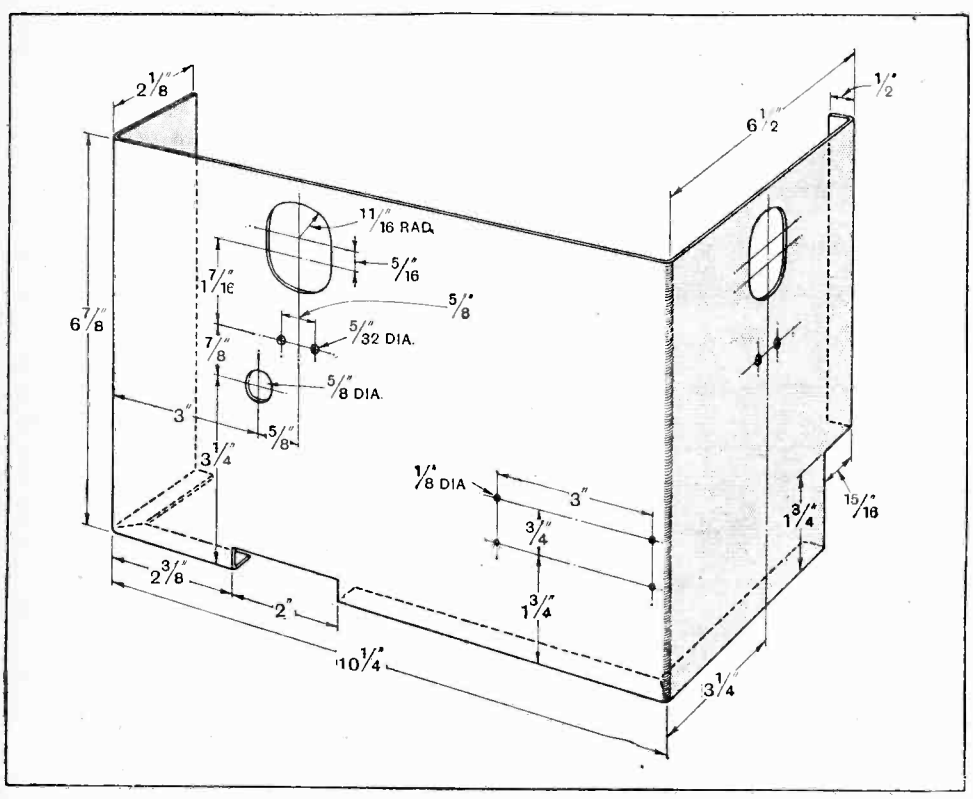
Constructional details for linking together the tuning condensers.

For the broadcast band these coils consist of 92 + 92 turns of No. 28 S.S.C. wire in a total winding space of 4in. and 1½in. in diameter.

So that the receiver can be operated from a single H.T. potential, the voltage of the screening electrode is obtained by dropping volts through a resistance. Being continuously variable, a critical control of the screen potential is provided in conjunction with the tuning of the set, an exceedingly useful feature, as the circuit can be brought right up close to oscillating condition, giving maximum amplification. It might be thought that a variable high resistance, used in this way, would be noisy in operation, but this is not so, though care is necessary to select a reliable resistance, for, being in continuous operation, it may soon become worn out, and the rubbing contact type is not to be recommended. Shunt reservoir condensers are connected by the shortest possible leads between the screen and the screen pin of the valve.

An exactly similar stage of intervalve coupling is provided between V_2 and the detector valve (V_3). Contrary to suggested practice, the apparatus, to simplify construction, is not provided with a screening box. The detector stage is on the corner of the baseboard, remote from other apparatus, yet it might be mentioned that should the reader decide to introduce a high-frequency choke in the anode circuit of the detector valve to prevent the passage of H.F. through the L.F. amplifier, then a screen becomes necessary up to the point of the grid input lead to V_3.

Reference might be made here to the effect of H.F. being passed on through the L.F. amplifier. Should this occur, a heterodyning effect will not necessarily result, but the quality of speech reception will be very much impaired. What happens is that H.F. reaches the loud-speaker leads, to which there is no serious objection except that the connections to the loud-speaker, acting as a small radiating aerial, readily pass energy back into the aerial circuit, being subsequently amplified many thousands of times. This effect, therefore, becomes very important in the case of a high-efficiency H.F. amplifier. It is best prevented by earth-connecting a centre tapping on the secondary of the output transformer, although it can equally well be effected by shunting a condenser across the secondary terminals and earthing one side by a short



Dimensional drawing for making the screen.

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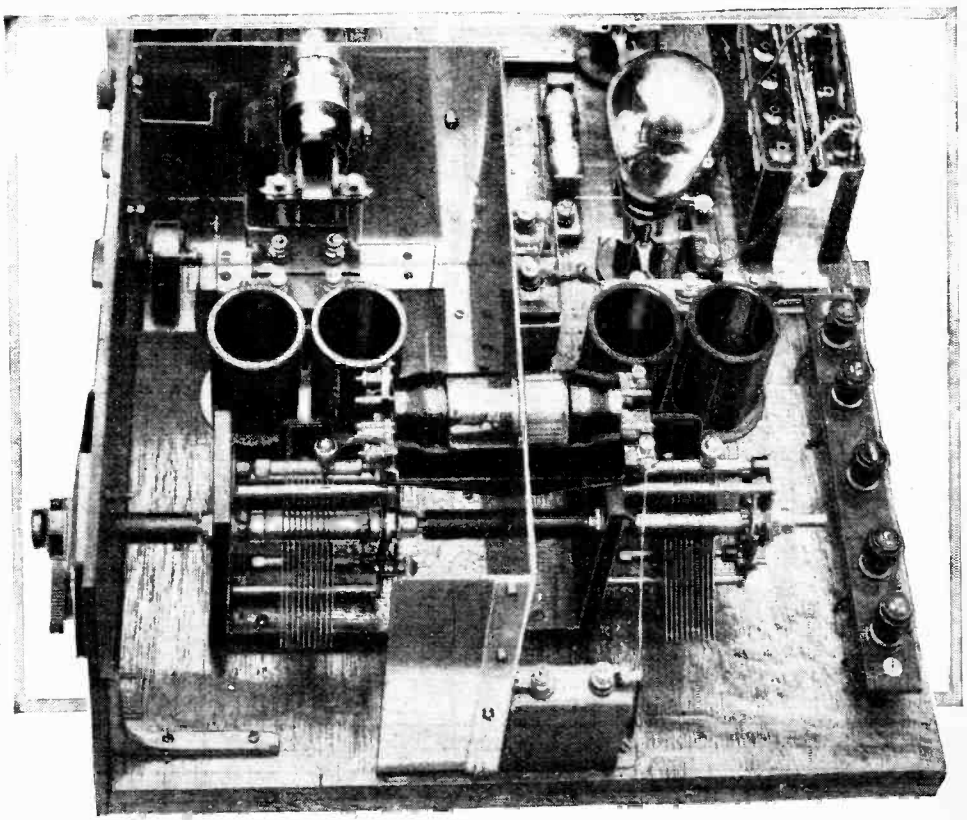
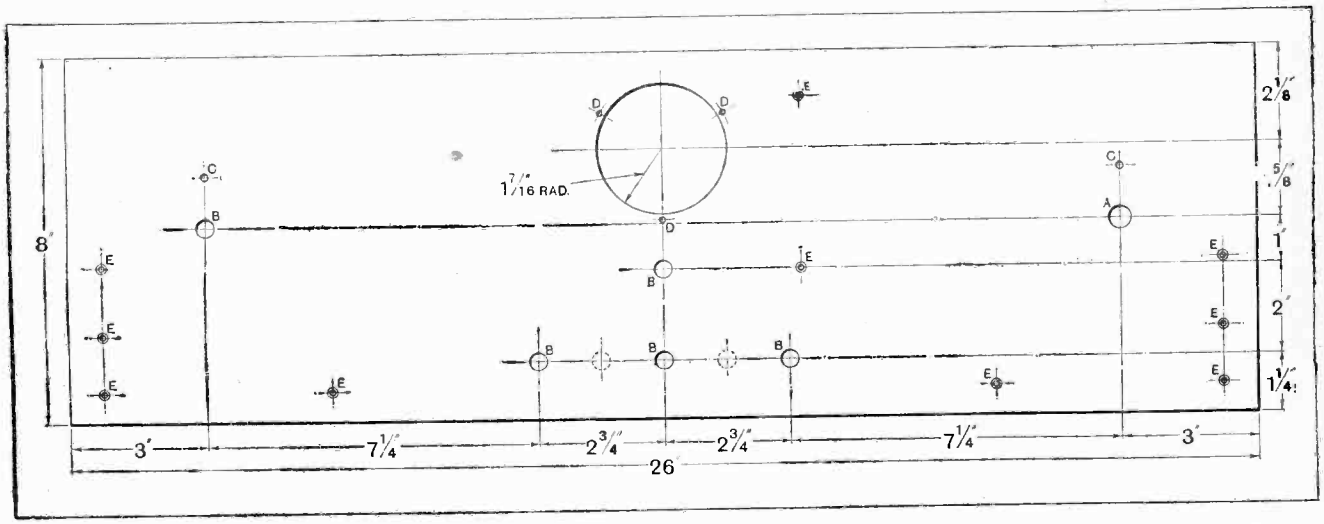
direct lead to the screen. This precaution need not be taken until after the set is tested. Here, again, the ideal would be to enclose the detector valve, together with the L.F. amplifier, completely in the screening box, but this would not eliminate the passing round of H.F. to the aerial that may have passed through the L.F. amplifier, and the shunt condenser precaution might still be necessary. With the capacity of 0.005 mfd. this shunt condenser will not materially affect the speech characteristics of a 1 to 1 or step-down output transformer. It may be found useful, also, to insert earthing tags under the case bolts of the L.F. transformers.

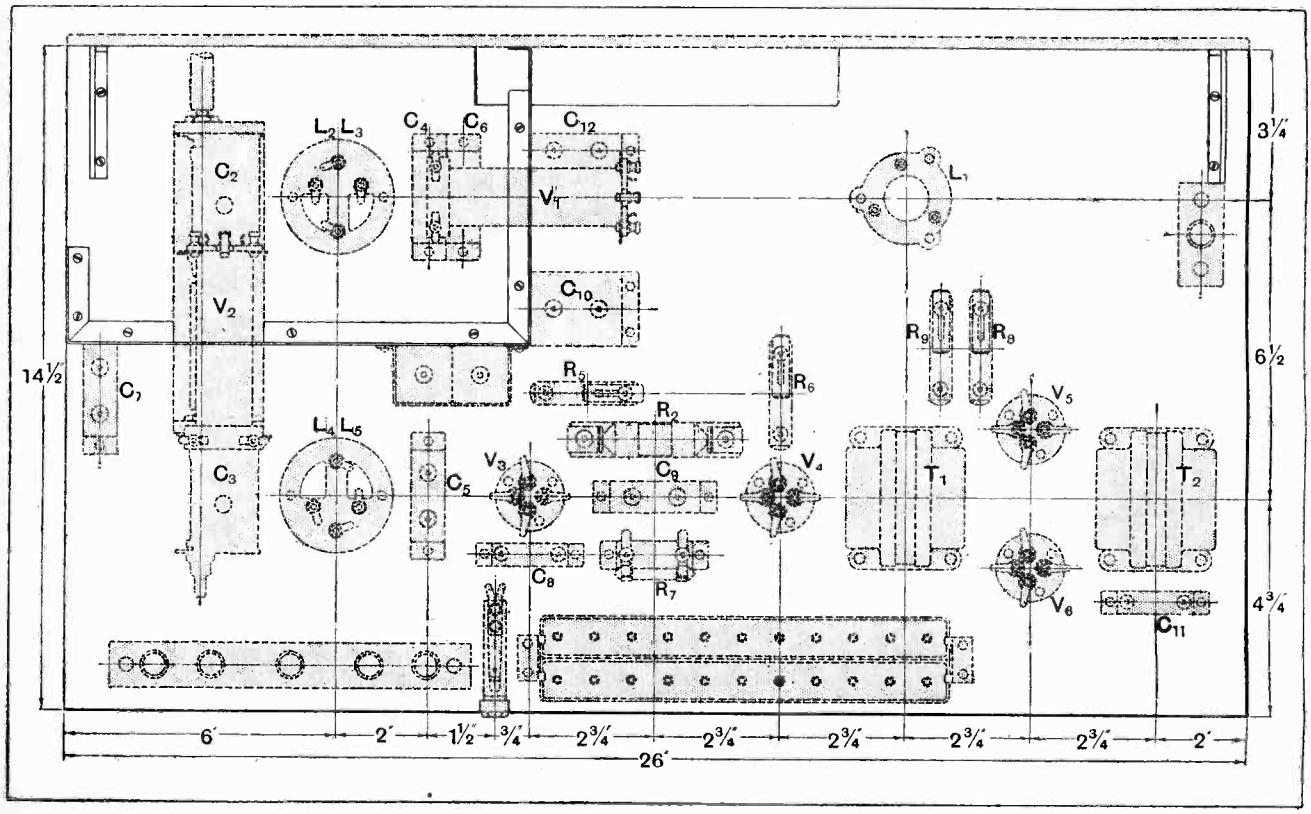


The method of linking together the two tuning condensers is clearly shown, together with constructional details of the screen.

Reverting to the H.F. tuning equipment, the two H.F. amplifiers are simultaneously tuned from one control. Although there are several two-section condensers on the market, none of them was suitable for use with the screened stages. Complete separation and spacing is required between them with this particular circuit arrangement, and some simple form of construction had therefore to be adopted. Two special condensers were obtained, with the spindle ends projecting from both, instead of one side only. With the aid of the projecting spindle a piece of drilled ebonite rod readily serves as a driving link. A base of hard wood is accurately made up to the dimensions given, as well as two rectangular ebonite end pieces with exactly similar drilling. These are securely screwed to the ends of the base piece, but are not reinforced with brackets, so that the alignment is controlled solely by the spindles. Deep scratch marks parallel to the axis are made with a file on the projecting spindle end of the front condenser, so that when the drilled ebonite tube is forced on to the spindle



Drilling details of the front panel. When only filament resistance and screened voltage control are fitted the two holes shown dotted should be drilled in place of the three marked B. Sizes of holes: A, 1/2in.; B, 3/8in.; C, 5/32in.; D, 1/8in.; E, 1/8in., and countersunk for 4BA screws.



Plan view showing the layout of the components on the baseboard. The parts are identified by reference to the circuit diagram.

there will be no chance of slip. A grub-screw locks the spindle of the rear condenser to the ebonite, so as to provide adjustment. The condenser spindles, unfortunately, are a little under ¼in. so that standard ebonite tube cannot be used for this purpose, but pieces accurately cut to length can be supplied with the condensers, the front one carrying a short piece of brass rod for attaching the dial. As there is no one-hole centre fixing nut on the front of the panel, only a few types of geared dials can be attached. While setting up the condensers, tags should be attached

LIST OF PARTS.

1 Logarithmic condenser, 0.0005 mfd. (Ormond).
2 Logarithmic condenser, 0.0003 mfd., with projecting end spindle (Ormond).
2 Pieces of ¼ drilled ebonite for driving condensers.
2 Vernier dials (type S.M. Ormond).
1 Variable resistance, 25,000 ohms (Centralab Rothermel Radio Corporation, or Variostat, Claude Lyons, Ltd., 76, Old Hall Street, Liverpool).
1 Paxolin or Pertinax panel, 26in. × 8in. × 3/16in., and terminal strips (Wright & Weare, 740, High Road, Tottenham, London, N.17. Geo. L. Scott & Co., Ltd., 69, Fleet Street, London, E.C.4).
1 Mahogany or oak baseboard, 26in. × 14½in. × ½in., and 2 battens, 2in. × ⅜in.
Aluminium for screen, 20in. × 7½in., or finished screen (Wilkins & Wright, Kenyon Street, Birmingham).
2 Colvern screened valve holders (Collinson's Precision Screw Co., Ltd.).
4 Valve holders (Simmonds Bros., Smethwick).
1 Utility "on-and-off" switch (Wilkins & Wright).
1 Dumetohm grid leak, 2 megohm., and holder (Dubilier).
1 Fixed condenser, 0.0003 mfd. (No. 620, Dubilier).
1 Fixed condenser, 0.1 mfd., mica (T.C.C.).
4 Fixed condensers, 1 mfd., (Sterling Mansbridge Marconiphone).
1 Fixed condenser, 4 mfds., (Sterling Mansbridge Marconiphone).
1 6-spring jack, optional (No. P.70, Igranic).
1 Wire wound anode resistance, 100,000 ohms, and holder (Dubilier).
1 Pair brackets.
2 "T" cells, 1½ volts (Siemens).
1 15-Volt G.B. battery (Siemens).
1 Push pull transformer, 3.5 : 1 (A.F.5.c., Ferranti).
1 Push pull transformer, 1 : 1 or 25 : 1 (O.P.3.c., Ferranti).
1 Radio meter, 100 mA 10 volts and 250 volts (type No. 24 R 3.F.a. Ferranti).
2 Peerless resistors, 6v., 0.25 amps. (Bedford Electric & Radio Co., 3-22, Campbell Road, Bedford).
2 Peerless resistors, 6v., 0.7 amps. (Bedford Electric & Radio Co.
1 Rheostat, 6 ohms, with knob to match variable high resistance (Rothermel; Claude Lyons).
No. 20 Tinned copper wire.
No. 22 Tinned copper wire.
2 Colvern bases and "binocular" coils, broadcast wavelengths (Collinson's Precision Screw Co.).
2 Colvern bases and "binocular" coils, long wavelengths (Collinson's Precision Screw Co.).
1 Colvern base and aerial coil, broadcast wavelengths (Collinson's).
1 Colvern base and aerial coil, long wavelengths (Collinson's).
6 Ebonite shrouded terminals (Belling & Lee).
5 Wander plugs (Lisenin Wireless).
Sistoflex.

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so as to facilitate wiring at the points shown in the practical wiring diagram. Where tags are inserted under a stiffening bar of the condenser the length must be cautiously reduced by an amount equal to the thickness of the tag. In order that the condensers may tune together it is necessary that they should be of the logarithmic type. It is obvious, however, that single dial control, although desirable, cannot be obtained merely by linking the aerial tuning condenser to the common shaft. Owing to aerial capacity, its tuning scale will differ from that of the inter-valve couplings.

As this form of receiver is so entirely new to the majority of readers, construction should be undertaken by easy stages, and although the meter is a desirable component it need not be fitted at the onset. As far as possible the leads to the meter should be bunched and bound together with cotton, and passed down through a single hole in the baseboard.

Appearance is improved by constructing the panel from Paxolin or Pertinax, polished and light brown in colour, which looks well, is stiff even in thin sheet, and the surface does not deteriorate. The panel should be purchased exact to size, as owing to the toughness of the material filing is a laborious job. A hole for the meter is made by drilling small holes around a circle, linking them up with a fine saw blade or fretsaw, and filing. The manufacturers of the meter, however, would do well to supply a suitable form of cutter to assist the amateur in mounting the flush pattern instrument.

Unless the L.F. amplifier is required for use with a gramophone pick-up, the volume control R_3, the third knob on the left, need not be provided, the screened grid potential resistance serving as an excellent control of volume. The filament rheostat is desirable, and the two knobs can be fitted in the alternative position shown on the panel drilling diagram.

In connection with the use of a gramophone pick-up a break jack is shown on the baseboard which may be wired into the circuit of the input to the first L.F. valve.[1] A simpler process, however, which avoids complicating the wiring, consists of removing the tuning coil L_4, L_5, plugging in one side of the pick-up lead by means of an old valve pin into the socket which connects to the grid of the detector valve, while the other lead from the pick-up is connected by means of a tag to the junction between the two grid cells, so as to reduce the grid bias to only $1\frac{1}{2}$ volts.

[1] See circuit on p. 352, *Wireless World*, September 21st, 1927

(*To be concluded.*)

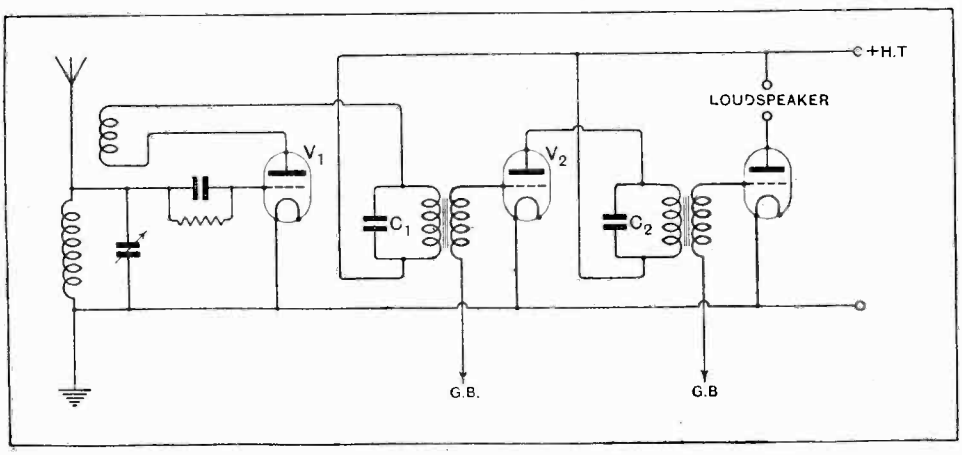
CONDENSERS ON TRANSFORMER PRIMARIES.

IN the circuit diagram which, despite its faults, is probably the most widely used circuit of all, the question arises as to whether C_1 and C_2, shunting the transformer primaries, are necessary, and if so, what should be the value of their capacities.

The condenser C_1 is required to allow the radio-frequency currents necessary to supply reaction to flow freely round the plate circuit of V_1, while at the same time it must block effectively the low-frequency currents of the highest speech frequency and force them to pass round the transformer windings. Necessarily, these requirements lead to a compromise; C_1 must not be too small to fulfil its high-frequency function, nor large enough to fail in its duty to currents of low frequency. The capacity of 0.002 mfd. commonly recommended for C_1 (a legacy from long-wave working) is unnecessarily high for the broadcast waveband, and 0.0002 to 0.0005 mfd. is a more suitable value.

Since there are (or should be) no high-frequency currents in the plate circuit of V_2, the condenser C_2 is not in any way essential to the satisfactory working of the receiver.

There are occasions, however, on which it is better to retain C_2 and to increase C_1 above the figure just quoted. If, through poor design of the transformers or loud-speaker, low notes are missing from the music reproduced, so that the resulting quality is sharp and "tinny," C_1 and C_2 should be increased in value until they shunt away the unpleasant excess of high notes. The reproduction, though including only the middle part of the musical scale, may thus be made reasonably inoffensive.



Typical circuit showing by-pass condensers across transformer primaries.

In other circuits, such as the Reinartz and its modifications, where an entirely separate path is provided for the high-frequency currents in the plate circuit of the first valve, the condenser C_1, unless required as suggested above for tone-control, may be omitted altogether. Nor should it be overlooked, in considering this condenser, that certain makes of transformer have a condenser, of the correct size for tone control, incorporated in them by the manufacturers.

A. L. M. S.

BACK COUPLING IN L.F. AMPLIFIERS.

The Effects of Anode Supply Impedance on the Performance of Amplifiers.

By M. G. SCROGGIE, B.Sc.

THE problem in broadcast reception which has perhaps received more attention than any other during the last two or three years has been the "levelling out" of the frequency characteristic, giving what is termed straight line amplification; in other words, the design of receiving apparatus which responds to a substantially equal extent to modulation frequencies over a band of about 30-10,000 cycles per second. A receiving system can be roughly divided into three sections: the H.F. amplifying and tuning circuits, the L.F. amplifier, and the sound-reproducer. There has been some discussion at times as to whether the radio engineer should aim at perfection for each of these component parts separately, thus enabling any loud-speaker, say, to be connected to any receiver (assuming an appropriate mode of connection) equally well as regards fidelity of result, or whether the problem should be simplified by designing one part to compensate for the defects of another, which obviously necessitates that the whole receiving gear be considered as a unit.

Whichever point of view is taken, the subject now dealt with is of considerable importance, and will be found, in examples which are usual in actual practice, to have an influence far exceeding many features which have received attention in L.F. amplifier design.

From the very first days of multi-stage audio amplifiers, trouble has been experienced with instability, which is invariably due to some form of "feed-back" or stray coupling, and the greater the amplification the greater the danger of howling. The causes within the amplifier itself are now generally appreciated, but recently the common use of various sources of anode supply other than batteries has led to a renewal of the trouble in a number of cases, and it is proposed to indicate the causes and prevention of such. But it is also important to note that it is not sufficient merely to make the amplifier stable, and that amplifiers which themselves conform admirably to the requirements for faithful reproduction of music, etc., can be, and frequently are, used in a manner which gives them a frequency response characteristic which would appal the designer.

It is practically universal practice to feed the anode current to two or more valves of an amplifier from a common supply, and it is seldom that the impedance of this supply can be neglected, more especially if it takes the form of old or small dry cells or a battery substitute. This impedance is the most common cause of oscillation in L.F. amplifiers, and it also modifies the frequency curve to a greater or less extent. A mathematical discussion of the most usual combinations of valves will be found in a paper by J. E. Anderson,[1] which is well worth studying. Unfortunately it is usually out of the question to submit practical cases to rigid calculation, owing to the difficulty in knowing all the impedances in the circuits at every frequency, but we can derive useful qualitative information. Treating it at first very simply, assuming no phase shifts other than 180° (a total reversal), consider a resistance-coupled amplifier, the essential parts of which appear in Fig. 1. Suppose G_1 to receive a signal which makes its potential positive (relative to normal). Then the anode of the same valve, and consequently the grid of the second valve, become negative, and so on, as indicated by the + and − signs. It is emphasised that these are signal potentials only, and have nothing to do with the steady potentials due to anode battery, grid bias, etc. The largest current change presumably takes place in the last anode circuit, and if R is the resistance of the battery or other supply, common to all anode circuits, then all the preceding anodes will have an additional positive potential forced on them, depending on the magnitude of R. Thus the signal potential on the second grid will be opposed, that on the third grid will be partly opposed, and partly strengthened by the amplified feed-back potential on the second grid, and so on. Of these two spurious effects the latter is the larger owing to the step-up in the second valve. By similar reasoning it will be evident that it is the relation between the last anode and the first grid affected by the anode supply (in this case No. 2) that determines the resultant effect on the common impedance, as the greatest magnification takes place between these points. In the case shown the effect of R is to weaken the signal, as the last anode is in phase with the earliest grid, the second, connected to the anode supply. Stating it generally, *in an amplifier in which each grid is in phase with the preceding anode, and opposite in phase to the succeeding anode, the effect of a common anode supply resistance is to weaken the signal with an odd number of stages, and to strengthen it (and possibly cause oscillation) with an even number of stages*

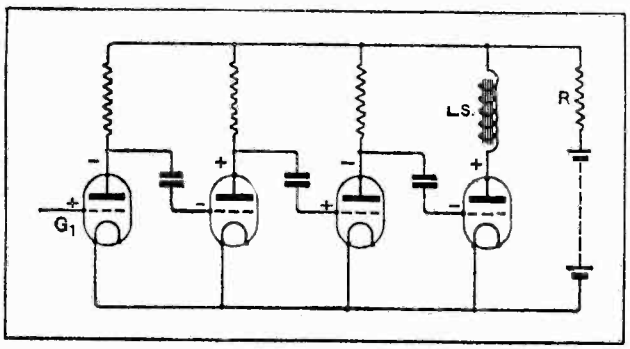


Fig. 1.—Schematic diagram illustrating the principle of back coupling due to battery resistance.

Note that the number of stages is considered to be the number of intervalve couplings. An important case arises when one or more H.F. stages are used prior to

[1] *Proc. I.R.E.*, March, 1927, p. 195.

Back Coupling in L.F. Amplifiers.—

G_1, which may be taken to be the detector grid. If H.F. couplings are used which transfer audio frequencies to a negligible extent, then they may be neglected in counting the number of stages, but not otherwise. For example, if a single H.F. valve is used coupled to G_1 by "tuned anode" or some method by which the anode supply is connected direct to G_1, even though it is only through the usual grid condenser of 0.0003 mfd. or so, then the amplifier in Fig. 1 becomes an even stage combination. With modern valves the amplification of one stage will usually ensure that the loss of feed-back potential in an inefficient coupling, as in the small grid condenser referred to, will be more than made up in the valve itself. This is the requirement for the distinction of ranking as a stage for the purposes of this argument. A L.F. amplifier may be perfectly stable when used alone and yet oscillate furiously if an initial H.F. stage is added. When a H.F. transformer is used, so that the detector grid is connected through a low-impedance tuning coil to the filament side, then the H.F. stage need not be taken into consideration.

A resistance-coupled amplifier has been dealt with, as it is nearly true to assume simple phase changes, but the same results are usual with choke-coupled amplifiers of one or two stages, which tend to be stable and unstable respectively. With more than two stages the results are somewhat uncertain if estimated from the foregoing rule, as vector analysis is necessary to cope with the phase variations, and in general it is not possible to predict what will happen unless one knows all about all the impedances, involving immense labour. To a still less extent the principle applies to transformer-coupled amplifiers. These allow one the possibility of making the grid opposite in phase to the preceding anode by reversing one winding. When this is the case, the problem is further complicated by the interwinding capacity which acts so as to reduce the amplification.

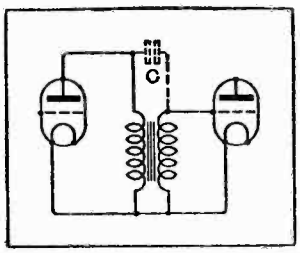


Fig. 2.—Capacity between windings in a L.F. transformer modifies the phase difference between grid and anode.

Why this is so will be seen on referring to Fig. 2, where batteries are omitted, as only alternating potentials are being considered. Suppose the transformer windings to have zero magnetic coupling. Then, if C is the capacity between windings, the combination will act as a choke coupling, with the grid approximately in phase with the anode. If now the windings are magnetically coupled, they can either assist or oppose the capacity coupling. The resultant will not generally be the arithmetic sum or difference of the two, as it is unlikely that the two effects would be exactly in phase. The former condition, referred to as "normal," is obtained if the two windings are of the same rotation, and similar ends go to grid and anode, while the other condition will be referred to as "reversed."

While the foregoing treatment is limited in application, it is considered that the conditions requiring vector work involve the knowledge of so many quantities that are uncertain that it is preferable to resort to actual trial.

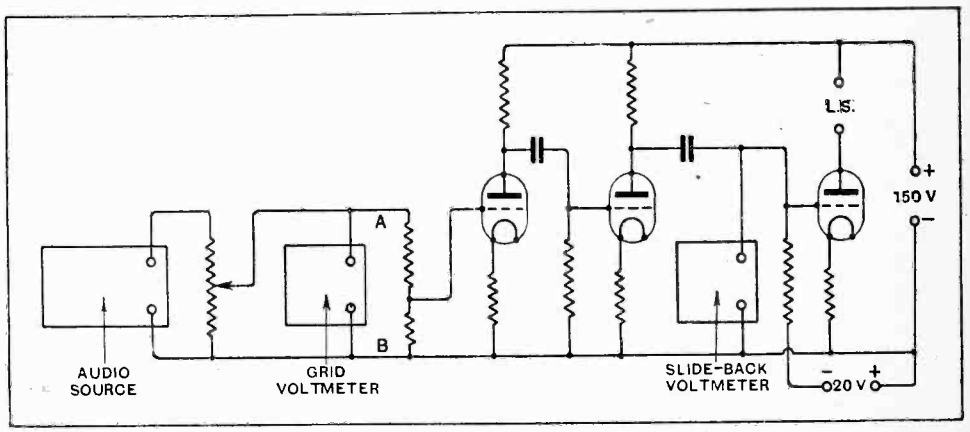


Fig. 3.—Layout of apparatus for obtaining amplifier characteristics.

In order to obtain numerical data on effects which had been observed qualitatively by ear, a series of amplifier measurements has been carried out with the more usual circuits, and the resulting curves are more eloquent than verbal description.

Arrangement of Apparatus.

A word as to the method of measurement. The general scheme is shown in Fig. 3, which is a modification of that previously described.[2] The same amplifier was used throughout except for the couplings. The first two valves had a magnification factor of about 20 and slope resistance of 35,000 ohms, the corresponding figures for the last valve were 2.7 and 2,600. Sufficient bias was applied to each grid to avoid grid current. The anode resistors were 50,000 ohms, grid leaks 1 megohm, and coupling condensers, unless otherwise stated, 0.01 mfd. mica, giving a 95 per cent. pass per stage at 50 cycles. The loud-speaker was a "Kone," and was used to provide an appropriate load for the last valve. The input voltage was obtained from a source of A.C. of variable frequency and pure wave-form[3] controlled by potentiometers; a simple grid type valve voltmeter was arranged so that the alternating potential across AB could be kept constant at 1.5 volts, and a known fraction was applied to the first grid. The output to the last valve was measured by a special type of slide-back voltmeter (see Fig. 4 and Appendix), which has proved unusually convenient and accurate, and can easily be adapted to any range. Amplification is defined as the ratio of the A.C. voltage

[2] P. K. Turner, "The Performance of Amplifiers," *Experimental Wireless*, Feb., 1927, p. 97

[3] *Experimental Wireless*, July, 1927, p. 424.

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generated in the last valve to that applied to the first, so in this case is 2.7 times the ratio of the measured voltages.

Three types of anode supply have been used: (1) an accumulator battery of 150 volts with a total resistance (including leads, fuses, etc.) of about 40 ohms; (2) the same with an added non-reactive resistance as specified; (3) an A.C. battery eliminator with a generous filter, including 8 mfd. across the output terminals, in addition to other capacities not directly across the output.

Some Typical Curves.

Fig. 5 shows frequency curves with two resistance couplings. About 500 ohms in the battery provoked oscillation, and the readings were taken with 400. Though this may appear somewhat large, it is, nevertheless, a figure frequently exceeded in actual practice. Even the curve with battery alone shows signs of the small unavoidable resistance. With the A.C. mains unit, on the other hand, it was impossible to work the amplifier. In these circumstances stability was obtained by a device which had previously been found successful. The common

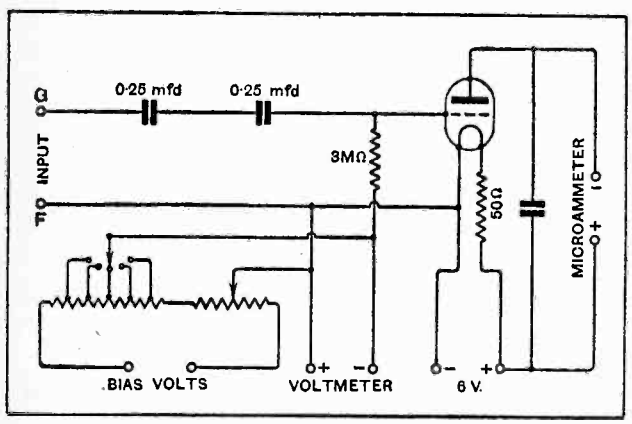

Fig. 4.—Connections of slide-back voltmeter.

impedance being greatest at low frequencies, the tendency to oscillate is at the lowest frequency that can be passed by the amplifier; if very large coupling condensers are used, the oscillations are in the nature of slow pulses at perhaps one per second. If the first grid condenser is reduced to a small capacity, the possible frequencies of oscillation are cut off to some extent. The second grid condenser should be kept large, as the feed-back to it is in a stabilising direction. In obtaining the curve a 0.001 mfd. grid condenser was used for the first coupling. One need not be afraid of losing the low notes thereby, as the A.C. unit supplies them, and in this instance is seen to emphasise them to a remarkable extent. Better results would probably be obtained with a smaller condenser still.

Passing on to Fig. 6 we see the somewhat alarming results obtained with a resistance-coupled stage followed by a transformer. As little as 60 ohms in the battery sufficed for instability, and the effect of 40 ohms is indicated. The enormous hump at 200 cycles is the frequency at which it is trying to oscillate. With the eliminator it

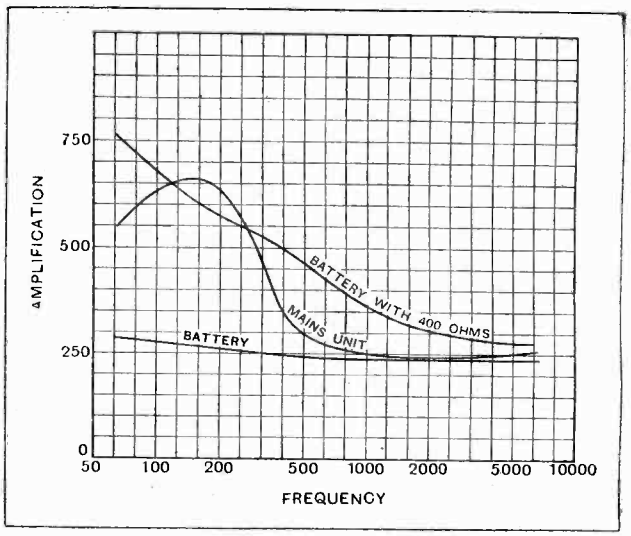

Fig. 5.—Frequency characteristics of a two-stage resistance-coupled amplifier.

was necessary to reduce the grid condenser to 0.00005 mfd. in order to obtain a curve. The tendency is still to emphasise 200 cycles, and the lowest notes, not being boosted up by feed-back, are cut off entirely by the inadequate condenser.

Fig. 7 shows the effect of a reversal of transformer winding (the secondary). The curve with battery resistance was taken with 400 ohms, and indicates poor amplification with a tendency to shrillness, which latter would probably be counteracted by the by-pass condenser which is usual in a complete receiver. The mains unit curve shows a pronounced resonance just below 2,000 cycles. This is interesting, as it is the first example we have come across which is an exception to the general rule which was laid down for simple amplifiers, and which was stated to apply to a less extent where reactive couplings were present, owing to complicated phase shifts. Here we have an amplifier which, from a scalar point of view, should

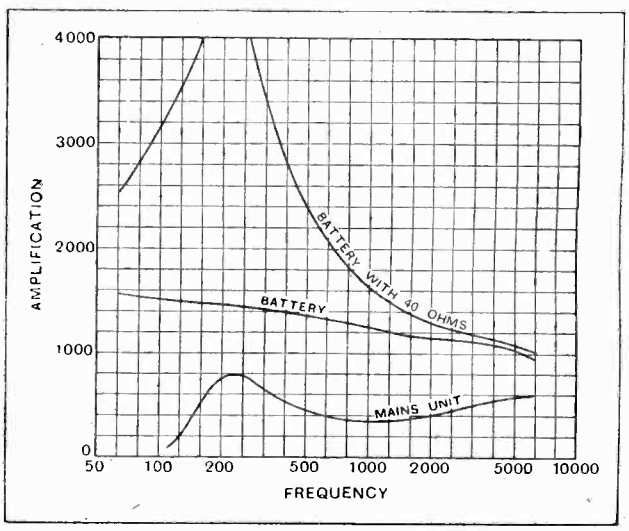

Fig. 6.—Resistance-coupled stage followed by transformer-coupled stage.

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be damped by a common impedance, but at this particular frequency the curve rises above that corresponding to no common impedance, showing that there is a total phase shift into another quadrant than one would normally expect, with consequent regeneration.

This would naturally lead one to expect, even without working it out in detail, that an amplifier with two transformer couplings would be still more likely to depart from the scalar theory. And this is so, for when tried it was found to be impossible to run off the A.C. unit at

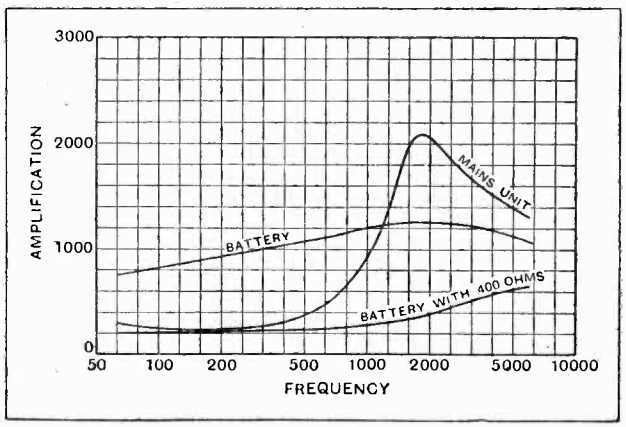

Fig. 7.—Two-stage amplifier as in Fig. 6, but with transformer secondary winding reversed.

all with any of the four possible phase combinations obtainable by transformer connections. In other words, there was always some frequency at which the total phase shift was more than 90° with the " stable " connections. Actually this is a necessary but not sufficient condition for oscillation.

The two curves shown in Fig. 8 are with both transformers normally connected, and with 100 ohms as a battery resistance, as instability resulted with 400. The magnification with such an amplifier is higher than one can expect to handle without special precautions.

Practical Application of Results.

And now for conclusions. It will be quite evident that the best policy is to use a low resistance supply, and limit the total amplification to about 1,500. Where these conditions are not possible, the best arrangement must be judged from a consideration of the particular requirements. Possibly a curve can be chosen to fit in with the deficiencies of the loud-speaker (they all have deficiencies !). Almost any amount of peaking below 100 cycles can be tolerated, unless the receiver is also excessively selective. It is assumed that overloading does not take place.

It should be remembered that a push-pull type of amplifier entirely avoids the difficulty because the signal current does not traverse the anode battery at all. Such an arrangement is, therefore, almost essential in certain classes of work where a common supply must be used without interaction of circuits. It is the last valve of an amplifier that causes most of the trouble, due to the relatively large current changes in it; and if, instead, two valves are used with push-pull input and output transformers, not only will the output be doubled but improved results will be obtained where for any reason a low-impedance supply is not used.

It is most necessary that consideration should be given to the proper interpretation of these curves, in order to appreciate the corresponding aural impressions. Firstly, it should be observed that a linear scale of abscissæ has been used, partly because it is familiar (except to telephone engineers) and partly because it shows up the various effects prominently; but the ear is decidedly insensitive to amplitude, and its response is more appropriately depicted by a logarithmic scale. An irregularity in pitch is intolerable, as may be demonstrated by moving the speed control of a gramophone during the playing of a record, but fortunately there is much lower sensitivity to irregularity of amplitude. It should be remembered that listeners in different parts of the same room receive sounds whose intensity varies in a totally different manner with frequency owing to various effects such as reflection. Further, when a complicated mixture of frequencies is being transmitted, such as that from a large orchestra, the effect of a given rise or hollow in the amplification curve is of greatly different importance according to the part of the frequency spectrum where it occurs. Thus a reduction to one-tenth strength of frequencies in the neighbourhood of 1,000 per second would produce a much larger apparent diminution of volume than a similar reduction at much lower or higher frequencies.

Looking at Fig. 5, it is a matter of actual fact that even a trained listener would have some difficulty in deciding, by ear alone, which condition was the best. With many loud-speakers the rising curves would un-

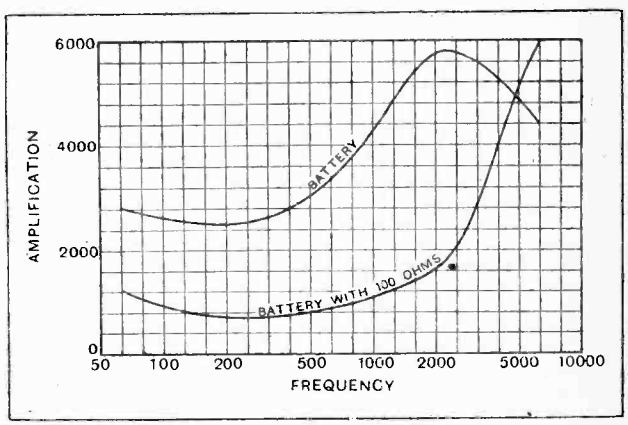

Fig. 8.—Two stages of transformer coupled amplification with normal connections.

doubtedly produce a more level effect at the ear than the nearly straight one. The total suppression of frequencies, as in Fig. 6 (lowest curve), is a condition more strenuously to be avoided than variations even of 2 or 3 to 1, as in Fig. 5.

The general results of these measurements indicate that the characteristics of individual coupling components are not a criterion of the performance of an amplifier, either as regards quality or magnification, and the design must be given greater consideration as a whole than has been usual in the past.

Back Coupling in L.F. Amplifiers.—

APPENDIX.

The slide-back voltmeter, the circuit diagram of which appears in Fig. 4, is based on information given in a paper by W. B. Medlam and U. A. Oschwald.[4] Of the numerous types this one has proved to be very generally useful, as it is unaffected by D.C. up to hundreds of volts, the calibration is almost unaffected by change of valve, it is impossible to damage the microammeter as the emission is adjusted to about the full-scale reading of the instrument, the battery voltages need not be exact, though for accurate work a small constant correction can be applied for deviations from the standard 6 volts, the load is small as there is no grid current, and the range is limited only by the potentiometer dissipation, while above about 5 volts peak input the scale is linear. A balancing battery is connected, of a voltage over the greatest peak voltage to be measured, and by means of the coarse and fine adjustments the microammeter can be very rapidly set to a small fixed value (1 microampere has been chosen). A Cambridge Unipivot is used as one happens to be available, but a less accurate instrument will obviously serve the purpose, as no readings are taken from it. The peak volts are then read off the D.C. voltmeter less a small fixed quantity. A curve is used for the low input voltages. The valve is of a nominal two-volt type, run at a very low filament temperature in order to limit the emission to a few microamperes. The grid condensers are paper ones picked for very high insulation (over 10,000 megohms each), and the frequency error is less than $\frac{1}{3}$ per cent. above 10 cycles.

[4] "The Thermionic Voltmeter," *Experimental Wireless*, Oct. and Nov., 1926.

Reception in India.

A correspondent recently returned from India tells us that during last July, August and September, PCJJ, Eindhoven, was received in Waziristan on two valves at loud-speaker strength. On a few occasions, he states, the results were really excellent, notably when 2LO was re-broadcast and the announcer's voice was clearly heard. Equally good results were also obtained on a short-wave set at Razmah. These were somewhat unexpected, as the station is surrounded by mountains and every building roofed with corrugated iron. Also, during these months the Army wireless stations are interrupted nearly every day by heavy thunderstorms, and any attempt to listen on wavelengths of 200 to 500 metres is rendered almost impossible, owing to atmospherics.

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Short-wave Transmissions from Germany and Holland.

Several readers have reported hearing the short-wave transmissions from Langenberg on 43.9 metres, usually on Sundays about midday. One correspondent gives the strength of the received signals as R6 on two valves. We understand that this experimental transmission is being conducted by the Deutscher Funkverband of Berlin.

PCLL, at Kootwijk, is also transmitting on 18 metres, on Monday, Wednesday, and Friday afternoons at between 13.00 and 16.00 G.M.T., strength about R5 on two valves. This station is in communication with Bandoeng, Java, and, we understand, sometimes relays music and other items received from the Dutch East Indies.

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Notice of Tests.

Mr. J. Croysdale (5US), "Eastholme," Margerison Road, Ben Rhydding, Yorkshire, asks us to state that he is transmitting on 44.5 metres every Sunday from 10.30 to 13.00 G.M.T. at each half-hour, and also at 14.00, 18.00 and 18.30 G.M.T. on Sundays, and at 18.00, 18.15 and 23.00 G.M.T. on Mondays, Wednesdays, and Saturdays, up to the end of the year. Reports will be much appreciated and duly acknowledged.

TRANSMITTERS' NOTES AND QUERIES.

Mr. F. G. Ingleton (6FI), 48, Grasmere Road, Muswell Hill, N.10, is also transmitting on the 45-metre waveband and will welcome reports from short distances.

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The Experimental Radio Society (2BDP), Haute Croix, St. Johns, Jersey, C.I., is standing by on Sundays between 10 a.m. and 2 p.m., or at other times by arrangement, to report on amateur transmitting tests on 45 and 30 metres.

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Calibration Signals.

The Q.R.P. Transmitters Society, whose headquarters are at 178, Evering Road, Clapton, E.5, will send out calibration waves for the benefit of amateurs working on 44 to 46 metres. These waves will be accurate within 0.1 per cent. (*i.e.*, about 0.05 metre).

Transmissions will be as follows: "QRP de 5YK. Here QRP T. S. calibration service QRH —— metres," followed by a half-minute dash and AR. They will be sent at 10.00, 10.05, 10.10, 10.15 and 10.20 G.M.T. on Sunday, December 18th, and on January 1st and 8th. The wavelength will be in steps beginning at about 46 metres, the exact length being announced at the time, and finishing at about 44 metres. Postcards from amateurs using these calibration signals will be welcomed and will enable the Society to decide whether a continuation of this service is desirable. Communications should be addressed to the hon. sec., Mr. C. D. Abbott, 120, Cavendish Road, S.W.12.

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Low Power Transmissions.

Mr. W. F. Floyd (5WF), 88, Ilbert Street, London, W.10, has been carrying out low-power tests on the 150-200 metre waveband and will welcome reports from listeners who have heard his signals.

With an input of 0.7 watts (9mA. at 80 volts), he has had reports from Manchester and Yorkshire, the wavelength being 163 metres, and with an input of 0.95 watts (12 mA. at 80 volts), he has worked with Belfast on 45 metres and the signal strength was reported R5. He tells us that the valves he was then using were Cossor 210 H.F. and 220 P., wired in parallel, and, incidentally, pays a tribute to the excellence of British valves. For the last six months he has been carrying out these tests, employing as oscillators ordinary 2-volt receiving valves; those in use at the time of writing have both been working for the past three months under a strain far in excess of that for which they were designed, but their performance is still just as good as when first fitted.

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A Correction.

We regret an error on page 711 of our issue of November 23rd. 6QJ should read H. L. Humphries and not H. J. Humphries.

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New Call-signs and Stations Identified.

2PM	W. B. Bodemeaerd, 262, Philip Lane, N.15.
2YP	Capt. V. R. Krohn, The Gray House, Brasted, Kent. (Change of address.)
5AH	A. Horton, 23, Glenfall St., Cheltenham.
5AU	D. Campbell, 19, Cranbourne Gdns, Upminster, Essex. (Change of address.)
5FR	J. L. Jeffree, 2, Fernhurst Rd., Croydon, Surrey. (Change of address.)
5FU	H. G. Foukes, 27-29, High St., Rhyl, N. Wales.
5GA	B. Logan, The Apex, St. Martins Hill, Canterbury.
5GU	J. O. J. Hudson, 107, Chedington Rd., London, N.18. (Change of address.)
5TA	A. C. Cossor, Ltd., Highbury Grove, London, N.5.
5US	J. Croysdale, Eastholme, Margerison Rd. Ben Rhydding, Ilkley, Yorks. (Change of address.)
6AM	(ex 2ARL), W. N. Doble, 1, Pickwick Rd., Dulwich, S.E.21.
6CY	A. S. Clacy, 10, Melrose Avenue, Reading.
6CR	A. E. Carter, 41, Parkside, Cambridge.

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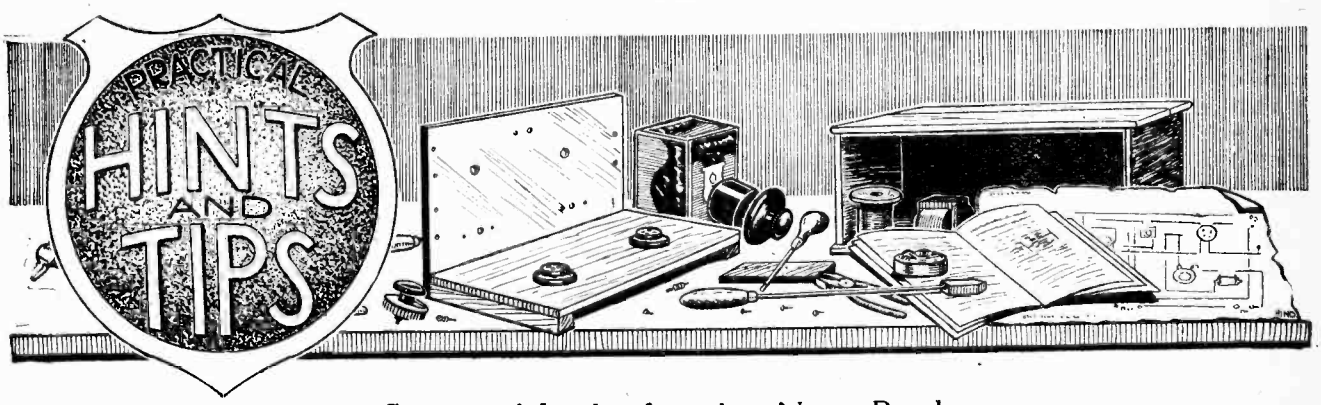
QRA'S Wanted.

2GS, 2PA, 6EO, 5VA, 6MF, 6QM, EF 8WZ, EF 8XO, EP 1BL, FB 8HL, FE 2VO, FL 1AB, NQ 20B, OA 2AE, OA 2RO, OA 6ME, OZ 2AY, OZ 4AE, XEN, OQQ, XEP 1MA, IRB.



A Section Mainly for the New Reader.

THE SELECTIVITY OF THE "STANDARD FOUR."

IN the article describing the "Standard Four" (*The Wireless World*, November 30th, 1927) it was stated that selectivity could be increased very considerably by using a high-impedance, high-magnification valve as an H.F. amplifier. The gain resulting from this substitution is so real that in all probability it is wise to recommend it in every case where the distance separating transmitter and receiver is less than ten miles; indeed, the choice of an H.F. valve should always be governed largely by geographical situation with respect to near-by stations. Where lack of selectivity is likely to be a serious problem, it is, therefore, assumed that an "R.C." valve, with an impedance in the order of 50,000-70,000 ohms and a voltage factor of about 35 will be used.

An important point arises with regard to the bias voltage to be applied to these valves. Certain types are so constructed that grid current (which is undesirable, as it introduces damping) does not begin to flow until the grid is appreciably positive with respect to the filament; these may safely be used without any bias, so G.B.$_1$ may be removed, the leads connected to it being joined together. The ordinary valve of the class under consideration does, however, require a small negative voltage, generally between 0.5 and 1 volt. This obviously cannot be obtained from a dry cell, and at first sight it would appear to be desirable to fit a potentiometer, which would be connected exactly in the same way as that controlling the detector. Fortunately, provided 6-volt valves are used, it is an easy matter to obtain "free" grid bias by inserting the filament rheostat in the negative low-tension lead, as shown in Fig. 1. The average R.C. valve rated at six volts will give adequate emission with some $5\frac{1}{4}$ to $5\frac{1}{2}$ volts applied to it; thus a bias voltage of from $\frac{1}{2}$ to $\frac{3}{4}$ volt is readily obtainable from the "drop" across the resistance in circuit. This is one of the instances where it is permissible to depart from the standard *Wireless World* practice of always connecting filament resistors or rheostats in the positive low-tension lead.

It should be emphasised that any increase in working impedance over some 60,000 or 70,000 ohms will noticeably reduce the amplification obtainable; it is, therefore, essential that a considerable H.T. voltage (at least 120) should be applied to the H.F. valve with a minimum bias voltage. Generally speaking, results are improved by increasing this voltage, as by doing so the impedance will be reduced. It is largely to prevent any undesirable increase in working impedance that the use of minimum grid bias is recommended.

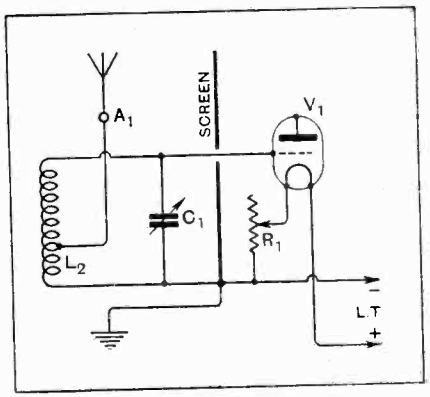


Fig. 1.—How to obtain "free" grid bias for an H.F. amplifier. The reference letters on components correspond with those in the original "Standard Four" descriptive article.

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LOOSE-COUPLED RECEIVERS.

THERE seems to be a definite tendency to revive the use of the loosely coupled and separately tuned aerial circuit, at one time regarded as essential for an efficient receiver, and which still has undoubted advantages when good reception of both medium and long broadcast wavelengths is considered as essential. It must be admitted, however, that the addition of an extra tuning control is rather a drawback where the amateur is lacking in experience, and the arrangement is generally recommended only to those who have had some practice in manipulating simpler receivers and who are willing to devote some thought to the operation of controls which are of necessity more complex.

It seems probable, however, that the difficulties associated with this type of circuit are really more apparent than real, and that most of them will disappear if a methodical course of procedure is followed. It is important that the various circuits should be kept approximately in tune, and thus searching should be carried out by moving the various condenser dials in step with each other, proceeding slowly until the readings corresponding to a number of wavelengths have been recorded. It must not be forgotten that variations in coupling will change the wavelength to which the aerial and secondary circuits are tuned, and thus it is necessary to readjust both variable con-

densers after each alteration. This peculiarity probably accounts for a good deal of the difficulty experienced by the beginner, to whom it is sound advice to suggest that minimum use should be made of this adjustment, and that when a good coupling has been found (it will almost always be a "loose" one), the coils should be left in this position until the user has acquired full confidence in his ability to cope with additional complications.

A word of warning should be offered regarding a puzzling effect which is sometimes encountered in the operation of a receiver including a loose-coupled aerial circuit and a neutralised H.F. amplifier. If this latter happens to be imperfectly balanced it will sometimes be found that when the aerial circuit is slightly detuned signal strength will increase, due to a reduction of aerial loading. A further movement of the condenser may result in the production of self-oscillation. This is another complication which may be avoided; first, by adopting an up-to-date balancing system, and secondly by not attempting to obtain reaction by partial deneutralisation. This aid to sensitivity is becoming less necessary, due to improvements in H.F. transformers and valves. When it is required the coupling between aerial and secondary circuits should be extremely weak, in order that the disturbing effects of varying damping may be reduced to a minimum.

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ADJUSTING H.T. VOLTAGE.

A DIFFICULTY arises when two or more H.T. voltages are applied to a multi-valve receiver in cases where the supply is obtained from accumulators. A little consideration will show that the cells towards the negative end of the battery are supplying current to all the valves, while those at the other end are feeding only that valve (or those valves) to which maximum voltage is applied. Thus there will be a tendency for the first-mentioned cells to discharge more quickly; consequently they will be exhausted before the others, and, strictly speaking, they should receive a longer charge. This will generally be inconvenient unless the battery is charged in sections—in itself an inconvenient procedure—and the arrangement shown in Fig. 2 is suggested as a suitable method of overcoming the difficulty.

The diagram shows in skeleton forms the anode circuits of a typical four-valve receiver. Now, on the assumption that anode bend detection is used, there is little real reason why a common voltage of from 100 to 120 should not be applied to V_1, V_2 and V_3, which function respectively as H.F. amplifier, rectifier, and first stage L.F. amplifier. As regards the output valve, V_4, there is a growing tendency to increase voltage to, perhaps, 160, or even more; in such cases the advantages of the method advocated come into play.

The calculation of the resistance value of R_1 through which the first

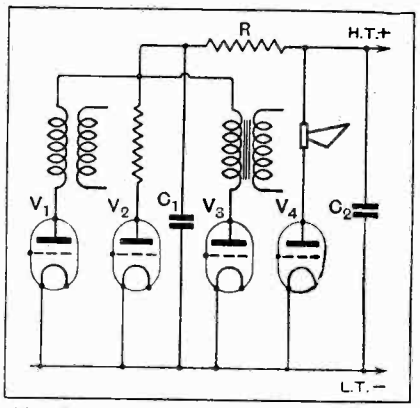

Fig. 2.—An equal discharge of all cells in an H.T. accumulator battery may be assured by inserting a reducing resistance (R) in the common anode circuit of those valves requiring less than maximum voltage.

three valves are fed is a simple matter, provided that we know the current which they will consume at the required voltage. This can be ascertained with sufficient accuracy from the manufacturers' published curves, bearing in mind the fact that the adjustment of anode voltage for modern valves in modern circuits is by no means critical. Having ascertained this current, the necessary resistance (in ohms) is given by dividing "volts to be dropped" (*i.e.*, the difference between the desired voltage and that to be applied to the last valve) by "current taken" (in amps.).

This will be made clear by taking a typical example. We will assume that, at the required voltage of 120, our first three valves take a total current of 4 milliamps. (0.004 amp.), and that the voltage to be applied to V_4 is 160. "Volts to be dropped" are given by subtracting 120 from 160, so the figures in this case are 40 ÷ 0.004, thus giving 10,000 ohms as the resistance of R, which, incidentally, should be of the wire-wound type. Commercial resistors of about 20,000 ohms intended for use as potential dividers in eliminators are generally suitable, and are quite inexpensive.

The by-pass condenser C_1 is important, and should not be omitted: it may have a value of from 2 to 4 mfd. C_2, which is the conventional shunting capacity across the main H.T. supply, is of little use when this is derived from an accumulator battery, so it is as a rule unnecessary that it should be retained.

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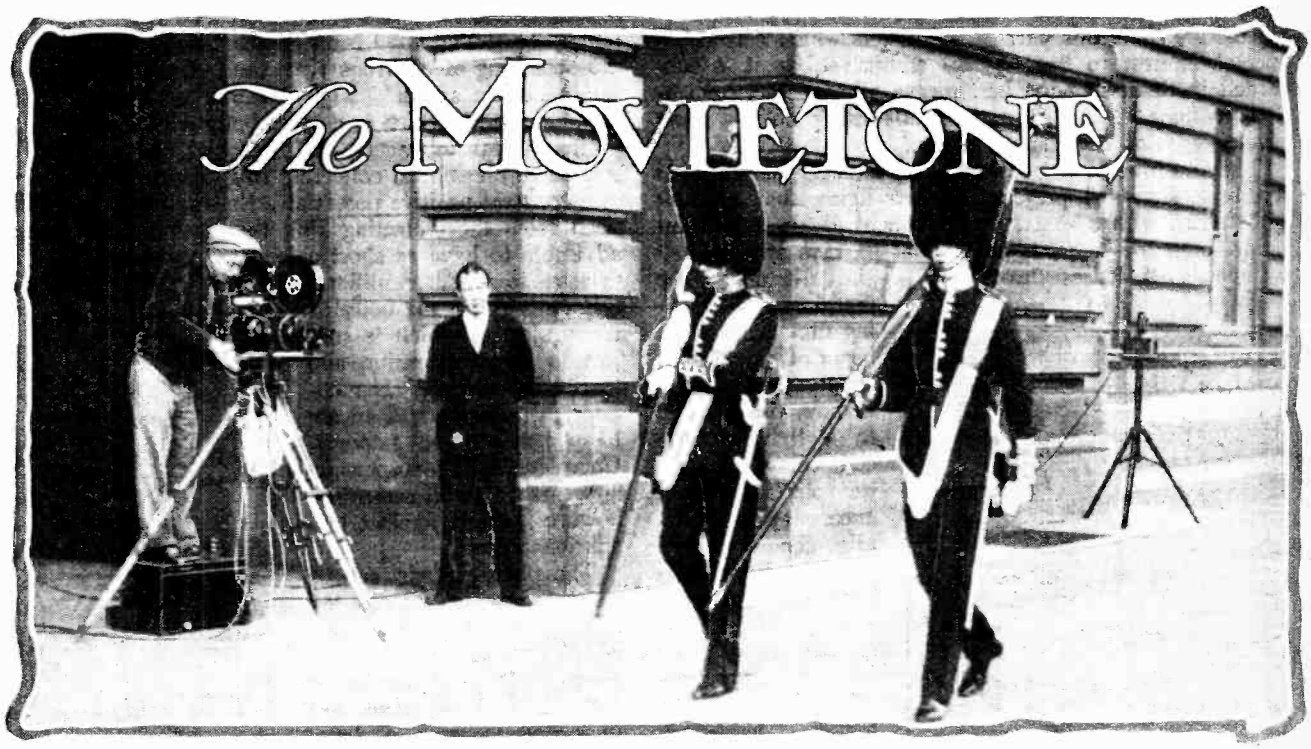
AERIAL LOSSES.

Many a reader has probably at some time or other taken his set, the pride of his heart, to a friend's house just to show him how things should be done. It would be nearly true to say that just as many readers have been disappointed, and that the demonstration was not quite such a success as was anticipated.

The reason is, of course, wrapped up in the subject of aerial losses. The "feel" of any set incorporating reaction on to the aerial will be altered very considerably by an alteration of the size and the efficiency of the aerial to which it is attached. A small aerial will probably require a smaller feedback than the existing arrangements can cope with, with the result that the set cannot be properly tuned owing to persistent oscillation, while an unduly large aerial will probably call for more reaction than can be produced smoothly.

The remedy is to use, for broadcast wavelengths at any rate, the type of circuit to be found in the "Everyman Four," which is not greatly affected by changes in the constants of the aerial. It is not a bad plan, after having neutralised a circuit of this class by "listening through" the H.F. valve with its filament circuit off to make quite sure that it will not oscillate when the valve is relit and the aerial disconnected. It sometimes happens that a set is not truly neutralised and is relying upon the aerial losses to keep it stable. This is bad, and will lead to trouble if it is suddenly decided to use, say, an indoor aerial or a frame aerial for demonstration purposes.



A Highly Developed Talking Film System Giving Remarkably Realistic Reproduction.

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

JUST as the three-electrode valve is being utilised to improve the reproduction from gramophone records, so it would appear to be destined to play a big part in the development of kinematography. No one visiting the New Gallery Kinema, where the Movietone talking film is being shown, can fail to be impressed by the extraordinary advances that have lately been made in fidelity of reproduction and realism of effect, for which due credit must be paid to the Western Electric Company, backed by the research department of the Bell Telephone Laboratories. It needs a keen sense of relative values to appreciate the merits of design of a speech amplifier and series of loud-speakers which can magnify many million times the minutest sound impulses represented by a tiny, flickering beam of light not more than one-thousandth of an inch broad, and deliver them to an audience of, say, 1,500 people with a volume and faithfulness which is practically the same as the original. The synchronisation of realistic speech and music with the film undoubtedly adds a new interest for the cinema-goer, and it would appear safe to predict that in a few years' time most of the larger cinemas will be equipped with apparatus for synchronous sound reproduction.

The Movietone system of talking films involves the photographic recording of sound on a $\frac{1}{10}$in. margin of the standard 1$\frac{3}{8}$in. film, using a standard camera and a standard projector, to which are easily fitted special additional apparatus; simultaneous with the recording of sound the associated scene is photographed on the rest of the film, and when developed and printed as a positive presents an appearance as shown in Fig. 1. There are a number of methods whereby the marginal record of sound is obtained, and readers are referred to an article which has appeared in this journal [1] under the title of "Speaking Films."

Action of the Photo-electric Cell.

In general the sound waves picked up by a microphone are converted into electric pulsations and are passed to a low-frequency valve amplifier and made to actuate an electromagnetic mechanism similar to the movement of a small loud-speaker, which, being between a bright source of light and a narrow slit near the film in the camera, causes the light through the slit to oscillate in sympathy with the original sound waves and so vary the exposure on the edge of the film. The small diaphragm which causes the light to oscillate naturally has mass, and therefore a natural period of vibration, which may fall within the frequencies associated with music and speech, thus giving undue prominence and an unnatural effect to certain notes; reference will be made later to means of neutralising this defect. As an alternative to the above electromagnetic method of recording, it should be mentioned that in some films the sound-track is made by the A.E.O. flashing lamp scheme already described in *The Wireless World*. The sound represented by tiny lines of varying depth and opacity on the film have now to be converted in turn to light fluctuations, electric pulsations, and ordinary sound

[1] *The Wireless World*, January 7th, 1925.

The Movietone.—

waves, and it is this part of the article which may be of special interest to the wireless enthusiast, as it is concerned in discussing the best means of getting a tremendous volume of undistorted signals using no less than seven stages of L.F. amplification.

The first process of creating light fluctuations is achieved within a standard projector by arranging that a small pilot light, with a short, stout filament giving a brilliant point source of light, is set so that its rays are directed by means of lenses through a $\frac{1}{1000}$ in. slit on to the margin of the moving film. The light beam of varying intensity thus formed is now directed on to a light-sensitive cell which changes its electric resistance sympathetically. There are two types of these cells available, namely, selenium and photo-electric. The former has the advantage of developing a higher light-dark current ratio, but suffers from lag, while the latter develops a relatively much smaller current change but is instantaneous in action, and is used in the system under discussion. In order to understand the functioning of the photo-electric cell, light must be considered as an electromagnetic disturbance, and matter as consisting of atoms built up of aggregates of electric charges with positive nuclei surrounded by negatively charged electrons. When an electromagnetic wave falls on an atom of metal, for instance, it is not unreasonable to expect that the equilibrium of opposite charges will be upset, and that electrons will become detached. Actually in practice this is the case, and the effect is found to be most pronounced with electropositive metals such as sodium, potassium, and rubidium. The theory has been put forward that the vision of the human eye is due to the detaching of electrons from the rod and cone cells by photo-electric action. Fig. 2 shows the details of the Movietone cell, which is a glass body with internally deposited metal in vacuo; the detached electrons are attracted to the central collecting ring, which is maintained at a constant positive potential. So small are the oscillations from the collecting ring that it has been thought advisable to have as short a lead as possible to the first three-stage L.F. amplifier, necessitating the housing of this unit within the body of the projector, which is subject to heavy vibration and to the influence of commutator disturbance and an arc lamp passing 100 amperes. Complete spring suspension and earthed metal screening, however, guard against any spurious effects.

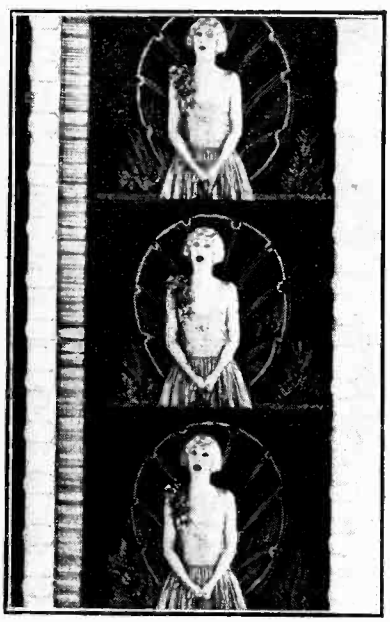


Fig. 1.—A specimen of film on which sound has been photographically recorded on the left-hand side.

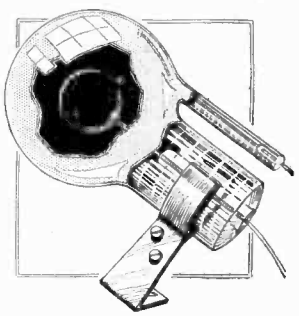


Fig. 2.—Photo-electric cell. Note the collecting ring which is kept at a positive potential. The metallic deposit on the inside of the glass container is earthed.

The photo-electric cell is resistance-capacity coupled to the first valve, the values of the grid and anode resistances being of the order of two or three megohms, but in order to give a large margin of safety with regard to overload, the next two stages contain anode resistances not exceeding 30,000 ohms and grid leaks of the order of $\frac{1}{2}$ megohm. No high-frequency cut-off takes place as in an ordinary wireless receiver using resistance coupling in the first L.F. stage, since the absence of a detector valve avoids the necessity of a shunting condenser. The valves derive their grid bias from the progressive drop in potential produced by having their filaments in series, and by being fed from a 12-volt accumulator; separate grid bias batteries with attendant risk of deterioration and drop in voltage are thus avoided. An output transformer couples this amplifier (shown as A in Fig. 3) to the input transformer of the power amplifier (B in Fig. 3), but the oscillations are first passed to an equaliser and then to a volume control.

Importance of Volume Control.

Reference has already been made to the accentuation of certain frequencies due to the natural period of vibration of the light diaphragm in the camera; this resonance peak

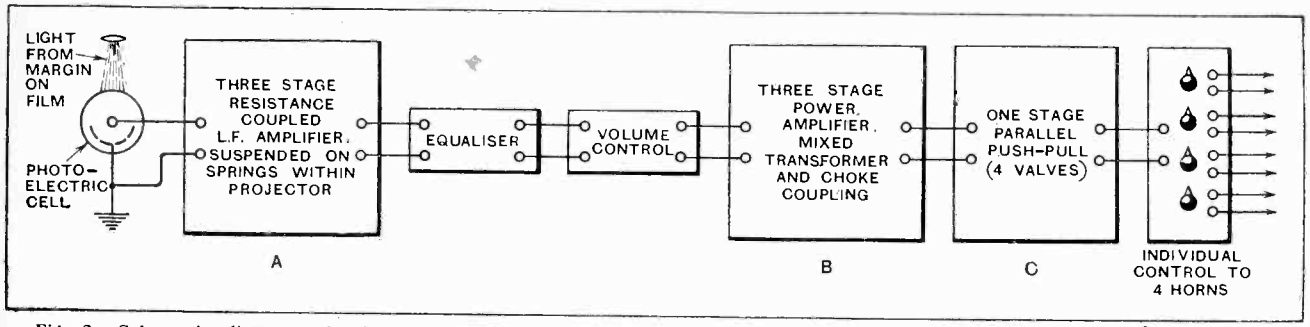


Fig. 3.—Schematic diagram showing successive processes for conversion of light fluctuations to electric oscillations which are amplified by seven L.F. stages.

The Movietone.—

is neutralised by a filter circuit contained within the equaliser.

There are many factors which militate against realistic effect even if the quality of reproduction is perfect. The comparative volume at which each item must be delivered is very important. For instance, the cheering by a crowd at a football match must be presented relatively much louder than a speech by some dignitary; furthermore, it is necessary that the amplifier be short-circuited during periods when there is no sound accompaniment to the film. It is therefore arranged that the volume control or fader (shown in the schematic diagram) is within easy reach of the operator, who alters it according to pre-arranged settings obtained at rehearsals. The design of this control, which is placed between the output and input transformers of amplifiers A and B respectively, is interesting in that it consists of a balanced network of tapped wire-wound resistances so arranged that the amount of attenuation introduced into the circuit may be varied in small steps over a wide range without altering impedance relations.

Amplifier Details.

Further amplification is now obtained by applying the signals to the three-stage amplifier B, which contains an input transformer followed by an orthodox choke-coupled stage, which is again followed by a choke-coupled stage in which an auto-choke is used instead of the usual grid leak. The last valve of this unit is choke-coupled to the push-pull amplifier C. There is evidence that the replacement of the grid leak by a suitable choke in resistance and choke-coupled L.F. circuits is gaining in popularity on both sides of the Atlantic; many examples of amplifiers using this method were to be found both at the Olympia and Manchester exhibitions, the claim being made that the lower D.C. resistance of the choke allows a charge, that may have accumulated on the coupling condenser due to an extra loud passage, to be dissipated more easily. The principle of mixing the types of coupling to create a shift of phase angle, so that the effect of feed-back due to a common resistance in the H.T. battery is nullified, is to be commended. The amplitude of the signals is now such that sufficient grid bias cannot be obtained from using the drop in voltage from valves wired in series and fed from a 12-volt battery; a separate battery therefore is used.

Final amplification is now effected by four power valves in parallel push-pull, the potentialities of which scheme were discussed in detail in the issue of *The Wireless World* dated November 30th, 1927, under the heading of "The Last Stage." About 30 volts grid bias is applied to this stage, showing that it is not anticipated that a grid swing of more than 100 to 120 volts will be applied to the input. It must be inferred, therefore, that each of the valves in the preceding six stages is being worked on a small portion only of the available straight part of the characteristic, thus preventing overload even with extra loud passages.

To create the illusion that speech or music is coming from any point between the top of the special sound-porous screen and the orchestra pit, two loud-speakers are put in each of these positions, as is shown in Fig. 5, so that by distributing the ratio of output to either pair by means of individual controls (shown schematically in Fig. 3) the desired effect is obtained. Careful attention must be paid to the apparent location of sound origin, as was evinced in a demonstration given to the writer of this article of the grotesque effect of making speech come from a man's forehead! In this connection it would appear inadvisable to exhibit close-up pictures of people's faces as subjects for Movietone accompaniment. The design of the loud-speakers is interesting, especially considered in the light of the exceedingly good results obtained; a sketch showing how the 14ft. logarithmic horns are bent round so as to occupy a minimum of space is given in Fig. 7. The movement is of the coil-driven type, wherein a small cone made of duralumin or similar alloy is attached to the speech coil and is contained within the body of the unit. The field coil consumes about 10 watts (7 volts 1½ amperes), and is energised by an accumulator.

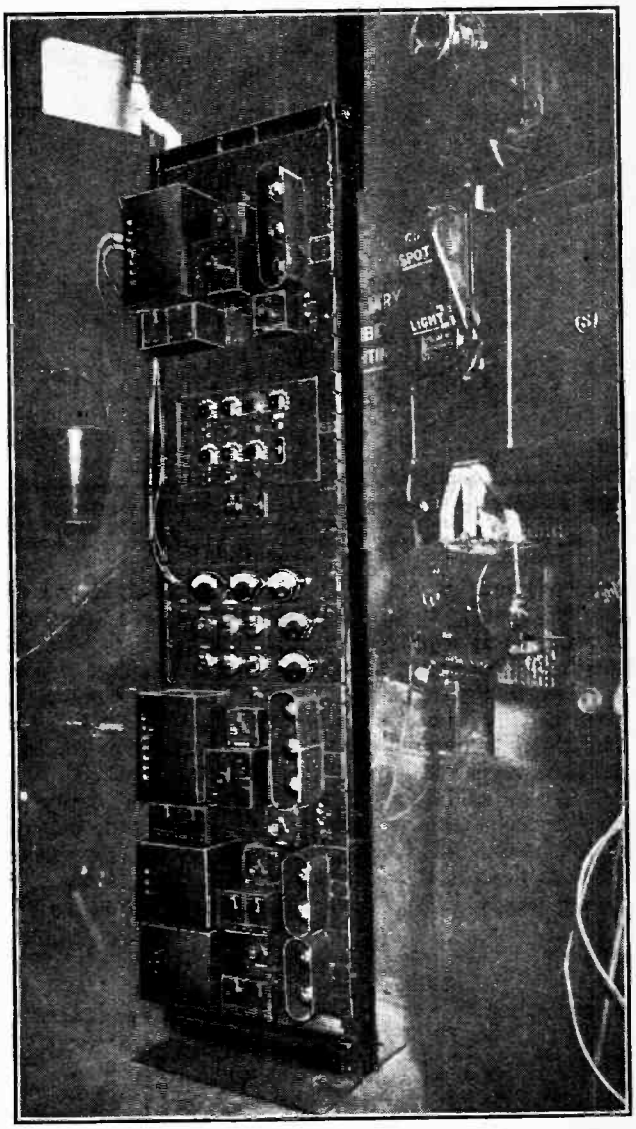


Fig. 4.—The panel in the operator's box. The three valves at the top belong to amplifier B, while the four valves at the bottom are associated with the parallel push-pull stage C. The three valves placed intermediately are spares.

The Movietone.—

That the gap between the speech coil and the pole pieces is about $\frac{1}{32}$in. shows the precision to which the manufacturers have worked in machining each component part. Sketches of the coil-driven unit and the logarithmic horns

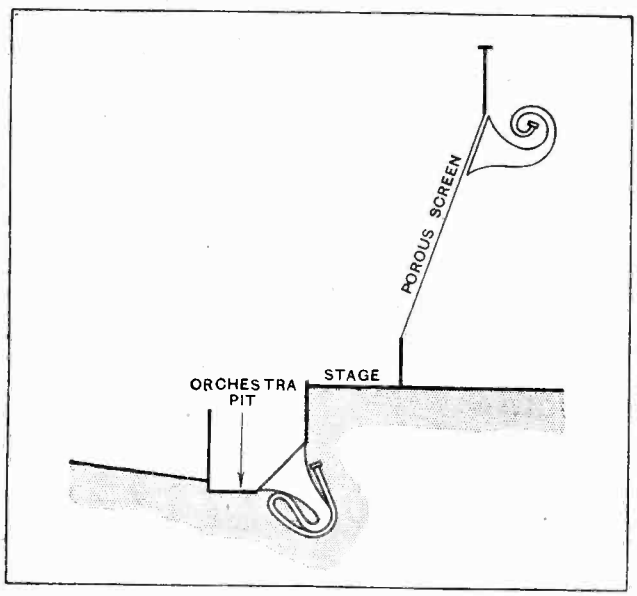


Fig. 5.—Diagram showing the disposition of loud-speakers. By distributing the volume of signals unevenly the sound can be made to appear to emerge from any point between the top of the screen and the orchestra pit.

are shown in Figs. 6 and 7. In setting up four large loud-speakers such as those already described some knowledge of acoustics is required; effects of echo have to be eliminated, and care must be exercised with regard to relative positions of the horns and the angle of their mouths. A peculiar interference effect is produced if the polarity of the field coil in any one loud-speaker is different from the rest; the leads and terminals are therefore marked.

Two sets of H.T. and L.T. accumulators supply the amplifier requirements, arrangements being made that the spare batteries are always on charge. The ordinary motor which is used to drive a standard projector is not sufficiently steady in speed for Movietone reproduction; a special motor is supplied which is automatically controlled by a three-electrode valve regulator. If for any reason the speed of a sound-recording film changes, a sudden alteration in pitch occurs which is very noticeable. The constant speed motor serves the dual purpose of preventing change in pitch and of providing a means of synchronously driving a gramophone turntable for use with records which have been made by the Vitaphone process soon to be exploited in this country. By this method the impulses from a gramophone pick-up are applied to the same amplifiers and loud-speakers as those used with the Movietone, but orchestral music of general appeal can be played as an accompaniment to any suitable film which is not of the sound-recording type.

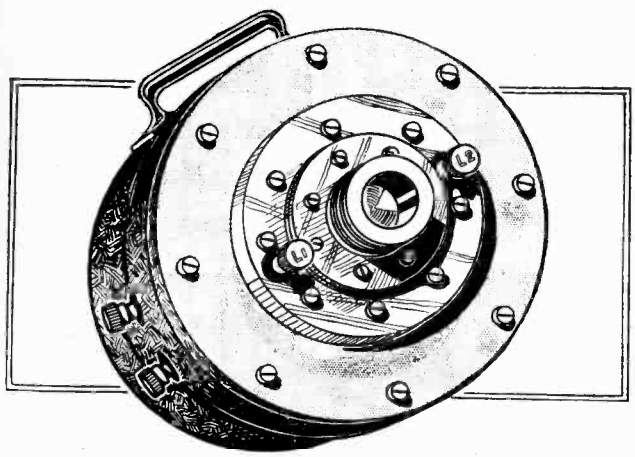


Fig. 6.—The moving coil unit measuring about 6in. × 3in. The gap is about 1/32in. and the field consumption 10 watts.

While it is obvious that it is not within the scope of the wireless amateur to construct replicas of the apparatus described in this article, there are certainly general lessons to be learnt in the distortionless reproduction of

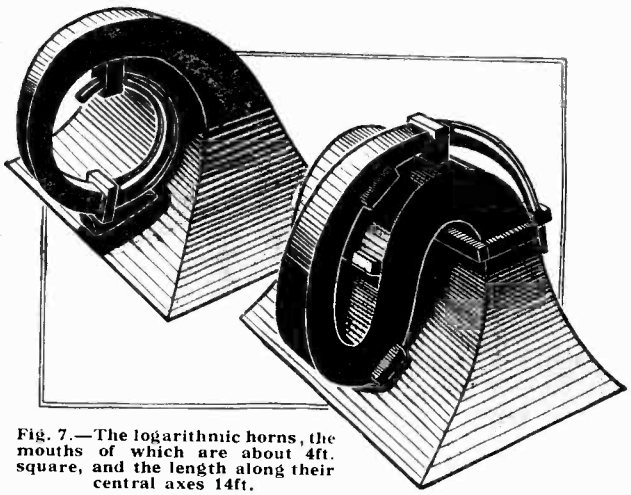


Fig. 7.—The logarithmic horns, the mouths of which are about 4ft. square, and the length along their central axes 14ft.

loud signals. If a number of stages of L.F. amplification be employed in a wireless receiver, it is of importance to mix the types of coupling to minimise L.F. oscillation as has already been explained; furthermore, the potentialities of substituting a low-frequency choke for the usual grid leak in resistance and choke coupling should be tried, as the effect of overloading a valve is likely to be less apparent. The excellent characteristics of the logarithmic horn have been fully described in a constructional article in this journal, dated November 16th, 1927, and those who are keenly interested in faithful reproduction would be well advised to make use of one in conjunction with a well-designed movement, preferably of the balanced armature type.

Movietone equipment is not sold outright, but leased on terms which allow the patentees to withdraw the apparatus if it is operated in a way which is prejudicial to their interests (this idea might sometimes well be applied by wireless set manufacturers!). When the price of the installation is reduced, as will surely occur with increased demand, the effect of its introduction to the country cinema to replace the piano handled by the village belle, will be astonishing. It can now safely be said that synchronised electric reproduction of sound as a substitute for an orchestra is *un fait accompli.*

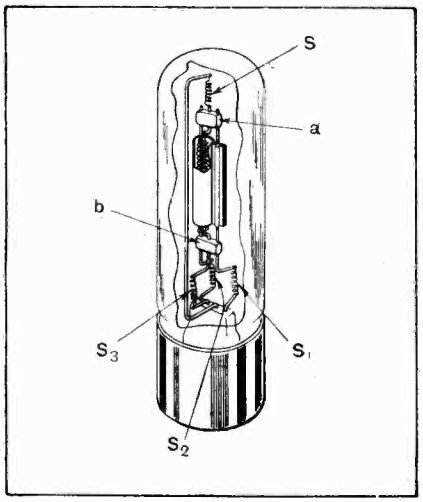
RECENT INVENTIONS

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.

Anti-microphonic Valves. (No. 268,334.)

Convention date (U.S.A.): March 26th, 1926.

Microphonic noise in valve amplifiers is usually caused by a vibratory movement of one or more of the electrodes, creating a momentary change in the space-relation



Valve with internally sprung electrodes. (No. 268,334.)

inside the tube and a corresponding fluctuation in output. In order to prevent this effect the three electrodes are first connected to quartz blocks a, b, so as to form a rigid assembly, and this is then resiliently suspended by a series of springs, S, S_1, S_2, S_3. The natural period of the springs is approximately 20 cycles per second, which is below the range of audibility, so that the effect of any external vibration is not communicated to the telephones or loud-speaker.

Patent issued to British Thomson-Houston Co.

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Short-wave Television. (No. 264,174.)

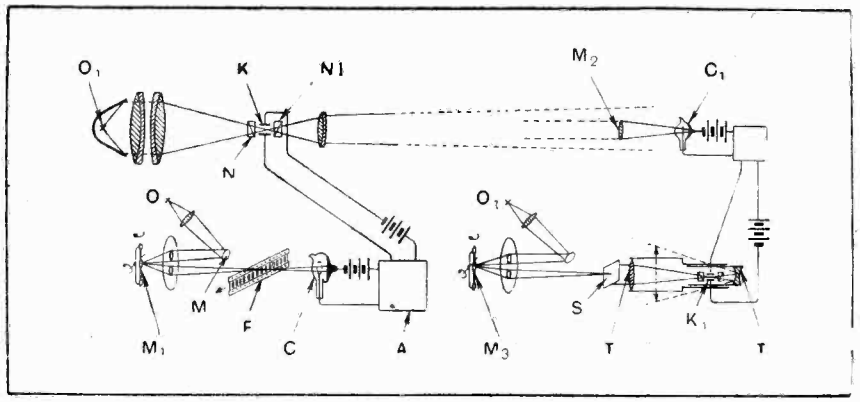
Convention date (Germany): January 8th, 1926.

The light and shade effects of a moving picture, such as a cinema film F, are reproduced upon a screen S, say thirty miles away, by using short-wave radiation having a wavelength lying close to the limits of visibility. The left-hand side of the figure represents the transmitting station and the right-hand side the receiving station. Light from a source O is thrown through a lens on to a convex mirror M from which it passes through a large objective on to an oscillating mirror M_1. The latter rotates simultaneously at, say, five cycles per second about one axis and at 500 cycles per second about an axis at right-angles to the first.

The resultant rays pass through the film F on to an optically sensitive cell C which converts the varying light effects into corresponding current variations. The output, after amplification at A, is applied as voltage variations across a Kerr cell K, filled with nitro-benzol and fitted with the usual analysing prisms N, N_1. A strong ray of light from a source O_1 is simultaneously passed through the cell K, and is thereby subjected to intensity fluctuations according to the voltage impressed across the cell from the amplifier A.

At the distant end, a condensing mirror M_2 picks up the stream of radiation and focuses it upon a sensitive cell C_1, the output from which is amplified and applied across a second Kerr cell K_1, similar to the first. This is situated inside a telescopic system of lenses T, T_1, through which the projected image is viewed upon the screen S. The screen is illumined from a local source of light O_1, the beam being projected through a system of lenses and a doubly-oscillating mirror M_3. The movements of the mirror M_3 are exactly synchronised with those of the mirror M_1 so as to ensure a clear reproduction of the transmitted image.

Patent issued to the Telefunken Co.



Telefunken short-wave television system. (No. 264,174.)

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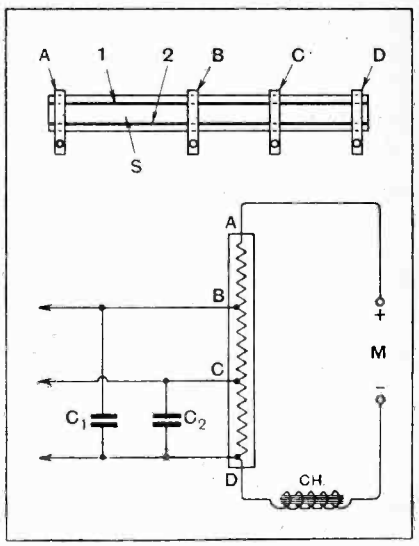
High Tension from the Mains.

Application date: September 6th, 1926.

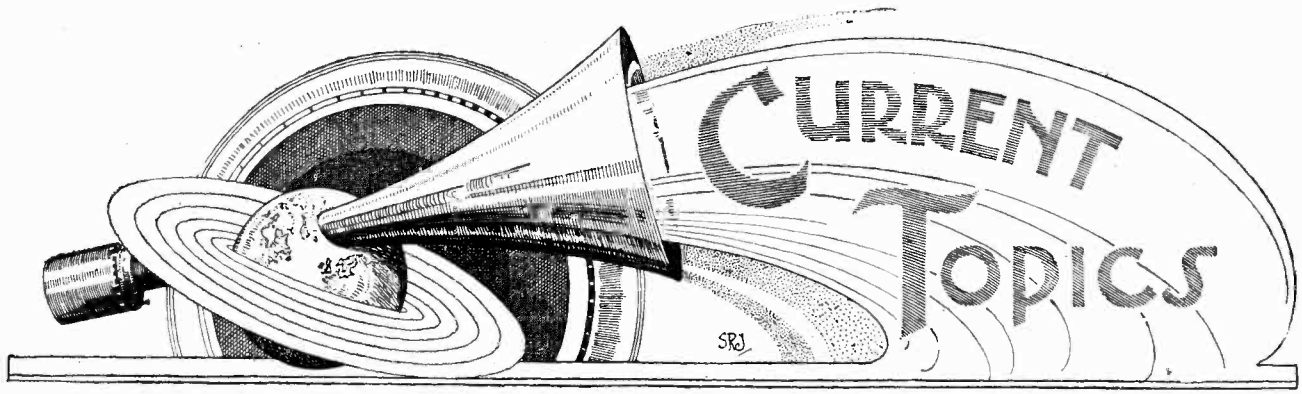
An economical form of potentiometer resistance, or voltage divider, consists of a series of graphite lines 1, 2 drawn on



Graphite line potentiometer (No. 277,168.)

one or both sides of a suitable insulating strip S. Ten such lines arranged in parallel are sufficient to give a supply of 10 milliamps. To avoid over-heating, each of the lines may be drawn on separate strips, the latter being spaced apart to allow of air circulation. Contact clips A, B, C, D are clamped across the lines to give variable tappings. The lower diagram shows the circuit arrangement, with shunt condensers C_1, C_2 inserted across the tapping points and a choke C H placed either in the negative lead as shown, or in the positive, or in both leads.

Patent issued to S. E. Grand.



Events of the Week in Brief Review.

AMONG THE PIRATES.

That the Wireless Act is no respecter of persons or professions becomes increasingly obvious as the days roll by. Last week's offenders included a coal merchant's manager and a registrar of births and marriages.

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THE GREAT SHUT-DOWN.

The ultimate elimination of 300 American broadcasting stations is promised by Mr. Pickard, chairman of the U.S. Federal Radio Commission, who states that the radio channels can be cleared only by this means. Plans for the great shut-down will be begun shortly.

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POLICE WIRELESS IN BUDAPEST.

Criminals have never taken very kindly to wireless, which has always been of greater service to those who have no secrets to conceal. So the criminals of Budapest will learn with little pleasure that the local Prefecture of Police has decided to install at headquarters transmitting and receiving apparatus for dealing with pictures by wire and wireless. Smaller sets are to be provided for the various district stations.

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POLISH STATION SEEKS BRITISH REPORTS.

One of the earliest Sunday broadcasts is that from the Posen station, which regularly begins its Sunday transmission at 9.15 a.m. (G.M.T.). The week-day programmes begin at 11.45 a.m. and go on until 11 p.m. The transmissions are on 344.8 metres with a power of 1.5 kilowatts, and the station directors issue a special request for reports from British listeners.

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BIDS BY ATLANTIC TELEPHONE.

The transatlantic telephone service participated in an auction sale at Sotheby's one day last week when Dr. Rosenbach, speaking from his bedroom in New York, gave telephonic instructions to his agent to bid for certain rare books. The call, which came through five minutes before the sale began, enabled Dr. Rosenbach to secure one of the two desired volumes. In the case of the other he was outbidden, but that was no fault of the transatlantic telephone!

RADIOMAR KHAYYAM.

"A Super-heterodyne beneath the Bough,
A Loaf of Caviare, a Jug of Champagne, and Thou."
—*Harper's Magazine*, New York.

Query: Given the first item, would one have much time for the others?

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APPROPRIATE GIFTS.

Mr. Lloyd-George and his daughter have given wireless sets to the North Wales Blind School at Rhyl.

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ONE OVER THE B.B.C.

Broadcast lessons in flying form an attractive item in the programmes of KOA, Denver, Col. Students are recommended to set a broomstick between their knees to represent a joystick and to sit "with perhaps electric fans blowing wind in their faces." An electric fan is undoubtedly a valuable restorative.

OLDEST WIRELESS JOURNAL.

The wireless Press of the world is to be represented in a special section in the International Press Exhibition at Cologne next May.

In the list of journals to be represented, *The Wireless World* stands out as the only pre-war wireless organ, having been founded in 1913! Altogether more than 330 wireless periodicals are mentioned.

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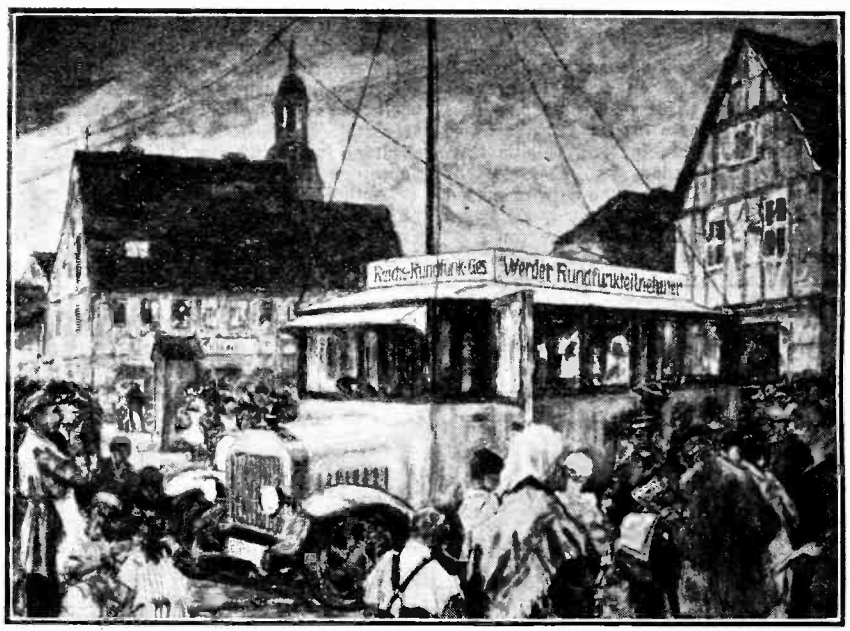
POST OFFICE ABANDONING SPARK.

The Post Office has taken a significant step in the direction of abolishing spark transmission by equipping the Grimsby coast station, known as Humber Radio, with interrupted continuous wave valve equipment in place of the existing spark apparatus. The station has been transferred to Mablethorpe, Lincolnshire, but its name will remain unaltered.

The station is also equipped with direction-finding apparatus, which will



BRINGING WIRELESS TO THE PEASANT.—A reproduction of a wash drawing showing the new broadcasting car of the German "Reichs-rundfunk" Society giving a demonstration in a small country town. The interior of the car is fitted with crystal and valve receivers, while the Reisz loud-speaker, seen at the rear, soon draws a curious crowd. It is hoped to introduce a set into every home.

be brought into use as soon as the apparatus is calibrated. Telephonic communication with ships equipped with radio telephony is being arranged for as quickly as possible.

It is interesting to note that the Post Office, in an official statement, says that the new step has been taken in pursuance of its general policy to abolish spark communication at all its coast stations. Valve transmission has already been introduced at the Seaforth wireless station with considerable advantage to broadcast listeners.

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SHORT-WAVE TO FRENCH COLONIES.

A short-wave wireless service has been opened between Paris and Hanoi (French Indo-China). This will assist the relaying of messages from France to the most distant colonies *via* French Indo-China.

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SPORT, WIRELESS, AND TRAVEL.

A combined Sport, Wireless, and Travel Exhibition is to be held at Bandoeng, Java, during June and July, 1928. The introduction of the wireless element is due to the wireless boom which is now sweeping the country, consequent upon the recent law permitting private ownership of receiving sets. Popular enthusiasm has also been fanned into flame by the two-way telephony conversations between Java and Holland.

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WIRELESS AND THE MEN OF ST. DUNSTAN'S.

The transformation which wireless can bring about in the lives of the blind is touchingly shown in the twelfth annual report just issued by the executive council of St. Dunstan's. One blinded ex-Service man who had been presented with a wireless set wrote: "A machine like the one you have sent me practically puts me on a level with people who have their sight, as what I don't see I can imagine." Another's tribute ran: "I greatly appreciate being able to . . . 'listen-in.' One feels more in touch with the world in general."

Full accounts and balance-sheets accompany the report, a copy of which may be had by application to St. Dunstan's Headquarters, Inner Circle, Regent's Park, London, N.W.1.

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FLYING ABOVE THE FOG.

The degree to which the Marconi wireless apparatus used on Imperial Airways machines flying between Croydon and the Continent is relied upon is shown by the experience of Captain A. S. Wilcockson, an Imperial Airways pilot who, on Saturday, November 26th, flew a Handley Page Rolls-Royce aeroplane from Paris to Croydon above a fog bank which obscured the ground practically the whole of the way. In spite of the denseness of the fog Captain Wilcockson completed his journey in 2 hours 26 minutes, which is a good average time for the trip from Paris to London.

Five minutes after leaving Paris Captain Wilcockson found himself in dense fog and had to rise 2,000ft. to get above it. At this height the aeroplane was flying in bright sunshine, and continued to do so for the greater part of the journey. It was, however, necessary to fly entirely by compass bearing. The pilot asked for several bearings and positions from Croydon during the journey, and these brought him in on a direct line to the Croydon Aerodrome. There was one break in the fog, about ten miles from Croydon, which enabled the pilot to recognise the ground and corroborate the fact that he was on the right bearing. The fog then closed in again and, in his own words, he "dropped right on to the aerodrome."

In an interview Captain Wilcockson said: "I had no difficulty at all in keeping in communication with Croydon at any time whether I was in the fog, above it, or when coming down to the aerodrome, but it would have been impossible to have made the journey without wireless. I was using the ordinary A.D.6 apparatus."

FORTHCOMING EVENTS.

WEDNESDAY, DECEMBER 14th.

Radio Society of Great Britain.—Annual General Meeting. At 6 p.m. (tea at 5.30). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "Some Applications of Condensers," by Mr. Philip R. Coursey, B.Sc., F.Inst.P.

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove, N.17. Lecture: "Low Frequency Transformers," by Mr. Middleton, of Messrs. Ferranti, Ltd.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Lecture by Mr. H. L. Kirke, of the B.B.C.

THURSDAY, DECEMBER 15th.

Stretford and District Radio Society.—At 8 p.m. At 6a, Derbyshire Lane. Annual Dinner.

Leyton and Leytonstone Radio Society.—At 8 p.m. At "Haydn House," Fairlop Road, E.11. General Debate on Grid versus Anode Bend Detection.

FRIDAY, DECEMBER 16th.

Radio Experimental Society of Manchester.—Lecture by Mr. Heywood.

South Manchester Radio Society.—At the Co-operative Hall, Wilmslow Road, Didsbury. Lecture and Demonstration on Low Frequency Amplification, by Mr. A. Hall, Chief Radio Engineer of Messrs. Ferranti, Ltd.

Leeds Radio Society.—At the University. Lecture by the Mullard Valve Co.

MONDAY, DECEMBER 19th.

Southport and District Radio Society.—At St. John Hall, Scarisbrick Street. Club Night.

Croydon Wireless and Physical Society.—At 5, Altyre Road, East Croydon. Talk on Sir Oliver Lodge's "N" Circuit, by Mr. M. M. Melinsky.

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TIME SIGNALS FROM RUGBY.

Amateurs who can tune up to the wavelength of 18,740 metres (C.W.) used by the Rugby station may be interested to know that a twice daily service of time signals has been inaugurated, the transmissions being given 10 a.m. and 6 p.m. (G.M.T.). The time signal is of the modified rhythm type recommended by the International Time Commission of 1925 and comprises 306 dots and dashes emitted in 300 seconds, the concluding dash being the exact hour.

The procedure is as follows:—1st signal: A dash followed by 60 dots at 55m. 00s. 2nd signal: A dash followed by 60 dots at 56m. 00s., and so on until the 306th signal—a dash, given at 00m. 00s.

The type of time signal has been designed to enable chronometer comparisons of extreme accuracy to be obtained.

WIRELESS FROM WESTMINSTER.

(FROM OUR PARLIAMENTARY CORRESPONDENT.)

The Cost of Rugby Wireless Station.

The cost of working the Rugby wireless station came up for consideration in the House of Commons last week.

In reply to Mr. O. Nicholson, Sir William Mitchell-Thomson (Postmaster-General) stated that the total capital cost up to March 31st last of the Rugby station, including site, buildings, and telegraph and telephone plant, was approximately £490,000. The telegraph services conducted at the station were only in an early stage of development and the telephone services had not yet been running for a complete year. It was therefore difficult to give accurate figures or to draw deductions from estimates. With that reservation, he estimated the present annual expenditure, including interest, depreciation, and amortisation of capital, at about £123,000, and the annual revenue at about £57,000.

TRADE NOTES.

D.P. Batteries.

Messrs. Wingrove and Rogers, Ltd., who recently acquired the broadcasting business of Radio Communications, Ltd., have now become the sole concessionaires for wireless batteries for the D.P. Battery Co., Ltd., of Bakewell, Derbyshire.

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Change of Address.

Owing to the increased demand for their "Simplicon" 4L ball gear variable condensers, Messrs. Williams and Moffat, Ltd., of Birmingham, have found it necessary to transfer their Small Heath business to Ladypool Road, Sparkbrook, Birmingham, to which address all future communications should be sent.

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Making a Tantalum Rectifier.

A blue print, giving a complete layout with constructional details, of a Tantalum rectifier suitable for charging H.T. accumulators without the use of a transformer, has been prepared by Messrs. Blackwell's Metallurgical Works, Ltd., The Albany, Liverpool. Copies can be obtained, price 1s. each, on application to the company.

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The B.T.H. Loud-speaker R.K. Model.

A singularly attractive brochure has been produced by the British Thomson-Houston Co., Ltd., Crown House, Aldwych, W.C.2, describing with coloured illustrations the B.T.H. Model RK Loud-speaker, as invented by Chester Rice and Edward Kellogg. This instrument is admittedly one of the finest electrical reproducers in existence. Reasons are given why this loud-speaker so nearly approaches perfection, and an invitation to hear it is offered to all radio enthusiasts and lovers of good music who care to ask for a demonstration either by their local radio dealer or at any of the B.T.H. showrooms.

CLUB REPORTS AND TOPICS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Measurements with a Buzzer Wavemeter.

Of interest to the ordinary experimenter, if not to the serious research worker, was a lecture on how to obtain measurements with a simple buzzer wavemeter, given by Mr. A. K. Bentley at a meeting of the Radio Experimental Society of Manchester on December 2nd. In a practical demonstration the lecturer showed that fairly accurate results could be obtained.

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

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The Short-wave Position.

In a lecture on "Recent Developments in Short-wave Broadcasting and its Reception," Mr. B. J. Axten recently gave members of the Croydon Wireless and Physical Society a complete *résumé* of the present position relating to work on the short waves.

Visitors are always welcome to the meetings of the society, particulars of which may be obtained from the hon. secretary, Mr. H. T. P. Gee, Staple House, 51 and 52, Chancery Lane, London, W.C.2

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"The Tickler."

The above is the title of the bright little magazine which constitutes the official organ of the Stretford and District Radio Society. The December issue—a double number—includes an interesting contribution on "Recent Developments in Radio Reception," by Mr. K. Alford, of the Igranic Co. Other contributors are the "Listener-in," "The Wanderer," and "The Jester," and each has something interesting to say.

Other societies would be well advised to consider the advantages attaching to the preparation of an official organ which provides a valuable stimulant to the club's activity.

Hon. Secretary, Mr. W. Hardingham, 21, Burleigh Road, Stretford, Manchester.

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An Interesting Receiver.

Mr. H. F. Smith, a frequent contributor to *The Wireless World*, provided an interesting lecture and demonstration at the last meeting of the Muswell Hill and District Radio Society. The lecturer drew an ideal circuit on the board with anode bend detection and resistance coupling with a transformer in the last stage, while the H.F. stage was coupled by the well-known "Everyman" transformer. A subsequent demonstration revealed great amplification, the more remarkable considering that only a temporary aerial was used.

Hon. Secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

Rice-Kellogg Loud-speaker Demonstration.

Members of the Ministry of Agriculture and Fisheries Radio Club benefited on November 18th by an interesting demonstration of the B.T.H. Rice-Kellogg loud-speaker, which reproduced the first part of the B.B.C. National Concert relayed from the People's Palace. Tone and volume were well-nigh perfect, and at times the audience of over 100 could easily imagine that the concert was actually being played in the hall.

Hon. Secretary, Mr. C. T. Stock, 10, Whitehall Place, London, S.W.1.

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A Cheap Short-wave Set.

Members' discussion night at the Wembley Wireless Society on November 25th disclosed some interesting novelties, including a one-valve short-wave set, capable of receiving KDKA, constructed by a member at a cost of slightly under £2. A profitable discussion on high tension battery eliminators completed an interesting evening.

All communications should be addressed to the Hon. Treasurer, Mr. H. E. Comben, B.Sc., 24, Park Lane, Wembley, Middlesex.

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Members' Discussion Found Valuable.

The Newcastle-upon-Tyne Radio Society is finding one of the most popular evenings on the syllabus is the Open Night, when discussions and questions fill the agenda. It has been decided to have an Open Night at every other meeting. Visitors and prospective members are very welcome at the meetings held on Monday evenings at 7.30 o'clock at the Y.M.C.A.

Hon. Secretary, Mr. William W. Pope, 7, Kimberley Gardens, Jesmond, Newcastle-on-Tyne.

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Loud-speakers in Parallel.

Mr. H. H. Carr, secretary of the Ilford and District Radio Society, gave a demonstration on November 24th of a three-valve R.C. receiver, obtaining both H.T. and L.T. direct from the D.C. mains, in accordance with a design published in *The Wireless World*. The instrument, which gave good results, was used in conjunction with two cone loud-speakers in parallel worked off two Bullphone reed units. These units were not of equal resistance, and it could be noticed that one handled the high frequencies, but the other gave prominence to the lower ones, the *ensemble* having a pleasing effect.

Hon. Secretary, Mr. H. H. Carr, 39, Lynford Gardens, Goodmayes, Essex.

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Annual Meeting of R.S.G.B.

The annual general meeting of the Incorporated Radio Society of Great Britain will be held this evening, Wednesday, at 6 o'clock (preceded by tea at 5.30), at the Institute of Electrical Engineers, Savoy Place, W.C.2. Mr. P. R. Coursey, B.Sc., F.Inst.P., will deliver a lecture on "Some Applications of Condensers."

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Marconiphone Public Address System.

Mr. F. Youle, of the Marconiphone Co., Ltd., gave an interesting description of the Marconiphone public address system in a lecture before the South Croydon and District Radio Society on November 30th. Following the lecture Mr. Youle gave a demonstration from the company's van.

Hon. Secretary, Mr. E. L. Cumbers, 14, Campden Road, S. Croydon.

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Irish Radio Transmitters' Society.

The Annual General Meeting of the Irish Radio Transmitters' Society was held at 5, Leinster Street, Dublin, on November 16th, when Col. M. J. C. Dennis, C.B.E., was elected president for the ensuing year. Vice-presidents are Messrs. F. R. Neill (Gi5NJ), and J. P. Campbell (Gw14B). Several other appointments were made, Mr. Denis G. Kennedy (Gw14C), 21, Morehampton Road, Dublin, being elected hon. secretary.

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Mains Wireless.

Members of the Southend and District Radio Society recently profited by an interesting lecture by Mr. A. W. Knight on how to use the electric mains to the best advantage for wireless purposes. The lecturer showed by diagram the cause of fluctuating voltages and demonstrated a mains set to prove that it was a practical proposition to use the mains in place of all batteries.

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

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Portable Transmitter and Receiver.

A combined portable transmitter and receiver was successfully demonstrated by Mr. Brooks-King at a recent meeting of the Torbay Radio Society, Belgrave Rd., Torquay. Two-way transmission and reception was successfully accomplished on 90 metres on a power of approximately 2½ watts with a Portland amateur station, signals being received at both places at about strength R5.

Hon. Secretary, Mr. G. E. Geeson, "Omar," Main Avenue, Torquay.

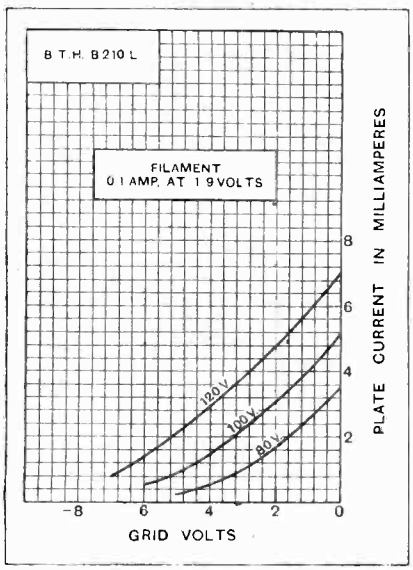
VALVES WE HAVE TESTED

New B.T.H. Nickel-filament Valves and a Low Radion.

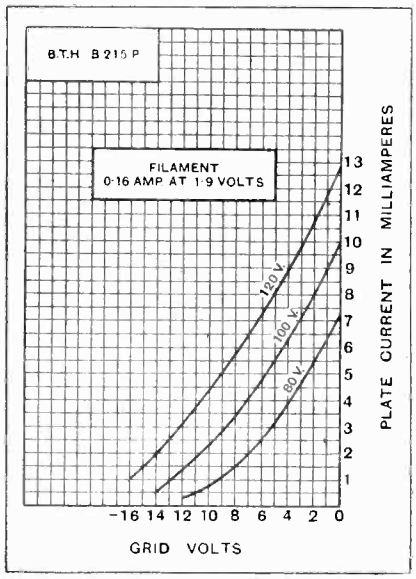
B.T.H. B210L.

THIS valve is a general-purpose valve in the two-volt class, and is a good example of such a valve. The figures obtained on test were as follows: amplification factor, 10.8; A.C. resistance, 13,000 ohms at 100-120 volts on the plate and -3 volts on the grid, giving a mutual conductance of 0.84 milliamp. per volt.

This valve is suitable for detection and for first stage L.F. amplification. The approximate grid bias values required when the valve is used as an amplifier are as follows:—



B.T.H.	B210L.
H.T. (Volts).	Grid Bias (Volts).
80	—1.5
100	—3.0
120	—4.5

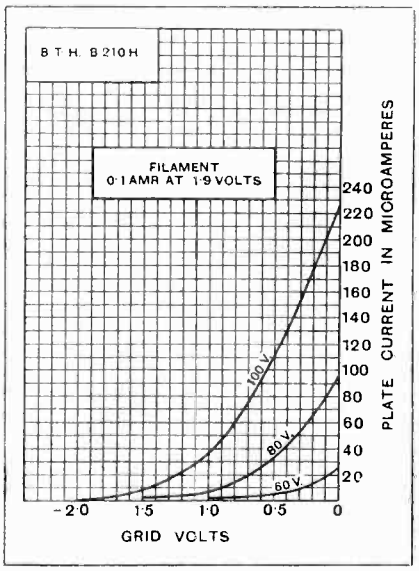


The amplification factor on test was found to be a little lower than the stated figure of 13, and the reverse grid current at 120 volts on the plate and approximately -0.6 volt on the grid was 0.3 microamp., indicating a very slight trace of gas, which, however, is probably not serious if it does not increase—*i.e.*, if it is not due to leakage and if the valve is not run on very high H.T.

A typical B.T.H. valve of the series tested.

B.T.H. B215P.

This valve is a 2-volt power valve for L.F. amplification, giving outputs suitable for driving a small loud-speaker.



Both the amplification factor and mutual conductance as found by test differed considerably from the stated figures of 7 and 1 milliamp. per volt, the actual figures found being: amplification factor, 5.5; A.C. resistance, 8,400 ohms at 100-120 volts on the plate and $-7\frac{1}{2}$ volts on the grid, giving a mutual conductance of 0.656 milliamp. per volt.

Valves we have Tested.—

These last figures are the actual working figures for the resistance and mutual conductance, the values of grid bias required for various H.T. voltages being given below :—

B.T.H.	B215P.
H.T. (Volts).	Grid Bias (Volts).
80	—4.5
100	—7.5
120	—9.0

The reverse grid current in the valve tested was rather large—being 1.1 microamps. at 120 volts on the plate — thus indicating a larger amount of gas than is desirable.

This figure was obtained after the valve had been running for some time to allow for as much to clean up as possible. The initial reading was approximately 4 microamperes.

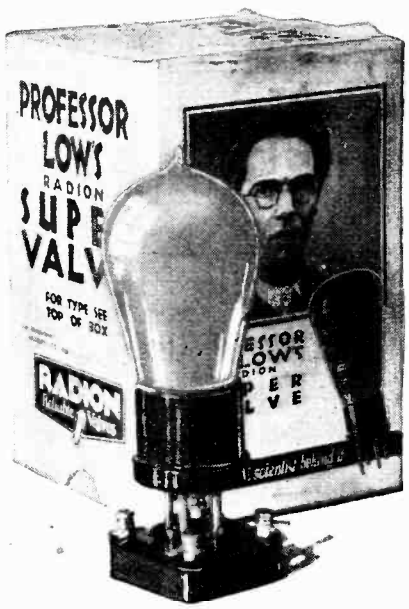
B.T.H. B210H.

This valve is one of the high-amplification type in the two-volt range for resistance-capacity or neutralised H.F. amplification.

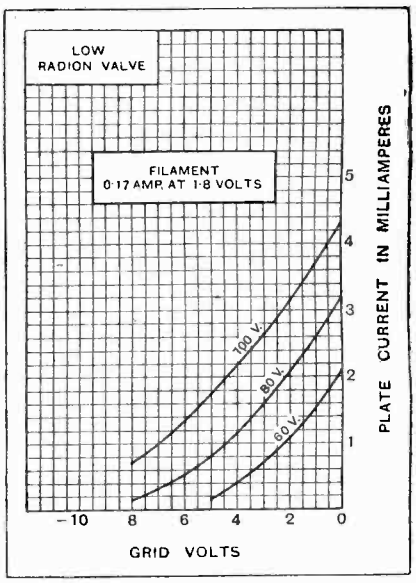
The figures found for this valve on test were : Amplification factor, 35; A.C. resistance at 80-100 volts on the plate and —0.5 volt on the grid is 250,000 ohms, giving a mutual conductance of 0.14 milliamp. per volt. This is quite a good valve of this type, with a 2-volt 0.1 amp. filament.

Low Radion Valve. Type 2v. 0.15, L.F.

This is a general-purpose valve in the 2-volt class with an amplification factor of 8.7; A.C. resistance, 19,600 ohms at 80-100 volts on the plate and — 4 volts on the grid, giving a mutual conductance of 0.444 milliamp. per volt.



The Low Radion valve.



These last two figures are not very good, but the valve appears to be quite well made, and should give good results as an L.F. amplifier or detector. The reverse grid current was found to be less than 0.05 microamp., thus indicating that the valve is dead hard—a good point.

It is quite a novel idea to put the characteristics on the bulb, but the transfer is likely to wear off if the valve is handled much.

Book Review.

Navigational Wireless.

Direction finding cannot be called a popular branch of wireless telegraphy, but no one will question its importance, and we welcome an addition to the small number of books devoted to the subject. Dr. S. H. Long, in his "Navigational Wireless," recently published by Messrs. Chapman and Hall, sets out to deal chiefly with the rotating frame system and in particular with its application to direction finding at sea. Of the 160 pages of text, about 90 are devoted to the principles and systems of direction finding and to the installation and calibration of the gear; about 30 pages to electrical principles and valves, and a large proportion of the remainder to maps and navigation, one of the objects of the author being to encourage both the wireless operator and the navigating officer to learn something of the other's duties with a view to improving the efficiency of wireless navigation. There are also sections on night effect and other errors, on beacon transmitters, and sound signalling.

In reading the book we met with a few points with which we do not altogether agree, and several mistakes have been allowed to slip through as is almost inevitable with a first edition. The book will, however, appeal to all who are concerned with direction finding work, and will be of particular value to users of the Siemens Marine Direction Finder.

Navigational Wireless, by S. H. Long, D.Sc., M.I.E.E., published by Chapman and Hall, Ltd., London. 12s. 6d. net.

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Books Received.

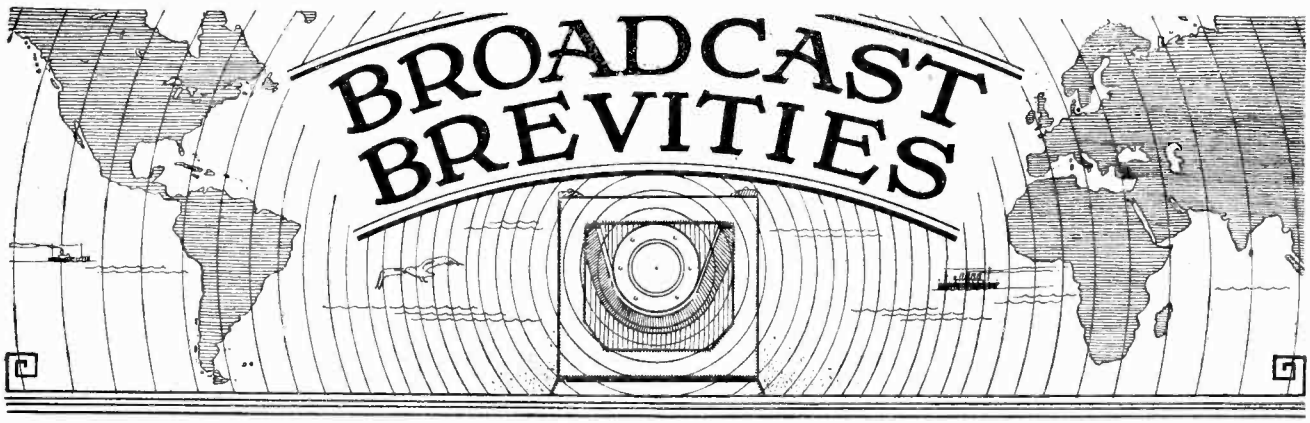
Lefax Radio Handbook, compiled by Dr. J. H. Dellinger, of the Radio Laboratory, U.S. Bureau of Standards, comprising Introductory Notes, Fundamental Principles, Elements of Receiving and Transmitting Apparatus, Operation of Receiving Sets, Aerials, Tables and Useful Data and Index; neatly bound in loose-leaf folder. Published by Lefax, Inc., Philadelphia, Pa., price $35.0, or with one year's supplements, $7.50.

Principles of Radio Communication, 2nd edition, thoroughly revised, by John H. Morecroft, assisted by A. Pinto and W. A. Curry. Pp. 1,001, with frontispiece and over 800 illustrations and diagrams. Published by John Wiley and Sons, Inc., New York, and Chapman and Hall, Ltd., London. Price 37s. 6d. net.

Pioneers of Wireless, by Ellison Hawks, F.R.A.S., from William Gilbert (1540-1603) to the present time. Pp. 297, with 24 plates and 45 diagrams. Published by Methuen and Co., Ltd., London. Price 12s. 6d. net.

Co-operative Measurements of Radio Fading in 1925, by J. H. Dellinger, C. B. Joliffe, and T. Parkinson (being No. 561 of Scientific Papers of the Bureau of Standards). Pp. 30, with 19 illustrations and diagrams. Published by The Department of Commerce, Bureau of Standards, Washington D.C. Price 15 cents.

Wireless Direction Finding and Directional Reception (Second and Enlarged Edition), by R. Keen, B.Eng., A.M.I.E.E. Pp. 490, with 329 illustrations and diagrams, and with 18 pages of bibliographical references. Published by Iliffe and Sons Ltd., London. Price 21s. net.



By Our Special Correspondent.

A Case for Oscillation.—The October Licence Problem.—Future of 2LO.—Watch 5GB! Broadcast Play Experiment.—Inter-studio Jamming.

The Howlers.

None of the measures now being taken appears to have alleviated the oscillation nuisance, and complaints are pouring into Savoy Hill to the tune of over two hundred per week. Each of these protests takes the form of a round robin signed by at least six sufferers. Add to these the number of cases which are not reported owing to laziness or general disgust, and we can form some notion of the amount of unskilled knob-twisting which goes on nightly.

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Is there "Justifiable Oscillation"?

A strong case for what he terms "righteous oscillation" has been made out by a friend of mine, who contends that justifiable oscillation should receive the same clemency as is meted out to justifiable homicide.

"If my neighbour is oscillating," he says, "I feel I have a moral right to draw his attention to the fact by a few crisp 'howls' on my own account. More often than not he takes the tip, and we have peace for the rest of the evening."

Perhaps he is right, but I cannot help thinking that if everybody in the neighbourhood acted accordingly when the first whistle started the ensuing state of affairs would be worse than the first!

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A Poser.

Here's a pretty problem. During what month in the year should one expect to see the largest increase in the number of receiving licences? Certainly not June or July, but if October were mentioned most people would agree, I think, that the tenth month stood a good chance, as it marks the beginning of the indoor season.

It is rather astonishing, therefore, to find October yielding the smallest increase this year, viz., only 4,447, as compared with increases of 17,000 in September, 9,000 in August, and 7,000 in July.

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The Annual Drop.

Looking back one finds that October, 1926, registered an even bigger drop in the licence curve, there being actually a decrease in the army of licensed listeners during that month, which compared unfavourably with every other month in the same year. It is true that in 1925 October showed an astonishing jump of 47,000 licences, but in 1924 it was October again which produced the most unfavourable figures.

So that is the problem. What is the explanation?

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A Human Solution?

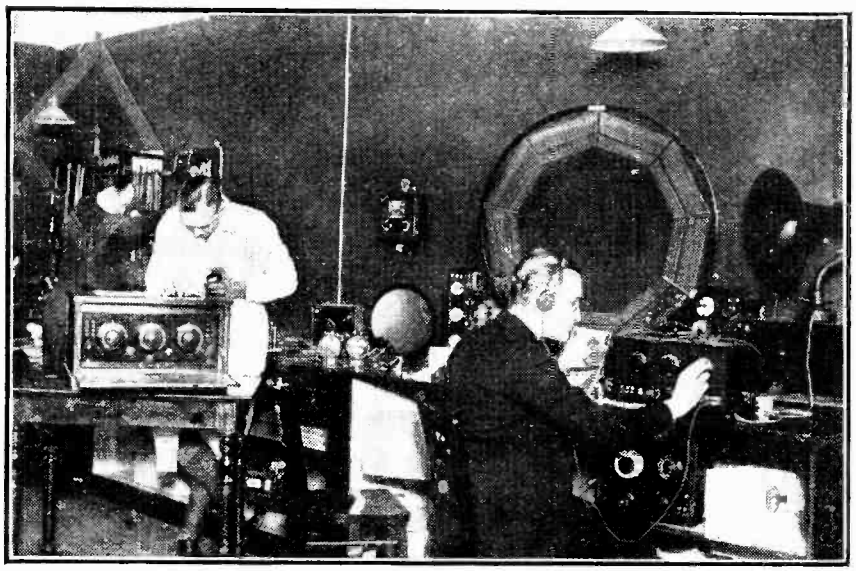
It seems to me that the only solution must lie in the fact that many licences date from October, their owners having first taken out a licence at the beginning of the "boom" winter of 1925. The very human trait of neglecting to renew the expired licence *immediately* may thus explain the hiatus in every succeeding October.

Is this assumption right?

Utopian Reflections.

We are certainly nowhere near the licence "saturation point," which I am inclined to place in the neighbourhood of four million. Nor shall we reach that figure until that Utopian age when every part of the country can count upon an uninterrupted service. When will that be? When pigs have wings?

Disregarding the last contingency, we may be certain, nevertheless, that at least one part of the country—the South Coast—will be a thorn in the flesh of the broadcasting authorities so long as ships continue to use spark. The best of regional stations can hardly hope to combat the Morse nuisance effectively and if, as I have been told, the southernmost regional station were to find its feet as far north as Potters Bar, the lot of South Coast listeners would be no better than it is to-day.



QUELLING THE GERMAN OSCILLATOR. A corner of a wireless laboratory just opened in the offices of a Berlin newspaper. We are informed that the inaugural ceremony was performed by President Wagner of the "Institute of Non-Oscillation"! The laboratory is to be used for demonstrations in listening without oscillating.

Will 2LO Remain?

It seems fairly probable that the London regional station will be proceeded with first, or at any rate at the same time as the station serving the Manchester area. What will happen to the present 2LO is distinctly problematical, for many people consider that the Metropolis must not be denied a station of its own.

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Warning!

Listeners must not be shocked at a sudden increase in the volume of 5GB. The new aerial is now in position, and the change-over from the old may be made at any time during the next fortnight. This will be accompanied by an increase in power of from 24 to 30 kilowatts.

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Watch-night Service from York Minster

The watch-night service from York Minster which is to be transmitted from 2LO, 5XX, 5GB, and other stations at 11.30 p.m. on December 31st will be the last broadcast of 1927. Special wiring is being installed in the Minster; eight extension points are to be arranged in different parts of the edifice, and three-quarters of a mile of cable will be required for linking these extensions to the central control point.

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First Transmission of 1928.

As usual, special broadcast arrangements are being made to celebrate the passing of the Old Year. The first broadcast in 1928 will be a "Grand Good-night," to be given at about ten minutes past twelve on the morning of January 1st.

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Are You Tormented?

A Birmingham critic says that, "like many another listener who has been tormented by the immaculate pronunciation of the B.B.C. announcers," he indulged in a "revengeful chuckle" when the announcer came a cropper the other evening in trying to pronounce the names of two political candidates.

The time has certainly come when announcers should make a few mistakes. There is no excuse for wilful efficiency.

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Stage and Screen Outwitted?

Is the art of broadcast drama about to produce something beyond the realm of the film and the legitimate stage? An exciting experiment will be tried tomorrow night (Thursday) with the transmission of a new type of play—"The Shadow"—from 2LO and 5XX. From what I hear, the author, Valerie Harwood, has embodied elements in this play which are guaranteed to have a weird and even hypnotic influence upon the listener. Only three characters are introduced—a newsboy, a man, and a woman.

The play is unique in broadcasting annals in that, beyond a brief outcry by the male characters at the opening of the play, the whole scene is carried through by the woman. (In this, of course, the play rings true!) But the play's most important feature is the extraordinarily effective use of silent periods.

Listeners who wish to extract the maximum thrill are recommended to turn down the lights.

FEATURES FOR CHRISTMAS WEEK.

London and Daventry (5XX).

DEC. 18TH.—Symphony Concert, conducted by John Barbirolli Pouishnoff (pianoforte).
DEC. 19TH.—"The Ship," a play in three acts, by St. John Ervine.
DEC. 20TH.—Nativity Play relayed from St. Hilary's Church, Marazion.
DEC. 21ST.—"Rigoletto," an opera in three acts by Verdi.
DEC. 22ND.—Carillon of Carols. Bizet programme.
DEC. 23RD.—"Hansel and Gretel."
DEC. 24TH.—Mabel Constanduros, alias Mrs. Buggins, gives a Christmas Party.

Daventry Exp. (5GB).

DEC. 18TH.—Chamber Music.
DEC. 19TH.—Haydn and Mozart Music.
DEC. 20TH.—"Rigoletto," an opera in three acts by Verdi.
DEC. 21ST.—Carol Concert by the Gloucester Cathedral Choristers.
DEC. 22ND.—Military Band Concert.
DEC. 23RD.—A Dickens dream fantasy by Stanley West.
DEC. 24TH.—Variety programme.

Bournemouth.

DEC. 19TH.—"On the Wings of Song."

Cardiff.

DEC. 20TH.—The Super Six in "Christmas Crackers."
DEC. 22ND.—"Cymanfa Ganu" Carol singing of the Silent Fellowship.

Manchester.

DEC. 24TH.—Christmas Eve in the North.

Newcastle.

DEC. 22ND.—Concert performance of "La Fille de Madame Angot" (Lecocq).

Glasgow.

DEC. 24TH.—A Dickens Christmas Programme.

Aberdeen.

DEC. 22ND.—Humorous Scottish Programme.

Belfast.

DEC. 24TH.—Christmas in Ulster, a random entertainment with Mrs. Rooney, of Belfast.

Shivers from Aberdeen.

On December 22nd the Aberdeen station will present a "Ghost Programme" with sepulchral songs by Reginald Whitehead (bass) and a really creepy play, "Out of the Shadows," which is guaranteed to give the maximum of thrills.

In a Baronial Hall.

"A Legend of Vandale" is to be broadcast from 5GB on Boxing Day, not Christmas Day, as stated last week. It takes the form of a comedietta. The scene is set for 10 o'clock on the night of December 26th in an old and decayed baronial hall. So anything may happen!

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National Concert on Friday.

The next national concert, to be given by the B.B.C. on Friday next, December 16th, will take place at the People's Palace, Mile End Road. The programme, conducted by Geoffrey Toye, is as follows: Prelude, "The Mastersingers" (Wagner), "A Shropshire Lad" (Butterworth), "Brigg Fair" (Delius), Concerto No. 7 in B flat (Handel), and Symphony No. 4 in F minor (Tchaikovsky). The soloist will be Mr. Roy Henderson (baritone).

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Inter-studio Jamming?

Many listeners can blame nobody but themselves if and when 2LO and 5GB provide a double concert on their sets, and attention to the little matter of selectivity will put things right. There is, however, one form of mutual interference between these two stations which is quite inexcusable, and for which the listener is not to blame. This seems to be due either to imperfections in the soundproofing arrangements at Savoy Hill or the effects of induction.

A case occurred in the afternoon of Sunday, December 4th, when a chamber music concert from 2LO and a military band performance from 5GB both originated from the London headquarters. During an interval between items in the 2LO concert a distant background of military music was plainly discernible. It disappeared when detuning, but was at once identified when tuned in at full strength from 5GB. Have any readers noticed this phenomenon?

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Danish Listeners to British Programmes.

The Danish stations are now regularly once a week relaying foreign broadcasting programmes. Needless to say, this is very much appreciated by the many owners of crystal sets who are not able to pick up foreign stations direct.

The Danish broadcasting stations have recently retransmitted several British programmes, particularly those including speeches by prominent persons in this country. English is the foreign language best understood by the people of Scandinavia, which is one reason why the B.B.C. programmes are specially favoured.

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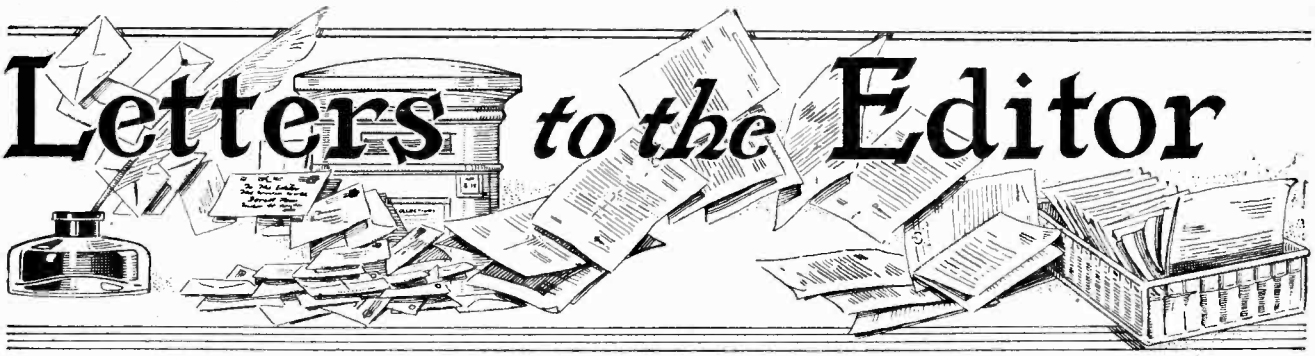
Fascination of Empire Broadcasting.

It is noteworthy that the Scandinavian listeners are much interested in the progress of our Empire broadcasting. When a special Empire programme from 2FC, Sydney, was rebroadcast a short time ago by the B.B.C., thousands of listeners in Scandinavia tuned in to Daventry. According to my correspondent they did not find speech very clear, but the musical items came through well.



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

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

EMPIRE BROADCASTING.

Sir,—It is obvious to any Colonial reader, from his letter in the October 12th issue, that Mr. Laity has had no experience in broadcast reception outside Great Britain, and I think he would be better advised to restrict his remarks to local affairs.

Speaking as a wireless experimenter of some 27 years' standing, eight of which have been spent in the Tropics, I can assure Mr. Laity that the only hope of receiving European broadcasting regularly lies in the adoption of a short wavelength such as 30 metres.

In Ceylon it is possible to pick up 300-500-metre broadcasting only during the months of November, December and January. Even then the results are very irregular and the programmes are punctuated with heavy atmospherics. On the other hand, the Eindhoven transmissions on 30.2 metres are picked up regularly by comparative beginners with simple sets and after 11 p.m. (local time) one detector and 2 L.F. valves will work a loud-speaker. There is some fading but little distortion.

We have an excellent broadcasting station, but the great difficulty is to obtain good programmes, as we have not the talent of Great Britain to draw on. Furthermore, there are vast tracts of country in the British Empire which are never likely to be reached by local broadcasting.

I have not the slightest doubt that every Britisher who reads Mr. Laity's statement that "the British Empire can look after itself" would feel a sense of shame at the indifference of one who is most probably a Britisher himself.

Colombo,
November 9th, 1927.

F. E. KENNARD,
Vice-President Ceylon Radio Association.

WIRELESS IN THE ARGENTINE.

Sir,—I have read with considerable interest the numerous letters appearing in *The Wireless World* with regard to Empire Broadcasting, and I think I am breaking new ground when I refer to the pleasure it would give to many Britons resident in foreign countries to be able to pick up a London broadcast programme.

Canada, South Africa, Australia, and India have, I understand, excellent local programmes in English, but those Britons living in distant foreign lands have to be content with wireless entertainment (when they can get it) in a foreign tongue, or, if they are short-wave fans, fare provided by the American stations 2XAD, 2XAF, and KDKA, and an occasional broadcast from PCJJ.

While the latter stations certainly give excellent programmes, and, in my case, there is plenty of local broadcast (Buenos Aires alone has ten stations operating simultaneously each night), these are not British, and although music is of no country, speech is, and it would be a boon to be able to hear a little B.B.C. stuff for a change.

London is not much farther than New York from Buenos Aires, and the American programmes are received on short waves at most satisfactory strength down here. 2XAD (22 metres) needs volume control on the loud-speaker—when static and HJG permit of good reception. I was glad to see that one of your readers has called attention to the interference caused by this HJG, and I am interested in learning if the identity of the station is traced.

I would like to point out that the paragraph in your issue of September 21st (p. 365), "In the Argentine," is rather misleading. First, there is no official licence for radio receiving sets; there is a request from the controlling authorities for registration (without any charge), but this is not compulsory, and very few enthusiasts have given in particulars; secondly, the crystal set is very little used out here, and the loose-coupled regenerative sets (known locally as either "Perry O'Briggs" or "Schnell") are far more prevalent.

There are fourteen local broadcasting stations, of from ½ to 5 kilowatts, and any evening a choice of ten is available. The programmes provided vary, some are excellent—such as the municipal transmission of the operas at the Colon Theatre—while others are mediocre. The stations depend upon their income from direct advertising, and this, although economical for the listener, has its drawbacks, as the items are interlarded with commercial propaganda.

The local attitude towards the amateur experimenter is most helpful, and no charge is made for a transmitting licence, which may be obtained after rendering an examination in the management of the apparatus and proof of a knowledge of the Morse code sufficient to read signals at a moderate speed. The main restrictions are the limiting of the wavelength to under 190 metres (with phone prohibited over 120 metres between 9 and 12 o'clock at night), and that commercial messages must not be sent.

Very few British sets and components are seen, the market being stocked with North American goods.

I have not yet had the pleasure of a QSO with a British station, and have no record of reception of my signals over there, but if this should meet the eye of any short-wave enthusiast I would greatly appreciate any efforts towards establishing communication, and would be only too pleased to arrange tests—my wavelength being 36 metres.

COLIN H. GRATTAN (SADGI).

Argentine.
October 17th, 1927.

ACCUMULATOR CHARGING.

Sir,—May I point out that the use of ammonia for cleaning the tops and sides of accumulators is to be deprecated. Ammonia is harmful in many ways.

A. W. B.

Newcastle-on-Tyne.
December 5th, 1927.

Sir,—Mr. Curtis Elliott has put his finger on the point in your issue of November 30th when he says: "If the job is done conscientiously." In how many cases are not accumulators left to the tender mercies of small boys or assistants who, also in many cases, know no more about the job than do their "bosses"! This "accumulator charging" is very often an offshoot of an alleged "Automobile Engineer" (save the mark!) and at the end of 12 months they calmly inform you that you require a new accumulator.

I am using an 8-valve instrument with six Exide W.H. cells, and have two charged every fortnight, and my instrument is working an average of five hours daily. I am charged 1s. each for charging the H.T. units—which is only 1s. a week for H.T. But—and a very strong *but*—I take the trouble to have, and use, a good hydrometer and voltmeter, and I give the charging station a fortnight to charge my two units.

No, Mr. Elliott, 4s. 6d. is not "outrageous," it is very reasonable, and if only there were more charging stations run on conscientious lines like yours, the dividends of accumulator companies would decrease. May I be permitted to add good luck to you, Mr. Elliott? FRANK D. BERRIDGE.

Farnham.
December 1st, 1927.

IDENTIFYING STATIONS.

Sir,—In your Editorial of November 30th I note with satisfaction you have again taken up this very important subject of identifying broadcasting stations.

While agreeing with your suggested system, and welcoming such as a step in the right direction, I feel that it would not meet the situation fully as it still leaves us with the difficulty of the foreign language.

There has been no lack of various workable schemes put forward since you first published my letter on the above subject about two years ago, and it would appear from information at my disposal that the real obstacle to their introduction is due to the lack of initiative on the part of the authorities concerned.

It may be of interest to your readers to know that, at the present moment, the technical Press on the Continent is devoting space to this very subject. A. A. SCHASCHKE.

Glasgow.
December 5th, 1927.

Sir,—Your leading article in the November 30th issue of *The Wireless World* is of great interest to an ordinary listener to home and foreign broadcast music like myself. The suggestion you make therein is one which would seem to solve the question of station identification if it were adopted by international agreement. If, as the result of your article, you obtain sufficient support of your proposal, what steps do you propose to take to secure the adoption of your scheme? Is it not a matter which The Wireless League could press forward through the B.B.C. for action by the International Body at Geneva?

I have only one small criticism of detail to offer. Why should the proposed automatic transmittter say "This is," etc.? Would not "London 2LO calling," etc., be clearer and sufficient for the listener abroad? And would not the German call, by similar means, be clearer to us if instead of "Here is," the call was, for instance, "Berlin. . . ."?

London, W.1. F. C. DAVIES.
November 30th, 1927.

Sir,—We have just read your Editorial upon identifying stations (in the November 30th issue of *The Wireless World*), and although we have not put it into words, we have felt for a long time that such a scheme is essential at the present time, and we hasten to add our vote in its favour now that the suggestion has been duly circulated amongst your many readers.

Apart from the entire elimination of the tedium of identifying stations on the part of the public, and the reduction in correspondence through the Service Depts. of all manufacturers, such a scheme, under successful working conditions, will do much to enhance the value of final tests of factory-made apparatus, for there is no doubt about the capabilities of a receiver about which it is recorded that it definitely receives such and such a station. For and on behalf of L. McMICHAEL, LTD.,

Slough. Leslie McMichael, Managing Director.
November 30th, 1927.

Sir,—I have observed the article in the November 30th issue of your paper on the subject of the difficulty of recognising foreign stations. This is the difficulty that every wireless enthusiast complains of, and whilst the suggestion in your article is quite good in its way, I do not think it goes sufficiently far.

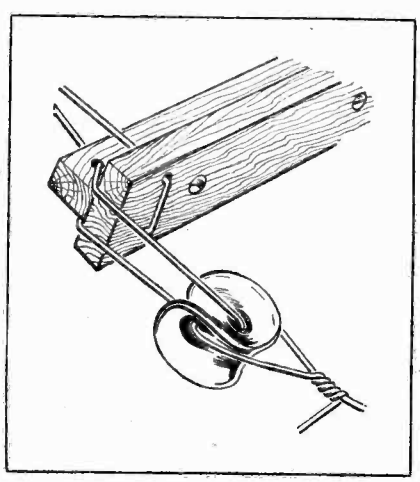
The names of many foreign stations are so lengthy, and difficult to understand, that, in my opinion, some totally different system of naming them should be adopted. I suggest the simple plan of each European station having a number allotted to it, and such number should be announced either by an automatic announcer, or by the usual announcer, before and after each item, such announcement to be made in the three languages which are understood almost all over the world, namely, English, French and German. For instance, if the number of the Berlin station was 25, it would simply be announced "Radio Station No. 25." All interested listeners would have a list of these numbers and corresponding stations, so that there would be no possibility of stations not being recognised. H. A. B.

Liverpool.
December 1st, 1927.

NOVEL IDEAS FROM READERS.

AERIAL SPREADER.

To be effective an aerial spreader must be both light and rigid. These essential characteristics are inherent in the type of spreader illustrated in the sketch. Two laths are screwed together at right angles to give a T-shaped cross-section, a form of assembly which possesses rigidity in two planes at right angles, and thus gives strength combined with lightness.—J. S. F.



Aerial spreader combining strength with lightness.

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OUTPUT CIRCUIT CONNECTIONS.

When H.T. is derived from D.C. mains and the loud-speaker is connected to the last valve by a conventional choke-capacity circuit, the method of connecting the loud-speaker must receive careful attention if the possibility of receiving shocks is to be avoided.

There are two alternative methods of connection; the loud-speaker may be connected between the condenser and H.T. +, or between the condenser and H.T. − (and L.T. −). The latter method of connection should be used when the negative main is earthed, and the former when the positive main is earthed. If shrouded terminals are used and other methods are employed to ensure immunity from shocks, it is advisable to connect the loud-speaker between the condenser and H.T. − in order to avoid passing the audio-frequency currents through the H.T. battery.—S. W. W.

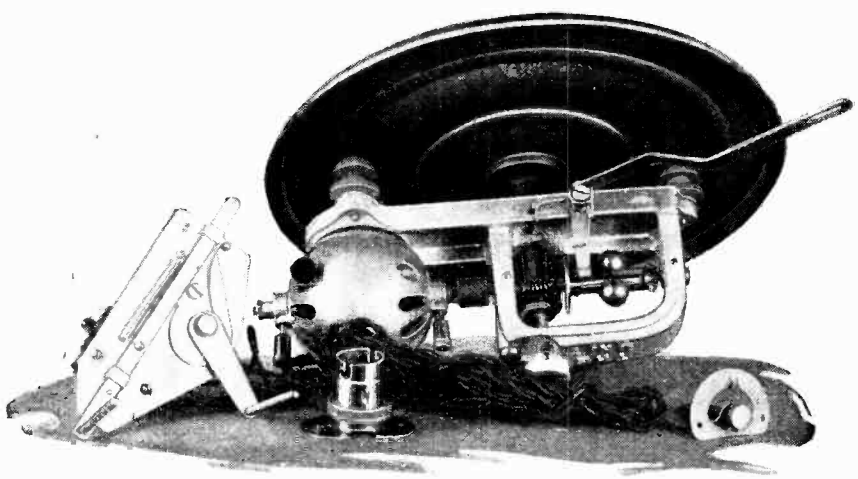
A Review of the Latest Products of the Manufacturers.

G.E.C. ELECTRICAL GRAMOPHONE MOTOR.

The now extensive use of gramophone pick-ups in conjunction with the amplifying stages of receiving sets has created a keen interest in gramophone mechanism and gramophone motor construction.

From the General Electric Co., Ltd., is obtainable an electrically driven gramophone motor complete with turntable and an ingenious switch action so that the tone arm in the course of its movement across the record controls the current supply to the motor. By this means the motor is started by swinging the tone arm into position, whilst when the record has been traversed the arm makes contact with another vertical support and stops the motor. A substantial aluminium casting supports the motor, governing shaft, and vertical spindle, all of which are well machined so that the running is absolutely noiseless. A brass mounted fibre-faced pinion is used for the worm drive to the turntable shaft.

The motor is of the universal type, and can be run on A.C. or D.C. supply. It is well built, the commutator having a particularly large number of segments, so that the motor will be self-starting on load, and another and somewhat interesting observation is that the possibility of a current ripple being conveyed to the pick-up is avoided. It was thought that the use of a mains connected electric motor might be a disadvantage when using a pick-up, owing to the subsequent amplification and the danger of mains noise being set up in the loud-speaker. This effect definitely does not occur. The motor is inaccessible, and a wooden frame is all that is required in addition to the pick-up and tone arm for reproducing gramophone records through the L.F. amplifier.



G.E.C. electrically driven gramophone action with which a gramophone for use with electrical pick-ups can easily be constructed.

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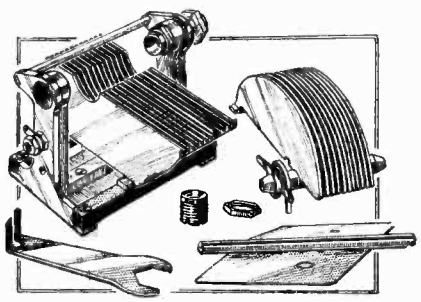
THE N.S.F. VARIABLE CONDENSER.

A particularly interesting form of variable condenser has recently been placed on the market by S. W. Lewis and Co., Ltd., 39, Victoria Street, London, S.W.1.

It possesses many outstanding points of merit. Principally, these include minimum dielectric losses produced by supporting the fixed plates on long ebonite bars, the use of a substantial aluminium casting as a frame, thus avoiding the risk of distortion when clamping the condenser to the panel, can be mounted either by one hole fixing, clamping screws, or screwed down to the baseboard, the fixed and moving plates are of substantial brass, stiffened and silver plated, and the usual pigtail connector is provided. In addition, the bearings are of the adjustable cone type, and engage upon liberal faces on a brass spindle to which the moving plates are attached. This brass spindle is hollow, so that the condenser shaft, which is a ¼in. steel rod, can be completely withdrawn without deranging the setting of the plates. That the spindle projects at both ends is a new and useful feature, as it facilitates the linking of the condensers together for simultaneous operation. This condenser is a specimen of high grade instrument making, all the parts being of good design, cleanly machined, and well fitted together.



The N.S.F. condenser. It has been dismantled to show its many novel features

It sells at the moderate price of 12s. 6d., with a capacity of 0.0005 mfd. The plate shape approximately follows a logarithmic law, and the condenser is supplied complete with marking out template and adjusting spanner.

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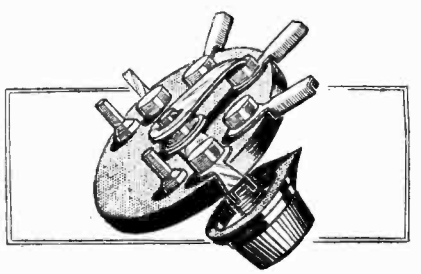
ZAMPA STUD SWITCH.

A particularly neat panel-mounting stud switch with five contacts is being marketed by The Mica Wireless Company, Market Street, Wellingborough. A small ¾in. knob projects from the panel, while a circular ebonite disc containing the contacts, stops and selector arm is hidden behind the panel. A good positive contact is made and the switch can be recommended where panel space is a consideration, and where a control is required in connection with tapped inductances, chokes or resistances, etc.



Five-way Zampa panel switch.

READERS' PROBLEMS

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

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

The Most Efficient "Pot" Winding.

Recently you published a table of pot magnet windings for a coil drive loudspeaker, and I should be obliged if you would inform me whether the 4-volt winding will prove as efficient as the 200-volt winding. A. N. R.

The field strength at the "gap" of the pot magnet in a coil drive loudspeaker is governed by the ampere-turns on the coil. It is possible, therefore, to obtain similar field strengths with either voltage provided suitable windings are employed.

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Effect of Electrostatic and Magnetic Fields in Directional Reception.

With reference to the article in the "Experimenters' Notebook" on directional reception in the issue of October 19th last, am I correct in assuming that it is the horizontal magnetic component of the signal wave which induces the E.M.F.s in the vertical sides of the frame aerial? When considering the case for the elevated aerial, is it correct to assume that both components of the wave contribute to the received signal, in so far as the vertical down lead is affected by the magnetic component and the horizontal portion by the electrostatic field? W. A.

The facts are, of course, that the magnetic force and the electrostatic force are at right angles to each other, but both co-operate in inducing a voltage in a wire which is parallel to the direction of the electrostatic force and at right angles to the direction of the magnetic force. As a result there will be no E.M.F. induced in the horizontal part of an aerial except in so far as the wave front is tilted forward, i.e., by reflection from the Heaviside layer or from other causes.

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Reaction and Tuned Anode.

In the article by "Empiricist" on reaction in receiving circuits in "The Wireless World" for November 9th, you show a tuned anode H.F. circuit with reaction. I should be obliged if you could furnish me with winding particulars of the coils L_2 and L_3 shown in Fig. 6, and the method of applying reaction. A. C. T.

The tuned anode circuit with neutralising winding should be made in the form of a solenoid with a closely coupled

RULES.

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

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

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

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

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

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

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

winding wound over the top of it and spaced from it. If the anode coil is made of the same dimensions as an "Everyman Four" coil, but included completely in the anode circuit, the neutralising winding can take the form of a

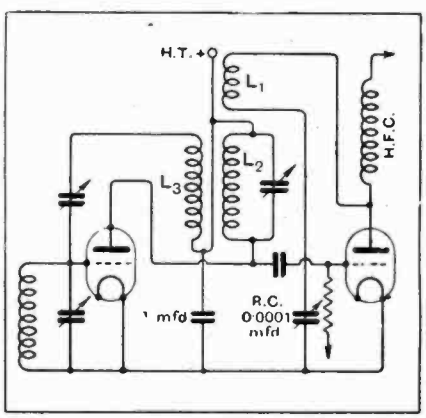

Fig. 1.—Applying reaction to a neutralised H.F. amplifier.

solenoidal winding wound the full length of the coil and spaced from it the same distance as the primary winding of the "Everyman" transformer. The number of turns should preferably be about half the number of turns on the anode coil, and the neutralising capacity will then be double the capacity to be neutralised, which is a convenient value.

For the purpose of applying reaction to this circuit, it is recommended that the reaction winding consists of about fifteen turns of fine gauge wire wound on the low potential end of the former carrying the anode and neutralising windings, and the amount of reaction controlled by a 0.0001 mfd. variable condenser. The method of applying this to the circuit under consideration is shown in Fig. 1.

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Polar Diagrams.

I am interested in the article on Directional Reception by "Empiricist" in the October 19th and 26th issues of "The Wireless World"; however, I should esteem it a favour if you could provide me with a little more detailed information. The point in question is the method of connecting the coupling coil to the frame aerial in the arrangement suggested for combining the two, in order to obtain various polar diagrams of reception. A. A. R.

It is correct to say that the coil is inserted in the centre of the frame winding, and that the centre of the coil is connected to an "earthy" point. On the other hand, there are so few turns on this coil for normal satisfactory operation that the inductance is not materially increased. Probably 2, 4 or 6 turns tapped at the centre and wound on a 2½in. former would suffice. The coupling coil would be a flat pancake consisting of a similar number of turns and mounted so as to be rotatable within the frame circuit coil. The loading coil used for the open aerial would vary according to the size of the latter, and can easily be tried out experimentally by substitution of a succession of plug-in coils. If the coupling is found too weak under these conditions to give the effect required, it is preferable to increase the turns on the flat coil in the aerial circuit. If this is done more resistance can be included in the aerial circuit for the purpose of making the arrangement aperiodic.

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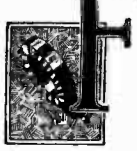
IDENTIFICATION OF FOREIGN STATIONS.



FROM the extent of the correspondence we are receiving we realise that in raising again the question of some means of identifying transmissions we have touched upon a subject in which all those who listen to distant transmissions are most keenly interested.

It is suggested that those who are specially interested to search for foreign stations and who want to identify them can do so by the knowledge of the wavelength on which the transmissions are sent out, and that the use of a wavemeter or the calibration of their receivers will give them an adequate means of identifying any station heard; but we are of the opinion that this method of identifying stations is becoming increasingly difficult, especially where you may get two or three German stations, for example, with wavelengths very close to one another.

There are naturally differences of opinion as to the form which the identifying signal should take, but the feeling that there is a real need for a signal of some kind is almost unanimous. The dissenters are mainly those who feel that the introduction of such signals between items will strike a discordant note and spoil the artistic effect of the programmes, and kill what illusion we have been able to cultivate that transmissions are taking place actually in our homes without the intermediary of wireless apparatus and a loud-speaker. If the identifying signals were too persistent it is quite reasonable to suppose that such an objection would be valid, but the transmission of a group of musical notes, as we have suggested, to indicate the number of the station transmitting, does not seem to us to provide any legitimate grounds for complaint, provided that the group of notes is not transmitted more often than is reasonably necessary.

If we are to be too critical of the possible result of spoiling the artistic effect of the programmes, how is it that when we listen to an orchestra we are not driven to protest against the periodic tuning of the stringed instruments between items of the programme?

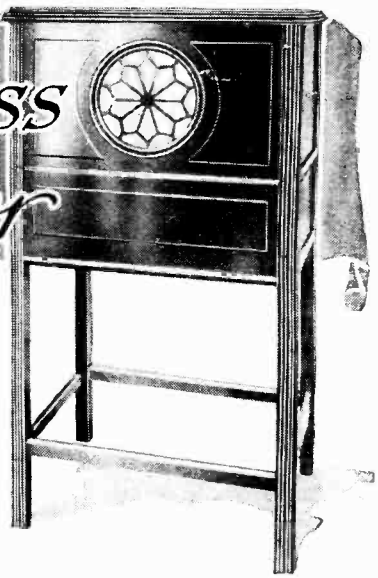
MORSE INTERFERENCE.

A RECENT announcement issued by the Post Office concerning the establishment of a new wireless station at Grimsby, to be known as the Humber Radio Station, contains news which will be very welcome to listeners. It is stated that the new station is equipped with valve transmitting apparatus on the interrupted continuous wave system, and that this system of transmission is in place of the spark system which is used practically all over the world for communication with ships. The statement goes on to say that the main objection to the spark system is that it causes considerable interference in the immediate vicinity with other services and with broadcast reception. The new type of equipment has been provided by the Post Office at this station with the object of reducing such interference and in pursuance of the Post Office general policy to abolish spark communication at all its coast stations. Valve transmission, it is stated, has already been introduced at the Seaforth wireless station, with advantage to listeners.

This, we believe, is the first public announcement of the intention of the Post Office to substitute continuous wave transmitters at all its existing spark coast stations. Undoubtedly listeners will find that this substitution will result in a great diminution of spark interference. We sincerely hope that Continental authorities will be moved to follow the example of the British Post Office, and particularly it is to be hoped that the French coast stations will realise the necessity for a change in their system of transmission. This result may be brought about more speedily now that France appears to be shaping a more definite policy with regard to its own broadcasting stations and appreciating to a greater degree the importance of a national broadcasting service.

In this issue we publish an interesting list of the wavelength allocations which were recently agreed upon internationally at the Washington Conference. It will be seen that as far as was practically possible at the present time the wavelengths allocated to broadcasting have been kept clear of likely interference from other transmissions.

Story of the Hornless Loud-Speaker



An Historical Survey of the Development of Free-edge, Fixed-edge and Inertia-controlled Cone Loud-speakers from 1879 to the Present Day.

THE design of a loud-speaker constitutes perhaps the most pressing problem in connection with broadcast development at the present date. In all other branches of design, a state of affairs has been reached where it is possible, ideally speaking, to attain any desired degree of perfection in reproduction. Admittedly this degree is not attained in the case of a very large amount of commercial apparatus, but it is fair to say that, owing to the defects usually associated with loud-speakers, it is not commercially worth while to go beyond a certain point in perfecting the design, say, of amplifiers. Similarly, as far as the broadcast transmission itself is concerned, the public are not critical beyond a certain degree as to the quality which is to be had, simply because with the reproducing means at their disposal they are not in a position to judge.

At the present time, therefore, it is natural that the attention of all who are interested in broadcasting should be largely focussed upon loud-speaker developments, and still more is this the case now that the electrical reproduction of gramophone records has opened up an entirely new field for their use, and possibilities are gradually revealing themselves of the creation of something which really deserves to be described as a musical instrument.

In the history of the art we discover two main lines of development which are strongly differentiated from each other.

According to the one, an air duct or horn is employed, the purpose of which is to enable the high velocity movements of a diaphragm of small area to agitate at relatively low velocity a large area of air, and thus to reproduce the vibrations at adequate volume and with the greatest possible fidelity over the whole of the musical scale. In a recent issue of *The Wireless World*,[1] some notes are given as to the dimensions and shapes of horns which attain this fidelity to a greater or less degree, and it is at once apparent from a study of these that we are compelled to employ apparatus of very large dimensions if we wish to attain satisfactory volume over the base notes of the musical scale.

The other main line of development embraces all methods of reproduction where a horn is not employed, and it is with these loud-speakers that the present article is concerned, or, rather, with that section of them where a diaphragm is used which agitates the air directly and not through the medium of a horn. The most common form of this diaphragm is a cone, and considerable attention has been given to the various methods of mounting and driving cones so as to give even reproduction at adequate volume over the whole of the musical scale.

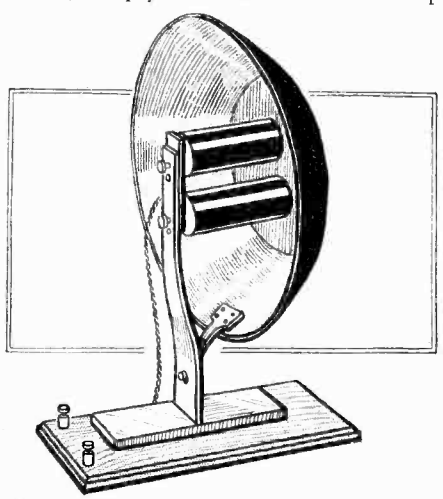


Fig. 1.—The hornless loud-speaker in 1879; a device due to Elisha Gray. The diaphragm is an iron pan which is set in vibration by the field from an electro-magnet.

The early history of hornless instruments of this type is to be found as much in phonograph and gramophone developments as in telephonic apparatus, though there are early examples of loud-speaking telephones which foreshadow modern practice in the most remarkable way. In a book by Mr. George B. Prescott, entitled "The Speaking Telephone, Electric Light, and other Recent Electrical Inventions," and published in 1879, an instrument is described which is illustrated in Fig. 1, and consists of an iron pan mounted so that its centre is in close proximity to an adjustable electro-magnet. This device, which is due to Elisha Gray, resembles very closely certain types of hornless loud-speakers in its general arrangement, though it would undoubtedly be very inefficient.

[1] November 16th and 23rd, 1927.

Story of the Hornless Loud-speaker.—

A very interesting type of loud-speaking telephone due to Sir Oliver Lodge is described in his British Patent Specification, No. 9712, of 1898, one of which is exhibited at the Science Museum, South Kensington. The most notable feature of this is the use of a moving coil drive which is illustrated in Fig. 2. The coil, it will be seen, is situated in an annular magnetic field and attached by a tripod arrangement to the device which it is intended to drive, which in the case of the Fig. 2 is a microphone for the purpose of amplifying the telephonic currents. For loud-speaking purposes the moving coil is shown attached to a sounding board, and arrangements are shown where such a board has a number of moving coils attached to it.

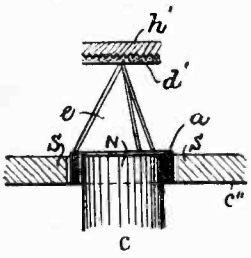
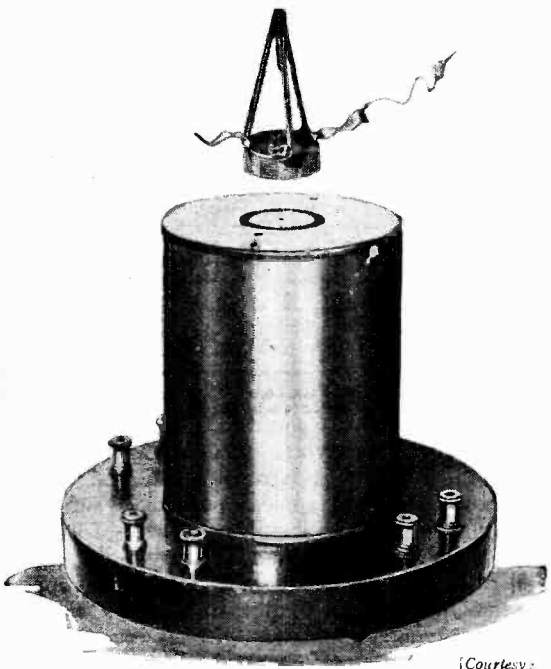


Fig. 2.—Sectional diagram of Lodge's moving coil movement, reproduced from British Patent Specification No. 9712 of 1898.

In the *Talking Machine News* for July, 1907, a phonograph is described due to Messrs. Starling and Cole, and termed by them the "Vibratophone." It will be seen from Fig. 3 that this consists of a paper cone mounted on a cardboard cylinder, the latter being provided with a stylus which rests on the phonograph record. The cone is stated to be about eight inches in diameter, and its function is indicated as that of setting a large volume of air in motion without distorting the vibrations of the stylus. The conical shape of the diaphragm is recommended for the purpose of rigidity, although "a perfectly rigid weightless plane" is indicated as being the ideal if only it could be attained.



[Courtesy: Science Museum Authorities.

One of the original Lodge moving-coil movements now in the Science Museum at South Kensington.

Another interesting device which is closely akin to the subject under discussion is described in the *Children's Encyclopedia* (published in 1908) under the heading of "Things to make and things to do." Here a variety of string telephone is described in which the transmitting and receiving instruments each consist of a bladder stretched into a conical form by clamping it to a wooden board provided with a circular hole about eight inches in diameter and attaching a weight to the centre point.

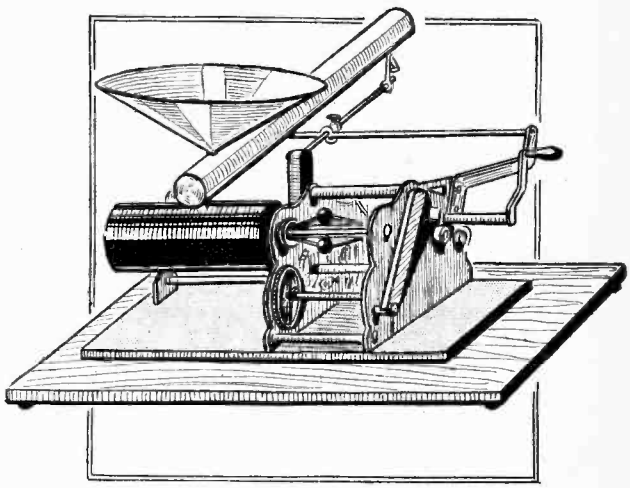


Fig. 3.—An early phonograph (1907) known as the "Vibratophone" which made use of a cone diaphragm, mounted on a cardboard cylinder.

Fig. 4 shows the stretching operation in process of being carried out, the bladder being moistened initially and afterwards left to dry and become hard. The conical diaphragms constructed in this way are used by interconnecting a pair of them with a wire which is supported so as to be in light tension.

What was probably the first commercial "large diaphragm" loud-speaker is described in Lumiere's patent No. 11,015 of 1909. This is concerned with the well-known pleated construction which is illustrated in Fig. 5 (*a*) and (*b*). In Fig. 5 (*a*) a pleated strip of elastic material is shown, some form of paper or vegetable parchment being usually used, and this is formed up into the diaphragm illustrated in Fig. 5 (*b*) by crimping one edge together and flattening the other out into a circular form. The edges *e f* and *g h* of Fig. 5 (*a*) are joined together, and the resulting diaphragm is thus circular in shape and thick in the middle, tapering towards the outer periphery. Owing to this construction each of the pleats is placed under torsional stress, and as a result it is claimed that the tendency to form nodes during operation is reduced to a

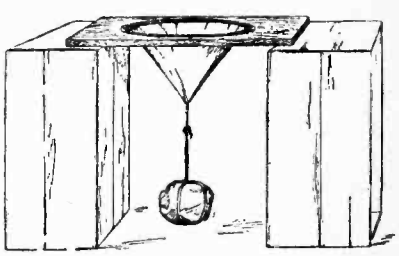


Fig. 4.—A diagram reproduced from the *Children's Encyclopedia* (1908) showing the formation of a cone diaphragm.

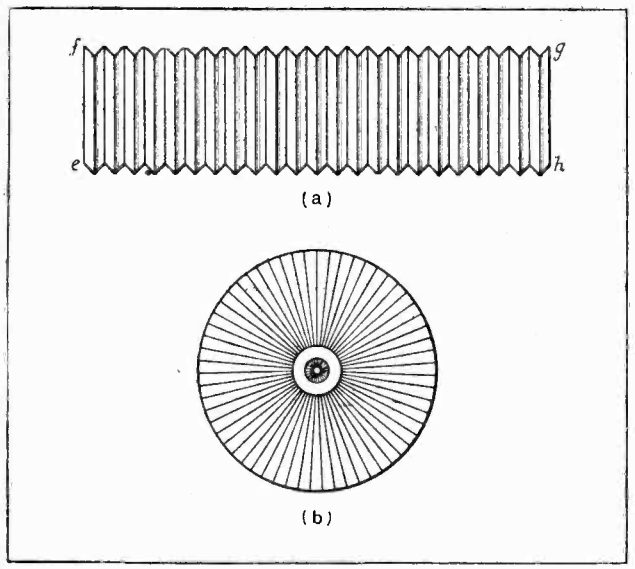
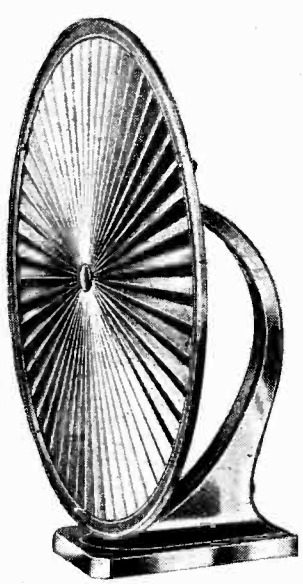


Fig. 5.—Pleated diaphragm construction described in Lumiere's patent No. 11,015 of 1909.

minimum. Loud-speaker and gramophone reproducing devices according to this principle were the first hornless instruments to appear on the British market in any quantity, and their reproduction, while somewhat weak in intensity, was characterised by a remarkable freedom from the resonance effects in the middle and upper registers which are characteristic of ordinary loud-speakers with inadequate horns.

More recent types of hornless loud-speaker have reverted to the conical diaphragm, which appears to be about the best compromise between lightness and rigidity that can be practically achieved. The best instruments of this class are not appreciably less sensitive than loud-speakers of similar standard employing a horn, and in general the quality of reproduction is purer.



The Sterling "Primax" loud-speaker manufactured in this country under Lumiere patents.

The cone instruments so far mentioned have not been telephone receivers in the proper sense of the word; the earliest electromagnetic device which the writer has been able to trace which employs a conical diaphragm is the well-known Brown reed type telephone which is described in patent specification No. 29,833 of 1910, from which Fig. 6 is reproduced. Referring to this figure, it will be seen that the customary flat telephone diaphragm is replaced by a flat reed E to which is attached a cone-shaped diaphragm F. In the specification it is stated that this cone may be constructed with its periphery quite free or else a flat ring of flexible material F^1 is provided to bridge the gap between the edge of the cone and the body of the receiver. The drawing shows the principle of construction as applied to a "watch" type telephone receiver, such as would be used in an ordinary pair of headphones, but its application in other directions is also indicated, and a particularly interesting comment is made

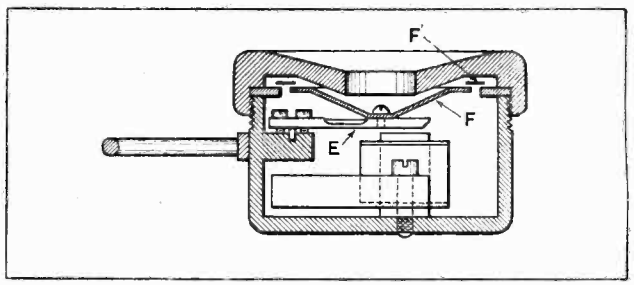


Fig. 6.—The Brown reed-type telephone, patented in 1910, makes use of a light cone-shaped diaphragm.

in the specification to the effect that a receiver of larger size is preferable when it is desired to make the sounds travel out into the room.

The next important contribution to the art is due to Hopkins, whose British Patent Specification No. 16,602 of 1914 shows a large conical diaphragm as the reproducing means for a gramophone. The distinguishing feature of this cone, as shown in Fig. 7, which is reproduced from the specification, is the rigid fixing of the rim to a pair of heavy clamping rings KK^1, which in turn are connected to a spider J which supports the actuating mechanism, in this case a system of levers con-

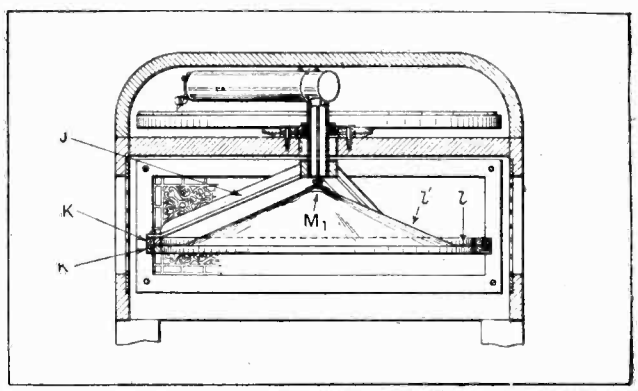


Fig. 7.—Method of suspending the cone diaphragm in the gramophone reproducer patented by Hopkins in 1914.

nected to a gramophone stylus. A diaphragm of at least nine inches in diameter is recommended, and the construction shows a central conical portion l^1 surrounded by an annular plane peripheral portion l for which various recommended dimensions are given. A cap M_1 consisting of a pair of metal cones located on opposite sides of the apex of the diaphragm enables vibrations to be impressed upon the latter without crumpling the material of which it is constructed.

Another form of "fixed-edge" cone is described by Farrand in his British Patent Specification No. 178,862 of 1921. One type of loud-speaker referred to in this

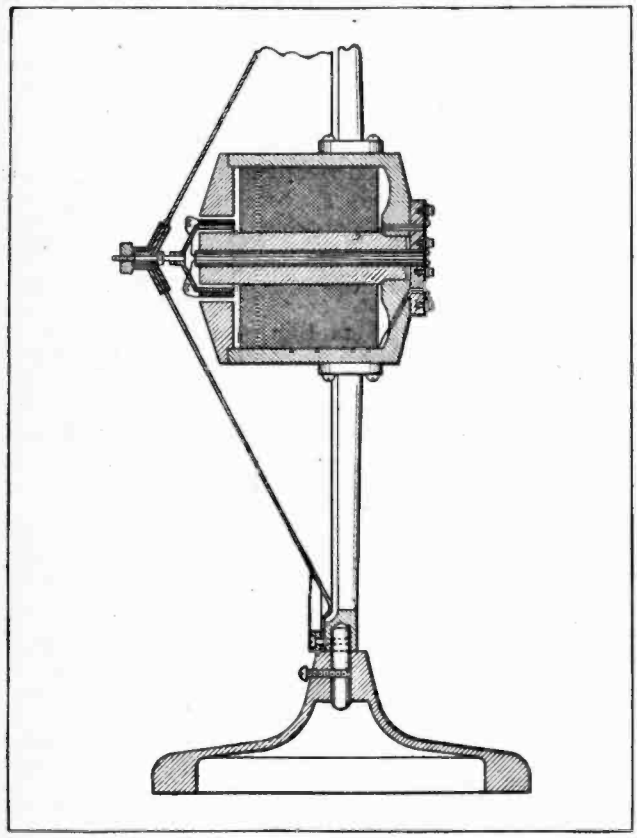


Fig. 8.—Coil-driven cone loud-speaker patented in 1921 by C. L. Farrand.

specification is shown in Fig. 8; in this case the cone is outwardly convex and driven by a moving coil armature of the usual type, the mechanism being housed within the concave side of the cone.

The " free-edge " principle of construction is described and illustrated in patent No. 231,798 of the Western Electric Company, from which Fig. 9 is reproduced. It will be seen from this figure that the diaphragm is of conical shape, and has no constraint whatever at its edge, which is turned over parallel to the axis so as to attain the greatest possible rigidity. A diameter not less than 9in., and preferably of the order of 18in., is suggested as suitable.

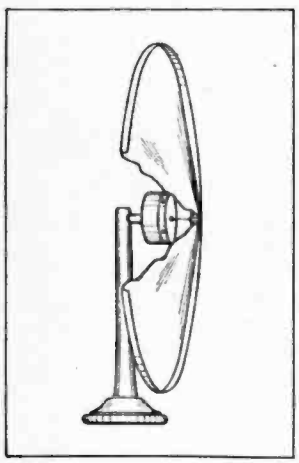


Fig. 9.—The Western Electric free-edge cone.

Some interesting types of conical diaphragm are shown in the Patent Specifications of Huguet d'Amour; the most important of these is the well-known and popular double-cone arrangement illustrated in Fig. 10, which is taken from his Patent Specification No. 239,245 of 1923. As will be seen from the figure, the diaphragm consists of a pair of cones secured together at their rims, the whole arrangement being supported at an opening on the inside of one of the cones by a pair of clamping rings which grip the inner edge of this cone. This construction is in a sense intermediate between that of the fixed and free edge types, since the front part of the diaphragm is a cone which is semi-rigidly supported at its rim by being secured to the rear part, and in consequence is neither fixed nor free at its periphery.

Essence of the Rice-Kellogg Patents.

Undoubtedly the most interesting recent developments in connection with hornless loud-speakers are those associated with the names of Rice and Kellogg. Space does not permit of any detailed consideration of the theoretical side of their work, and, furthermore, it has been more than adequately dealt with by other writers. From the standpoint of the present article it is important, however, to grasp the essential nature of their contribution to the art of loud-speaker design. This consists, in the first place, in the provision of a diaphragm which is flexibly mounted so as to have a very low natural frequency, and at the same time is rigid in itself so that the first overtone is at as high a frequency as possible. The control of the diaphragm is thus its inertia only, the restoring force due to the suspension being relatively so weak at ordinary frequencies that it has no appreciable effect in comparison. Now if a diaphragm of small diameter (say six inches or so) is to reproduce the various frequencies in their correct proportion, it must move with an amplitude inversely proportional to the square of the frequency when energised with constant current.

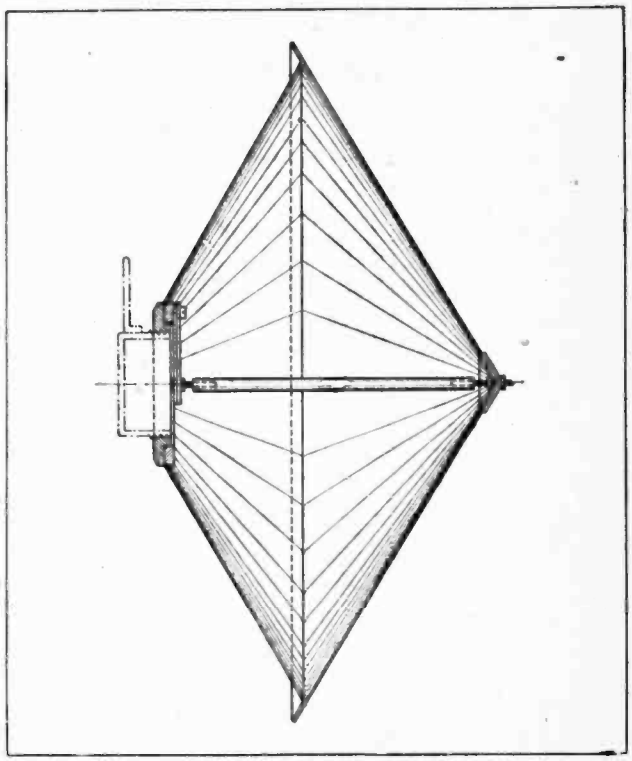


Fig. 10.—Double-cone diaphragm of the Huguet d'Amour loud-speaker (1923).

Story of the Hornless Loud-speaker.—

This effect is given with the inertia control arrangement above described, and it will hold good up to the frequency where the diaphragm ceases to act as a simple plunger

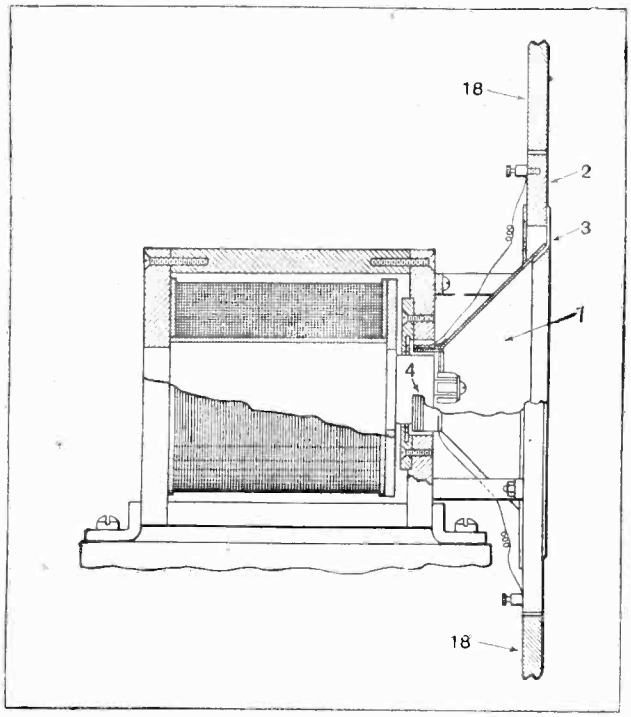


Fig. 11.—The Rice-Kellogg loud-speaker (1925) in which the principle of inertia control is applied to the diaphragm.

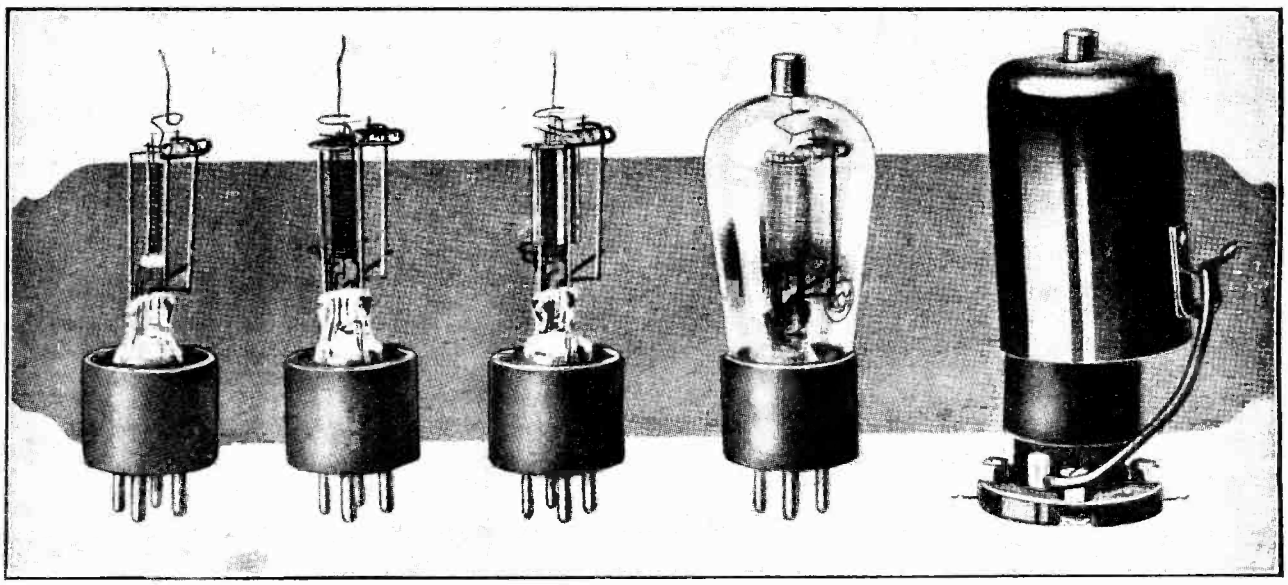
and breaks up into complex overtone modes of vibration, so that if the first overtone is high enough to lie above the audible range the frequency scale will be exactly uniform.

The feature of inertia control is a notable departure from previous standard practice for cone type loud-speakers as in all cases, even with free-edge cones, the control has been of such a nature as to bring the main resonant frequency well within the audible range, the figure of 800-1,200 cycles per second for example being specified for the Brown reed.

The second essential feature of the Rice-Kellogg system is the mounting of the cone in the centre of a large baffle plate, the purpose of which, as is well known, is to prevent leakage of air from one side of the cone to the other at the low frequencies with consequent loss of radiation.

These two features are illustrated in combination in Fig. 11, which is taken from British Patent Specification No. 245,796 of 1925. The figure shows the conical diaphragm 1 secured to a supporting ring 2 by a ring 3 of flexible material. The cone terminates in a cylindrical moving coil 4 working in the air gap of the field magnet. The fixed supporting ring 2 of the cone is secured to the baffle 18, the size of which is stated in another specification to be at least of the order of magnitude of one quarter of the wavelength of the longest useful sound wave; if therefore a baffle three feet in diameter is employed a frequency as low as 100 cycles will be effectively reproduced.

The foregoing notes outline the main tendencies of development in loud-speakers of the hornless type, but it is obviously impossible to do justice to many developments, particularly in respect of details of design, which have taken place during recent years, and it is equally impossible to state with any real certainty to whom the credit for the various improvements is due. The classification of conical diaphragms into "free-edge," "fixed-edge," "double-cone," and "inertia-controlled" types is a serviceable one for practical purposes, however, and it is believed that the examples given trace with a reasonable degree of accuracy the trend of development during the past few years.



THE SCREENED VALVE IN AMERICA. An interesting picture showing the new screened grid valve which is being put on the market by the Radio Corporation of America under the name "U.X.222." The picture indicates the construction of the valve, whilst on the right is shown the special type of shield which is recommended

A Section Devoted to the Assistance of the Beginner.

SHORT WAVE RECEPTION.

THERE seems to be a general tendency to regard the use of an oscillating receiver on the ultra-short waves as quite permissible, and, indeed, many amateurs whose wireless conduct is irreproachable so far as the normal wavebands are concerned have no hesitation in operating their short-wave sets in this condition. It is admittedly difficult to avoid occasional heterodyning of an incoming carrier wave, but, after having calibrated the receiver, there is no real need to interfere with the reception of other listeners on the wavelengths of the more popular stations. If they are coming through at sufficient strength to be really worth while receiving, their signals may be found without operating the reaction control at its limit.

The conscientious amateur should not rest satisfied until his control of regeneration is really smooth; if it is not, it will always be a difficult matter to avoid causing interference, and, moreover, the receiver can never give really satisfactory results.

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A CURE FOR L.F. HOWLING.

THE use of a choke-filter output circuit is rightly recommended as a preventative of low-frequency oscillation, which is often produced in a modern sensitive receiver when the H.T. battery develops a high internal resistance, or when the set is connected to a battery eliminator, the potential divider of which may act as an interstage coupling in a similar manner.

It should be clearly pointed out that the advantages of the choke filter—so far as the prevention of oscillation is concerned—are only obtained when this circuit is of the type in which one side of the loud-speaker is connected to L.T. negative.

The alternative methods of connection are shown in Fig. 1. The first (A) may now be considered as out of date; it admittedly achieves the desirable object of keeping the steady anode current out of the loud-speaker windings, but it does not restrict the development of audio-frequency voltages across any resistance which may exist in the battery (or potential divider). Thus it will not prevent self-oscillation, so the second

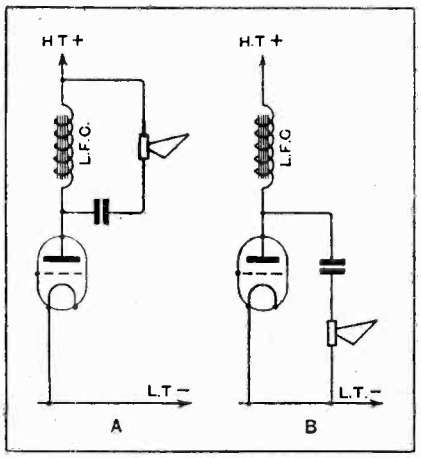

Fig. 1.—Alternative output filters.

arrangement shown in circuit B should always be adopted, particularly when there is any tendency towards this condition.

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SERIES FILAMENTS.

IT is usual to connect valve filaments in series when they are supplied with current from D.C. mains, as this procedure reduces the amount of energy which is lost through the insertion of the necessary voltage-reducing resistance. As there will always be a surplus voltage, it should be realised that there is no economy in using 2-volt valves, as these are no cheaper than those with six-volt filaments, which have, generally speaking, better characteristics. Of course, there is no real reason why an existing stock of the former valves should not be used up, as the same amount of current will be consumed, although the proportional wastage will be higher.

It is not generally realised that there is no objection to mixing valves rated at different filament voltages; it is essential, however, that their current rating should be the same.

There is inevitably a certain amount of risk of damaging valves when they are connected to a high-voltage source, so it is not a bad plan to take the precaution, while making preliminary adjustments, of inserting a "dummy" filament in each holder. This may easily be made with a few yards of fine resistance wire wound on a small bobbin; its resistance value should be the same as that of the valve. (The latter is easily calculated by dividing rated volts by rated amps., the answer being in ohms.) As a guide to the gauge of wire to use, it may be stated that Nos. 36 and 40 Eureka have resistances of, respectively, about 15 and 37 ohms per yard.

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THE "EVERYMAN FOUR" ON LONG WAVES

IT is well known that for reception of the long waves the H.F. amplifying stage of this receiver is eliminated; with this alteration the aerial is directly coupled to the detector valve grid coil, and conse-

quently it will sometimes be found, when receiving Daventry, that there is interference from a near-by medium-wave station. As has already been stated in these columns, a considerable improvement in selectivity may be effected by connecting in series with the A_3 terminal and the aerial a fixed condenser of some 0.0002 mfd. There is, however, another method which involves no addition, and which is often equally effective.

It is generally realised that the selectivity of a circuit is greatest when the proportion of capacity to inductance is highest. The circuit in question may be made to conform to this requirement by gradually removing turns from the long-wave loading coil until the long-wave station is "tuned in" with nearly maximum condenser reading.

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COIL CONSTRUCTION.

IN the early days of wireless telegraphy it was common practice to finish off single-layer solenoid coils by means of lengths of tape with which

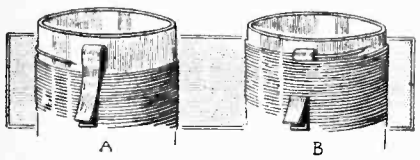

Fig. 2.—Securing the last turn of a solenoid cell by means of a short length of tape.

the last turn is secured in the manner shown in Fig. 2. This refinement seems to have fallen into disuse of late, but it can nevertheless be recommended, particularly as applied to unprotected interchangeable coils, which must of necessity be subjected to a certain amount of handling, and which should therefore be reasonably robust.

The method of procedure will be fairly obvious from a consideration of Fig. 2. The first step is shown in drawing A; when some half-dozen turns remain to be put on, a short length of tape or silk ribbon, folded double, is laid on the former in the manner shown, and the winding is continued over the loop. The last turn is passed through it as in drawing B, after which the loose ends are pulled taut and then cut off level with the wire.

Either two or three equally spaced lengths of tape should be used at each end of the coil; the procedure at the starting end will be slightly different, as the wire must be passed through the loops before beginning the operation of winding.

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L.F OSCILLATION.

One of the troubles which has become common in these days of highly efficient valves and H.T. "battery eliminators" or "mains units" is that of interaction between the L.F. stages of a receiver.

This trouble is generally manifested by a rattling noise in the loud-speaker not unlike the water-hammer effect one sometimes finds when a household tap is partially turned on. On rare occasions it may show up as a cyclic increase and decrease in signal strength not unlike fading.

One almost certain cure (if the receiver be transformer coupled) is to reverse the primary or secondary connections of one of the transformers. If a cross-over is to be made it is better, as a rule, that it should be done on the primary side.

Another way of mitigating the L.F. oscillation difficulty is greatly to increase the size of the condensers in the mains unit, or better still to use an entirely separate source of supply for the last valve. Neither of these two schemes is, however, particularly economical.

In the case of resistance-coupled receivers the trouble is serious, and will probably only be cured by the use of a separate source for the last valve, as already mentioned, or by reducing the value of the anode-grid coupling condensers which, unfortunately, robs the receiver of some of its low-tone capabilities. However, it should be pointed out that some loud-speakers which are inherently weak on the reproduction of these tones are actually improved by a proportionate reduction of their intensity in the amplifier.

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NOISES ON SHORT WAVES.

ANYBODY who has done much reception on wavelengths below 80 metres will know what a nuisance loose contacts anywhere near the receiver can be, particularly when the receiver is in a state of oscillation for the purposes of searching or receiving C.W. signals. The trouble is manifest as a scraping or crackling sound in the telephones, and sometimes quite a lot of hunting is necessary before the particular metal object causing it is found. Very often the cause is traceable to the telephones themselves, and is found to be due to looseness in the swivel suspension by means of which the earpieces are attached to the head-band. If this is so it can easily be proved by rattling the earpieces briskly, when the scraping noises will become worse. This sort of thing will happen on short wavelengths even though the telephone leads are shunted with a blocking condenser. The cure is to make all the swivels or pivots holding the earpieces fairly stiff and to take up all wobble. Lubricate the rubbing metal surfaces of all swivels with a small spot of oil. Sometimes a little lubrication alone is enough to stop the noises without the necessity for any adjustment.

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TERMINAL CONNECTIONS.

THERE is a right and wrong way of carrying out the majority of operations associated with a wireless receiver. The task of connecting a lead to a terminal, simple as it would

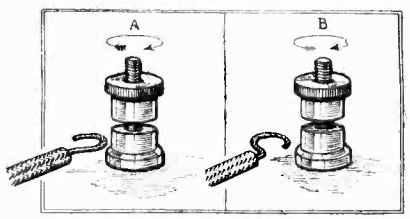


Fig. 3.—Incorrect (A) and correct (B) methods of connecting a looped wire to a terminal.

appear, is a case in point which may not be obvious to beginners. It will be found that, unless the loop in the end of the wire is bent in the same direction as that in which the terminal head is rotated when it is being tightened up, there will be a tendency for this loop to straighten out, with the result that the connection will become less perfect, and, if the receiver is subject to vibration, the lead will very possibly be displaced. The right and wrong methods are illustrated in Fig. 3.

The observance of this precaution is specially recommended where internal permanent connections are being made, either with terminals or nuts and screws; troubles due to incorrect procedure are most likely to manifest themselves when the diameter of the terminal heads or nuts is small.

WIRELESS AND METEOROLOGY.

Atmospherics Used to Trace Progress of Hurricanes in the West Indies.

By Our New York Correspondent.

THE disastrous hurricanes which swept the West Indies last autumn, and particularly the one which wrought such havoc in Miami, served very forcibly to draw the attention of the world to these great storms. They are an annual event, but seldom do they come in such numbers or with such intensity as they did last year. Every year they do an enormous amount of damage and take toll of many human lives on one or other of the many islands which go to make up the West Indies. Sometimes, as was the case last year, they reach the mainland of Mexico or the southern coast of the United States, where the population is denser, causing even greater loss of life and heavier damage.

The United States Weather Bureau has done much to mitigate the evil, by collecting information about the movements of these storms and telegraphing warnings to places which appear to lie directly in their path. It is, however, extremely difficult to get accurate information about the approach of a hurricane, for they approach rapidly from far out on a part of the Atlantic which is unfrequented by shipping equipped with wireless.

The breeding place for these hurricanes lies in the Doldrums, a calm region of low barometric pressure lying in the vicinity of the equator. Actually, they are believed to have their origin south and east of the Cape Verde Islands, near the African coast. From there they travel at a speed of something like 300 miles a day in a west-north-westerly direction, until they reach the West Indies, when they usually curve northward in general conformity with the configuration of the land they encounter.

Once a hurricane has reached one of the outlying islands, its progress can be followed accurately and warnings sent on in advance to places which appear to lie in its direct path, but there is always the risk that the storm will suddenly alter its course, missing some place which is expecting it, and striking another place which expected to be missed and is therefore unprepared.

The curse of atmospherics has been with us ever since the invention of wireless, and it still persists in marring our broadcast reception to-day, despite the long years during which some of the world's leading scientists have devoted their time and energies to the problem of the elimination of the effects of static.

The volume of atmospherics we get in this country, even during the worst spells of the year, is in no way comparable with that experienced in tropical countries. The volume of static experienced in the vicinity of the West Indies—in the Gulf of Mexico and the Caribbean Sea—is at certain times of the year stupendous. Even a nearby station is often completely blotted out by a continuous crashing roar of static.

Those familiar with wireless conditions in the Gulf of Mexico and the Caribbean Sea have long noticed that the periods of heaviest static occur during the hurricane season, *i.e.*, July, August, and September, and that conditions are at their very worst when a hurricane is raging somewhere in the area.

It is clear, therefore, that hurricanes announce their approach of their own accord and in unmistakable terms, but it has been left to an officer in the U.S. Navy, Lieut. E. H. Kincaid, to evolve the theory that the strength of static is proportional to the rate of change of barometric pressure, it already being a known fact that the static emanating from an intense cyclonic storm is greatest at or near its centre. Having developed this theory, Lieut. Kincaid proceeded to put it to the test, using for the purpose a wireless direction finder, to see if he could accurately follow the track of a hurricane, and the story of his success makes interesting reading.

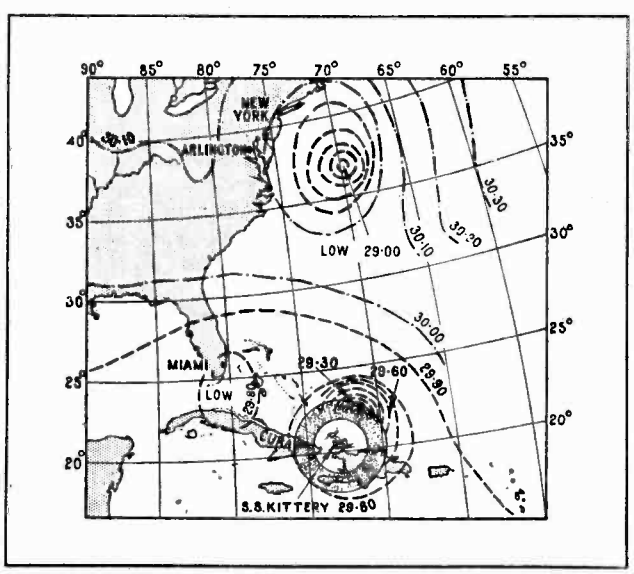


Fig. 1.—Intense static graph taken on the evening of September 16th, 1926, while riding out the Miami hurricane. Note isobars indicating intense area of low barometric pressure. Reception from Arlington and other points impossible owing to extreme intensity of static.

Observations on the *Kittery*.

For two years Lieut. Kincaid was navigating officer of the U.S.S. *Kittery*, a small naval auxiliary making regular trips between Hampton Roads (Virginia) and the West Indies. Her itinerary included the islands of Cuba, Haiti, Porto Rico, and the Virgin Islands. Since the *Kittery* is a small, flat-bottomed craft, it was of some considerable importance that she should know in advance what kind of weather lay ahead of her, so that, if necessary, she could run for shelter before becoming involved in the full fury of a storm.

For this purpose weather maps were made use of, the information wherewith to construct these maps being received on board daily from the naval wireless station at

Wireless and Meteorology.—

Arlington. It was soon found that there was a certain distinct relationship between the state of the atmosphere, as revealed by the weather maps; and atmospherics, as these latter affected reception of the reports from Arlington.

The ship's wireless operator became a static barometer. Every time he reported heavy static, an area of changing atmospheric pressure was found to be between the *Kittery* and Arlington, or the ship was close to some one of the islands where local static was intense. Apart from static caused by hurricanes, there is, in that region, a more or less steady static level which is subject to seasonal changes, diurnal changes, and local conditions. Anyone used to a particular locality in the region can quickly tell whether static conditions are above or below normal for the time of day and season of the year at which the observation is made.

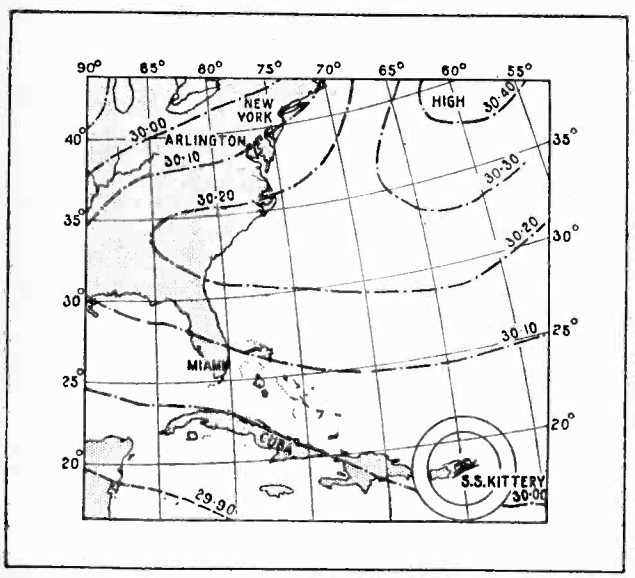


Fig. 2.—Static graph taken on the morning of September 24th, 1926, showing no static on a complete revolution of the D.F. pointer. Note relation between this condition and evenly disposed high pressure isobars; fine weather and good wireless reception.

The type of weather map which coincided with the heaviest static was noted, and in every case where static was intense, there was on this map a storm, trough of low pressure, or other depression of low or falling barometer between the *Kittery* and Arlington. Reception was impossible when the Nassau and Miami hurricanes were between Arlington and the *Kittery*.

It was further observed that the intensity of the static would invariably be proportional to the intensity of the atmospheric disturbance lying between the transmitting and receiving stations. That is to say, the intensity of the static depended upon the steepness of the pressure gradient. Fig. 1 shows the steep gradient experienced by the *Kittery* while riding out the Miami hurricane, when it was impossible for her to receive Arlington.

Furthermore, improved reception resulted from the passage of such depressions when the area between the *Kittery* and Arlington was occupied by a high pressure area. This is shown in Fig. 2. The ring of dotted lines round the ship in Fig. 1 indicates the volume of static received from all points of the compass. In Fig. 2 the ring is devoid of static. The method of obtaining these rings will be explained later on.

It was found that static was particularly mild if the area of high pressure was a large active one, with rather evenly formed isobars showing an even pressure distribution within it.

These observations led to the conclusion that static was either directly or indirectly due to the consequences of steep pressure gradients.

Direction Finder Brought Into Service.

Other ships had for years noticed these conditions in a general way, but had not taken the trouble to compare accurately static conditions with the weather maps. Lieut. Kincaid did, and pondered long and deeply over the matter. Finally he decided that a direction finder might help him to come to some more definite conclusions on the subject, so he applied for one, and it was installed early last summer.

From a purely scientific point of view, luck seemed to be with the investigator, for he had before him one of the worst hurricane seasons on record, and the *Kittery* was in them all. In July, when on her first trip with the direction finder, unusually strong atmospherics were heard while in Crooked Island Passage, and when the direction finder was swung on them, they were found to be sharply directional to the eastward of the Lesser Antilles, and are believed to have emanated from the hurricane which later became known as the Nassau Hurricane, owing to the damage it caused to that island.

The progress of this hurricane is illustrated in Fig. 3. At that time the *Kittery* was not equipped with a static recorder, so only the general direction of maximum static, as observed aurally, could be recorded on the chart, as shown in the figures.

It is worthy of note that in Fig. 3 the direction of maximum static does not pass through the exact centre of the storm, but through a point very close to it. This tallies with the frequently observed fact that static diminishes considerably, or dies out altogether, when the observer is located in the centre of a cyclonic disturbance, where the sky is often clear and the weather dead calm.

The static is most intense round the edge of the centre, where the winds are most violent, which seems to suggest that the static is formed by the friction of conflicting air currents, just as electrostatic electricity is formed by friction in a Wimshurst machine.

During the progress of the Nassau hurricane the direction finder was of direct assistance to the *Kittery* while she was *en route* from Guantanamo to Port au Prince, Haiti, for it indicated that the storm would pass to the northward of Haiti, thus leaving her unaffected.

Telephoto Receiver Used as Recorder.

At this time the *Kittery* was equipped with a Jenkins weather map receiver, an adaptation of that well-known inventor's system of phototelegraphy. By means of this receiver, the weather maps could be received directly in map form, instead of having to be laboriously plotted out on board from a long coded report, sent telegraphically, for the region. It was soon noticed that static, as in other forms of wireless reception, greatly marred the

Wireless and Meteorology.—

received maps, but this fact inspired the investigator to use the machine as a static recorder.

On her next trip, therefore, the *Kittery's* direction finder was hooked up to the weather map receiver, the L.F. output of the D.F. being taken to the input terminals of the map machine instead of to a pair of phones. The paper wrapped round the receiving cylinder was scaled from 0 degrees at the starting end to 360 degrees at the finishing end. Commencing with the D.F. pointer at 0 degrees, the machine was started, and as the cylinder rotated the D.F. pointer was turned by hand at the rate of 10 degrees per minute. The resultant record thus gave a graph of static conditions in all directions, a particularly heavy record at any particular part of the graph indicating heavy static in the direction shown by the degree scale.

These graphs, however, give little more than the *quantity* of static in any given direction. It remains for an additional attachment, which the Bureau of Engineering, U.S. Navy, and other sources are perfecting, to give the relative *intensity* of the individual impulses.

The month of September, 1926, was marked by an unusual degree of tropical storm activity in the region of the West Indies, for in addition to the Miami hurricane there were no less than four other storms of tropical origin. The tracks of the Bermuda hurricane, the Swan Island hurricane, and the Miami hurricane were faithfully and accurately recorded by means of the graph instrument, and the *Kittery*, by artful dodging, evaded every storm and arrived at her destinations on time.

The striking accuracy with which the various hurricanes were traced is exemplified in Fig. 4, where the static graph around the *Kittery's* position shows its directional properties in spite of the fact that she was, at the time, between two centres.

At the time the observations recorded in Fig. 4 were taken, the *Kittery* had just passed between the Bermuda hurricane and the Swan Island disturbance, and now faced the Miami hurricane. Fig. 5 shows the static experienced by the *Kittery* between the latter two storm centres. While the Swan Island disturbance gave most static, some static was also noticeable in the direction of the approaching Miami hurricane.

In his official report, Lieut. Kincaid says: "Having plotted the position of this hurricane twice daily, it was predicted that the centre would pass sufficiently to the northward of Cape Haitien for the *Kittery* to reach that port according to schedule. This prediction was correct. All precautions were taken, however, for encountering heavy weather.

"The ship left Cape Haitien before dark and rode out the storm in comparative safety in the lee to the northward of Tortuga Island, which rises abruptly to a height of 1,200ft., with deep water close up to it. The *Kittery* steamed in the lee all night, where the apparent force of the wind was reduced to gale force and the seas were negligible, although in the upper air above the island the wind could be seen by the clouds to be of hurricane violence.

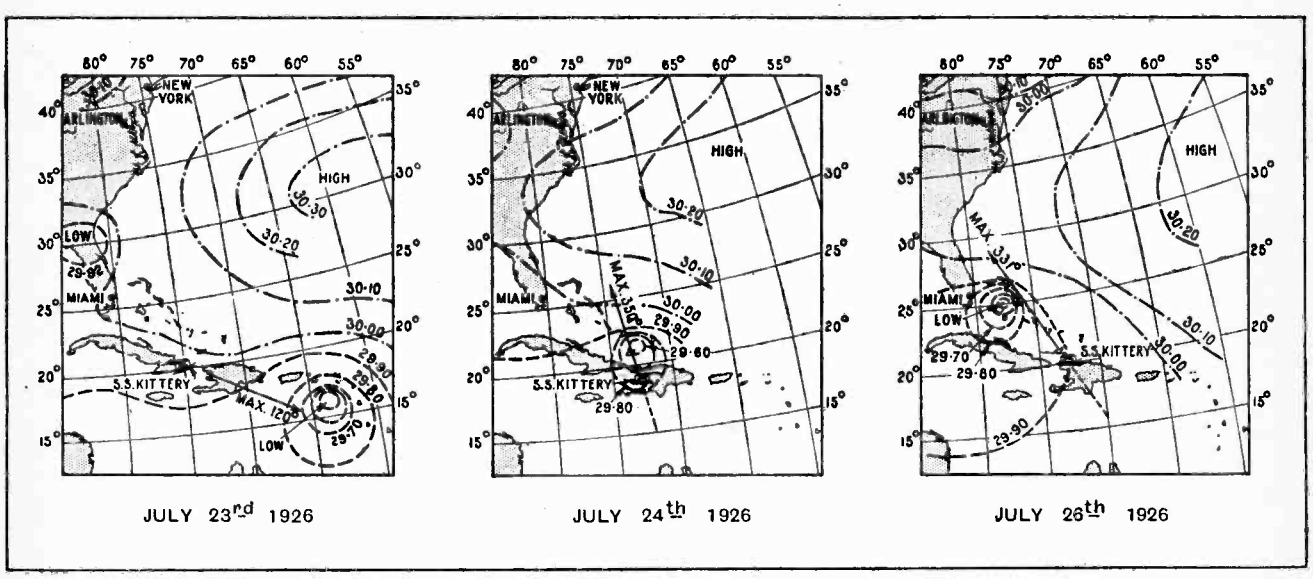


Fig. 3.—Maps showing direction of maximum static during the Nassau hurricane.

The static graph shown in Fig. 2 was taken on September 24th, after the passage of these hurricanes. The record is free of static all round the compass, and reception from Arlington was as clear as a bell. Lieut. Kincaid points out that good weather, both from the meteorological and a wireless point of view, is indicated by the fact that the morning of September 24th was the only time during the month when no static was recorded on a complete revolution of the compass.

Lieut. Kincaid seems to have been particularly fortunate in the number and frequency of the hurricanes he encountered, though probably his shipmates would be inclined to express themselves somewhat differently on the subject, with dark allusions to one, Jonah! However, from a purely scientific point of view, had the *Kittery* not encountered all these tropical disturbances within such a short interval of time, it might have required several years of observation to obtain adequate data to support

Wireless and Meteorology.—

Lieut. Kincaid's theory. As it turned out, conclusive proof was obtained from two successive voyages.

As a result, ships equipped with a direction finder and a static recorder can, by application of the theory that static intensity depends upon the pressure gradient, readily locate the hurricane's position, follow its track,

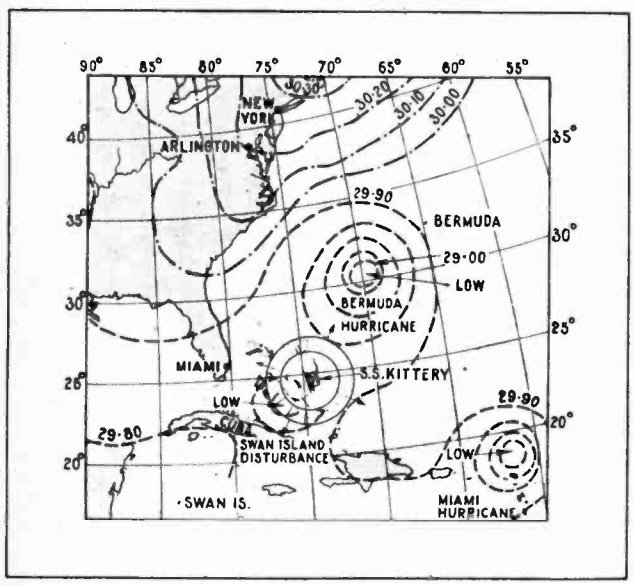


Fig. 4.—Static graph taken on the afternoon of September 14th, 1926, showing maxima between Bermuda and Swan Island hurricanes.

and thus avoid its fury. The elements of surprise and unpreparedness, which are frequently the cause of disaster, can now be eliminated.

Land D.F. Stations Projected.

Arising out of the results obtained by the *Kittery* in locating and tracing hurricanes, it is proposed to utilise existing U.S. Naval D.F. stations for the purpose of practising the picking-up of directional static, and if satisfactory results are obtained the next logical step will be the erection of special D.F. stations on several of the outlying islands. These stations would be so chosen that simultaneous bearings could be taken of directional static, and by the process of triangulation already used in finding the position of ships, the position of an advancing hurricane could be found with accuracy several days before its arrival at the islands, thus giving ample time for warnings to be circulated. Hourly observations would then accurately reveal the storm's progress and course.

Those afloat in large or small vessels could then have ample time to seek refuge, and those ashore could make preparations for the security, as far as possible, of their property.

The value of such arrangements, expressed in terms of human lives, will be appreciated when it is pointed out that thousands of West Indian natives depend upon the prevailing trade winds to earn their living. The fishermen of these islands particularly put their faith in these winds. In the early morning they may be seen sailing out to sea on the land breeze, returning at sundown on the sea breeze. They do this with regularity, day after day. Every hurricane which happens along takes a tremendous toll among these natives. The same applies to the sponge divers of the Bahamas, and to the inter-island traders.

Accurate hurricane warnings would also be invaluable to the densely populated areas in Florida and along the north coast of the Gulf of Mexico. By the time a hurricane gets so far north it is, of course, under close observation by the meteorological authorities, but they can only record progress *as it is made*; they cannot accurately forecast the future track of the storm, for by the time it reaches the coast it invariably curves in a more northerly direction, but it is impossible to foretell accurately just how and when it will curve. Its rate of progress may also alter suddenly.

The writer was in New Orleans in 1915 when that city was wrecked by a hurricane. Previous hurricanes had always curved away from the city, so that it came to be known as the "storm-proof city," and little notice was taken of the approaching hurricane until it actually struck the town, it having failed to curve away as usual.

Frequent D.F. observations of maximum static would enable the storm centre to be accurately located, and at least an hour or two's warning given of its approach before it actually arrived, thus enabling precautions to be taken to minimise loss of life and damage to property.

The results obtained by the *Kittery* last year have aroused a considerable active interest on the part of several American Government departments, and the progress made in following up the results will be watched with keen interest by both wireless men and meteorologists. If it can be proved that accurate and valuable results can be obtained in connection with West Indian hurricanes, there is scope for the adoption of the plan in other parts of the world where intense tropical storms occur, such as in the Bay of Bengal and in the China Sea.

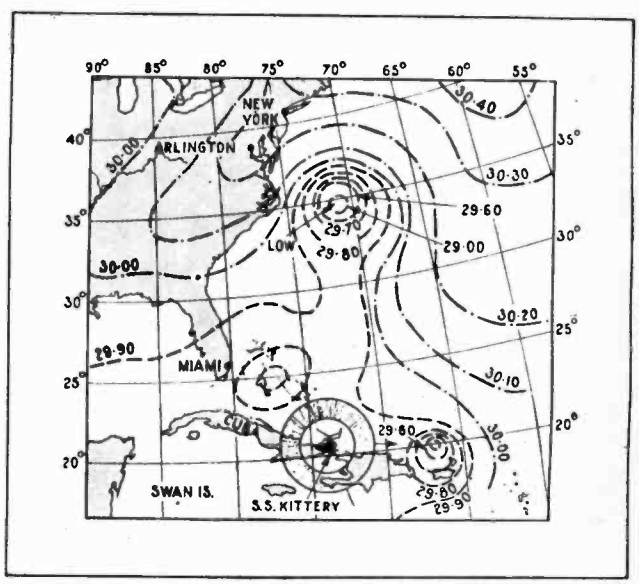


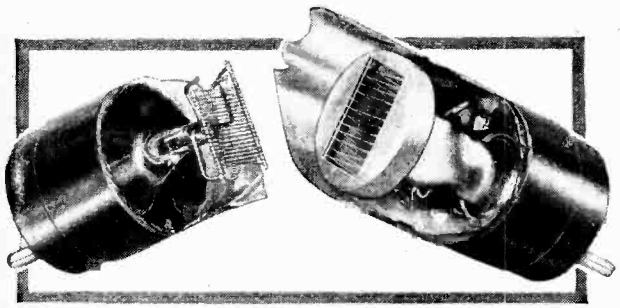
Fig. 5.—Static graph taken on the afternoon of September 15th, 1926, showing the two maxima between the Swan Island and Miami hurricanes.

THE COSSOR SCREENED VALVE.

Characteristic Curves and Practical Hints for Best Conditions of Working.

THE general principles underlying valves in which the anode or plate is screened electrostatically from the control grid have been set forth recently in this journal.[1] It will be clear to those who have conducted experiments with screened valves in a receiver, that they are in every way superior to any neutrodyne combination. The valve we have just tested is produced by Messrs. A. C. Cossor and has a low filament wattage, namely, 2 volts 0.1 ampere, *i.e.*, 0.2 watt. The filament, control grid and anode (which is invisible, due to the gettering) are of conventional design. The screen, shield, or screen grid (as it has been termed) is, to all intents and purposes, an ordinary grid let into a rectangular aperture in a flanged shield near the anode. The arrangement of the electrode is transverse, as distinguished from those of the G.E.C. of America valve, whose electrodes are cylindrical.

The filament and control grid are brought out to a three-pin socket at one end of the valve, whilst the screen and anode are taken to a two-pin socket at the opposite end. Both sockets are alike, and the spacing of the pins is identical with that in the usual three-electrode valve socket. In fact, each socket has four holes, three being used at one end, and two at the other.



Interior construction of the Cossor screened valve; the filament and working grid are on the left, while the anode and screen grid are on the right.

It is not clear which is the anode pin and which the screen grid pin. There ought to be some indication on the valve to distinguish between the two. The user should note, therefore, that when the valve is viewed from above with the filament end to the left and the three pins at the bottom, the screen grid pin at the right-hand end is nearer to him. If this fails to locate the screen grid it is a very simple matter to conduct a test. With filament lighted and the negative to the control grid, there will be no anode current when a voltage of, say, 120 is applied, provided the screen grid is free. If the voltage is applied to the screen grid, the anode being free, a current will flow, since the screen grid will function as the anode of a three-electrode valve.

[1] *The Wireless World*, August 31st, September 7th and 14th, October 19th and 26th, 1927.

Another point to be noted is that, with the early samples received, the length of the valve from socket to socket (overall) varies $\frac{1}{8}$in. or more, which is not always convenient. If a holder with vertical spring clips is used, there must be room to accommodate the longest valves.

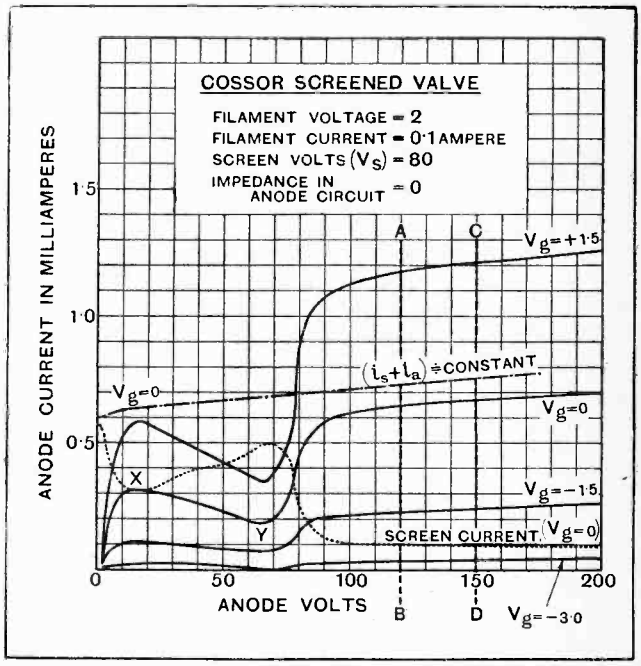


Fig. 1. — Characteristic curves of the Cossor screened valve. When $Vg = 0$, the amplification factor is 400 and the internal resistance 2 megohms.

The characteristic curves of one of the Cossor valves submitted for test are given in Fig. 1. They are of the same nature as those previously described in this journal. There is, however, a marked difference in the magnification factor and the internal resistance. The working part of the characteristic is usually that between the two dotted lines AB, CD. That is to say, one usually works with screen volts = 80, anode volts = 120 to 150, and grid bias between 0 and − 1.5. Of course, any part of the characteristic can be used. For example, if we select the points X or Y we have the extremely interesting case of zero damping due to the valve, since at both points the tangent to the characteristic curve is horizontal.[2] This being interpreted mathematically means that the internal valve resistance is infinite. In practice, the effect of absolute zero damping will be approximate, since allowance must be made for grid volt swing and anode volt swing due to incoming signals. But for really weak signals the damping is substantially zero, *i.e.*, the tuning curve of a tuned anode would be that of the coil and condenser alone.

[2] The amplification at X or Y is smaller than at $Va=120$ since g is less.

The Cossor Screened Valve.—

The high internal resistance of 2 megohms at $Vg = -1.5$ volt means that the valve damping is in general negligible. It is clear from the articles mentioned previously that ordinary coils (not low loss) are best suited for use with screened valves. The dynamic resistance of a tuned circuit with an ordinary coil is probably of the order 10^5 ohms, or one-twentieth that of the valve. It will be seen from Fig. 1 that when the bias Vg is fixed at -1.5, the current variation at, say, $Va = 120$ volts is greater from -1.5 to 0 than from -1.5 to 3 volts. To avoid distortion the amplitude or signal swing must be small (it usually is in the H.F. part of the amplifier). Distortion of this type at H.F. gives rise to auxiliary frequencies which are multiples of the signal frequencies. Provided they are by-passed and prevented from entering the L.F. amplifier, little harm results. Nevertheless, it is not desirable to have such distortion, and in cases where the amplitude is likely to reach 0.5 volt the grid bias should not exceed about -1.0 volt, which is awkward when bias cells are used.

The magnification factor is about ten times that of any three-electrode valve on the market. With the accompanying high internal resistance the actual magnification with an impedance Z can be written gZ where g is the mutual conductance or change is anode current per volt change on the grid. At $Vg = -1.5$ and $Va = 150$, $g = 2 \times 10^{-4}$ ampere per volt. Thus with a tuned anode of dynamic resistance 1.5×10^5 ohms the amplification would be $2 \times 10^{-4} \times 1.5 \times 10^5 = 30$, which would give ample stability. This is some way off the actual valve magnification of 400. The relatively small magnification is due to the small value of g, or alternatively to the high internal valve resistance which drops most of the A.C. voltage.

Tested in a four-valve receiver with 1 H.F. stage, the results were in every way satisfactory, there being no suspicion of oscillation. The set was, of course, specially designed for screened valves and had an external screen for the valve, also the coils were screened. The coils used were toroidal (substantially small external field) and wound with solid wire. Tested in a five-valve set (2 H.F.) with very small open aerial or a frame, the Continent of Europe could be searched with ease.

Belgian Amateurs.

Mr. J. Blanchart (EB 4EW), 59, Avenue des Tilleuls, Vieux Dieu, Antwerp, is now active on the 45-metre waveband with an input of about 40 watts and will welcome reports.

Mr. P. Duvigneau (EB 4AC), 16, rue de l'Eglise, Antwerp, the city manager of the Reseau Belge, is transmitting regularly between 0600 and 0800 G.M.T. and keeps up a regular schedule with OZ 4AC, Mr. R. E. Robinson, 3, Chetham Avenue, Dunedin, Otago.

Mr. Louis Era (EB 4BC), 46, Avenue van Put, Antwerp, the district manager of the Reseau Belge, has been active since November 1st with an input of 80 watts pure D.C., using the Levy type of aerial. He has been in two-way communication with a number of stations in Australia and New Zealand, including OZ 4AA, when this station was being operated by Miss Bell on November 8th.

Mr. Era has also kept up a regular schedule since November 16th with ARCX, the Norwegian whaler *N. T. Nielsen Alonso* in the Antarctic Ross Sea, the signal strength at each end sometimes reaching R7. ARCX transmits on 30.5 metres every day at 0700 G.M.T. After clearing his traffic with Bergen LGN, the operator, Mr. H. Olsen, listens for amateurs.

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A New Rhodesian Station.

Mr. G. G. Livesey writes to us from Southern Rhodesia, where he has been granted a transmitting licence for wavelengths up to 200 metres. His call-sign is FO 3SRB, and he is now transmitting on 20 and 40 metres. His input at present is derived from either dry cells, a hand generator, or an M-L converter, but ultimately he will be using 50 watts to a VO/50 Mullard oscillator and the wavelengths will be crystal controlled. The station is thirty-five miles from any town and 5,000 feet above sea level. He is comparing the efficiency of high- and low-angle radiators, the first system to be tried being a half-wave horizontal oscillator, current fed, and 40 feet above earth. Mr. Livesey will welcome reports from British amateurs, which should be addressed to him c/o Mr. Chapman, "Killarney," Lalapanzi, Southern Rhodesia.

TRANSMITTERS' NOTES

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International "Z" Code.

With reference to the International "Z" Code published in our issue of October 12th, page 509, and in response to the subsequent note on page 554 of our issue of October 19th a correspondent has kindly sent us a revised list, from which we take the following interpretations which supplement or correct those in our previous list :—

ZWR	Your signals weak but readable.
ZOD	Your collation is different.
ZRO	Are you receiving OK?
ZRC	Can you receive code?
ZHY	We are holding . . .
ZMP	Mispunch or perforator failure.
ZCW	Are you in communication with . . .
ZPP	Punch plain only.
ZFB	Signals fading badly.
ZRA	Reversed auto tape.
ZFS	Your signals fading slightly.
ZHS	Send high speed auto . . . WPM (words per minute).
ZSO	Transmit slips once.
ZTH	Transmit by hand or at hand speed auto.
ZST	Send slips twice.
ZMQ	Stand by for . . .
ZOH	How many messages on hand?

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Reception of Australia (2FC).

In our issue of November 23rd we suggested the possibility that the signals heard by a correspondent on an "Empire" short-wave receiver without either aerial or earth might have been on a harmonic of 2LO. We have since received reports from other correspondents of similar reception of 2FC, which make it clear that our scepticism was unfounded. A correspondent in Somerset tells us that he received this station at good loud-speaker strength on a modified "Empire" two, with one additional L.F. stage, on October 30th and, incidentally, remarks that he also found difficulty during the first fortnight of October in receiving distant short-wave stations.

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Australian Amateurs.

We are indebted to our contemporary, "Radio in Australia and New Zealand," for the following new QRA's and changes of address :—

2FM	A. Murray, 38, Cowles Rd., Mosman, N.S.W.
2RZ	J. Atkinson, 50, Spencer Rd., Mosman, N.S.W.
2WF	W. Fulton, 244, New Canterbury Rd., Petersham, N.S.W.
3AX	L. Askew, Deacon Ave., Mildura, Victoria.
3BH	C. R. Whitelaw, Railway Terr., Violet Town, Victoria. (Change of address.)
3CP	C. I. Patterson, 82, Burke St., East Malvern, Victoria.
3JJ	J. McMath, 54, St. Vincent Pl., Albert Park, Victoria.
3KS	J. Simms, 22, Epping Rd., East Malvern, Victoria.
3XK	(Ex 6KX) H. T. Simmons, 7, Wandsworth St., Moonee Ponds, Victoria. (Mr. Simmons has moved from his old address at Subiaco.)
7LJ	L. R. Jensen, Pedder St., New Town, Tasmania.

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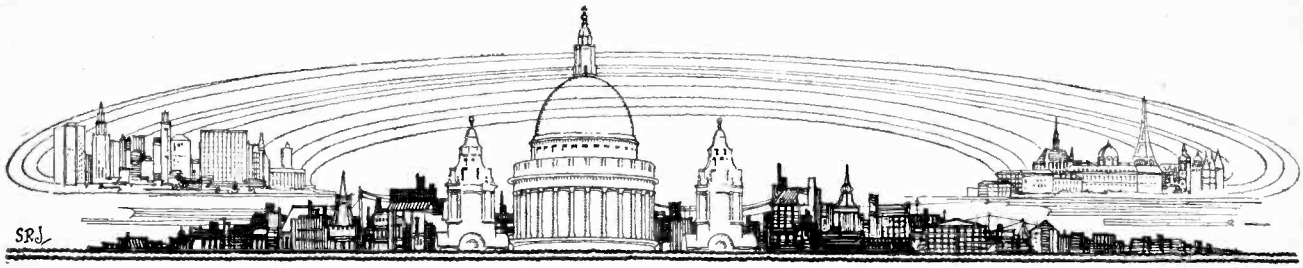
New Call-signs and Stations Identified.

6FI	(ex 2AWF) F. G. Ingleton, 48, Grasmere Rd., N.10.
6FM	D. Milner, 64, Bury St., London, N.9.
6KW	R. Kirlew, 11, Compton Road, N.21.
6MB	A. J. Buttress, 7, Mill St., Oakham. (Change of address.)
6SZ	K. Riley, 24, The Brent, Dartford, Kent. (Change of address.)
6YR	W. Hartley, 10, Claro Avenue, Harrogate. (Change of address.)
6ZR	C. R. Ponting, 11, Woolcott St., Redland Bristol.
2AIN	H. A. White, 5, Drakewood Rd., Streatham, S.W.16. (Change of address.)
2BLL	— Davies, 22, Graingers Lane, Cradley Heath, Birmingham.
FO 3SRB	G. G. Livesey, c/o — Chapman, "Killarney," Lalapanzi, S. Rhodesia.
GW 13D	R. V. N. Sadleir, 1, Summerville Park, Upper Rathmines, Dublin, S.W.4.
NB BE3	A. E. Redman, Devonshire, Bermuda.
NX 1XL	Hobbs Expedition, Greenland.



CURRENT TOPICS

Events of the Week in Brief Review.

DON'T BE LEFT!

According to reports from the trade Christmas, 1927, may prove a record one for wireless. The public demand for sets and accessories, notably loud-speakers, was never greater. Moral: Buy now before the stocks run out!

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GREETINGS BY WIRELESS.

Specially reduced rates are available until December 31st for telegrams of greeting sent by the Imperial Cables or by the Empiradio Beam Wireless Services. Telegrams will be accepted at all postal telegraph offices.

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WHO WILL PAY?

The Dean and Chapter of Exeter Cathedral state that they are unable to afford the installation of loud-speakers in the nave, as requested by members of the congregation. The equipment would cost £150, and the clergy suggest that the congregation should raise the money.

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PHYSICAL AND OPTICAL SOCIETIES EXHIBITION.

The eighteenth annual exhibition of electrical, optical, and other physical apparatus is to be held by the Physical Society and the Optical Society on January 10th, 11th, and 12th, 1928, at the Imperial College of Science, South Kensington.

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SUNDAY CLUB'S WIRELESS.

Father Degen, who has just opened a Sunday night club at Coalville, Leicestershire, has hit upon wireless as one of the incentives to membership. By means of broadcast concerts, books, and dancing, he hopes to keep the Coalville youth off the streets and to provide them with healthy recreation.

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DEATH OF ADMIRAL BULLARD.

By the sudden death, on November 24th, of Rear-Admiral W. H. G. Bullard, chairman of the U.S. Federal Radio Commission, American wireless has suffered a severe loss. For more than fifteen years Admiral Bullard had confined his work almost exclusively to radio communication, having been the first superintendent at the U.S. Naval Station, NAA.

ATLANTIC WIRELESS ANNIVERSARY.

Monday, December 12th, marked the twenty-sixth anniversary of Senatore Marconi's reception of the first Transatlantic wireless signal.

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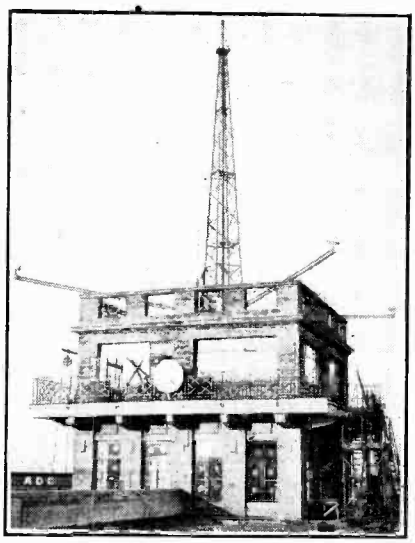
WIRELESS DEVELOPMENTS AT CROYDON

One of the most interesting features of the improved air port which is being busily prepared at Croydon is the new control tower, a photograph of which appears below. The tower contains the



WIRELESS GUIDE FOR AIRCRAFT. The new control tower at Croydon Aerodrome, showing the wireless mast. Continuous watch will be kept in order that distant aircraft can always obtain their bearings by reference to the Croydon transmissions.

wireless telephony and direction finding equipment which will be used to control the movements of aircraft over considerable distances, especially during fogs, when pilots have to rely solely on wireless to guide them to their destination. It is expected that the control tower will come into operation before the end of January.

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IS THE P.O. TOO STRICT?

An interesting magisterial comment regarding the Post Office and the Wireless Act was made by the Mayor of Penzance when fining Hedley Watkins for installing and working a receiving set without a licence.

"I am desired by the bench to say," remarked the Mayor, "that they consider some little time should be allowed by the authorities to people who are putting up an apparatus in order that they may have it tested, before being summoned."

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BEAM TO THE FAR EAST?

In the annual report of Marconi's Wireless Telegraph Co., Ltd., the directors express the hope that they will soon be in a position to make a statement with regard to the opening of a beam service with the Far East.

The beam stations are carrying an increasing volume of traffic. During the week ended December 3rd, 1927, the total number of words carried over the four circuits was at the rate of 34,840,000 words a year.

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CAPTAIN DUNCAN SINCLAIR.

Friends of Captain Duncan Sinclair will be interested to know that he has resigned his appointment as Chief of the Civil Aviation Wireless Section, and has now taken charge of the radio laboratory of the research department of the Igranic Electric Co., Ltd., Bedford.

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BAD FOR THE FISH.

The captain of an English trawler recently had cause to regret that his ship was not fitted with wireless. While on a certain fishing ground which was yielding large quantities of fish, he encountered a French trawler whose captain made immediate use of his wireless equipment to summon the other ships of his fleet. Within a few hours twenty other French trawlers arrived, and all of them steamed away with heavy catches.

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PICTURE TRANSMISSION DEMONSTRATED AT GENEVA.

A demonstration of picture transmission by wireless was given to representatives of the League of Nations at Geneva on December 8th. The system employed is an adaptation by Captain Fulton of the Thorne Baker process. For the purposes of his demonstration, Captain Fulton had both transmitting and receiving apparatus

in full view of the audience, says *The Times* correspondent.

The electrical impulses from the transmitter were relayed by telephone lines to the Geneva broadcasting station, some five miles distant, and the signals from the station were received in the demonstrating hall on an indoor aerial. Under their influence the receiver traced with striking fidelity a counterpart of the original photograph. A portrait of Sir Austen Chamberlain, postcard size, was broadcast and received in four minutes, the middle tones being surprisingly well reproduced.

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YOUR 1928 DIARY.

The many wireless amateurs who feel the need of a pocket compendium of information are saved the necessity of carrying a more or less bulky tome in each pocket by the possession of a "Wireless World Diary and Notebook," the 1928 edition of which has just been published. Among the special features are a glossary of technical terms, a list of British and European broadcasting stations, receiver notes, and modern valve data.

Copies are obtainable from the leading booksellers and stationers, or from the publishers, Iliffe and Sons Ltd., Dorset House, Tudor Street, London, E.C.4. The cloth edition is 1s., postage 1½d. extra; the leather case edition, with pencil and season-ticket holder, is 2s. 6d., postage 2d. extra.

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A CORRECTION.

A regrettable error occurred on page 635 in *The Wireless World* of November 9th, 1927, where in the wiring plan of the Super Seven I.F. unit the leads K and M are incorrectly marked. M should apply to the leads joined to I.S. tags of the H.F. transformers and K to the lead joined to the O.P. of the left hand transformer.

WIRELESS AT WESTMINSTER.

(From Our Parliamentary Correspondent.)

The Transatlantic Telephone.

In the House of Commons last week the Postmaster-General, in reply to Col. Woodcock, said that the number of wireless telephone calls between Great Britain and the United States during September was 148; October, 162; and November, 202. The present revenue approximately covered working costs, but not interest, depreciation, and amortisation.

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Amateur Wavelengths.

Replying to Mr. Ramsden, who asked a question relative to amateur wireless workers, the Postmaster-General said that there had been no recent change in the wavelengths allocated to experimental wireless stations.

"MUSIC FROM THE ETHER."

Professor Theremin's Recital at the Albert Hall.

THE descriptions in the lay Press of Prof. Theremin's apparatus have no doubt given sufficient clues for wireless enthusiasts to form a shrewd guess as to the contents of his "magic box," and those who attended the concert demonstration on December 12th heard sounds during the preliminary adjustment of the apparatus which are all too familiar to broadcast listeners.

In contrast to the Press notices, Prof. Theremin's lecture, a translation of which was read by Mr. Edwin Evans, was devoid of any attempt to create an atmosphere of mystery. Not only did he fully explain the principle of the instrument, but also its relation to music, and his discourse showed him to be something of an artist and idealist as well as a physicist.

The photograph shows Prof. Theremin before his apparatus. The rod on the left is connected to a source of electrical oscillations whose frequency is determined by the capacity to earth of the rod. By moving the hand in the vicinity of the rod, its capacity is changed, thus varying the frequency or pitch of the electrical oscillations, which are reproduced by a series of loud-speakers. The whole of the audible range of sound frequencies may be covered by moving the hand through a distance of two or three feet from the rod.

On the right-hand side of the cabinet in the photograph is a metal loop, the capacity of which is varied by the left hand of the performer. This is a volume control which has no effect on pitch, but which varies the sound output from zero to the maximum attainable by raising the hand out of the ring for a distance of twelve or eighteen inches. Prof. Theremin did not explain the principle of the volume control, but one method would be to cause the change in capacity of the ring to vary the anode current of a valve from which a variable grid bias to control the amplifying valves could be derived by a circuit of the type described on page 719 of the November 23rd issue of this journal.

Having demonstrated the variation of pitch and volume, Prof. Theremin went on to show that the timbre could be altered by the introduction of suitable harmonics, and the tones of the violin, 'cello, and human voice were successfully simulated. This is by no means new and was demonstrated with electric apparatus by Helmholz.

The skill of the performers was remarkably high; the intonation was good, and vibrato effects were easily obtained. The musical items chosen were simple, however, and of a character which showed none of the defects of the instrument. The most important limitation is the *glissando* effect, or sliding from one note to the next, which is inevitable, since the hand cannot move instantly from one position to another. Judicious use of the volume control *between* notes can remedy serious defects of phrasing, but a rapid staccato passage would be physically impossible.

Prof. Theremin suggests that a much greater freedom and range of expression is permitted the artist if he can be free from material contact with his instrument; but it is doubtful if such a limitation is felt by the expert instrumentalist after long practice, and the new "musical box" will rather tend to fetter musical expression so long as it is impossible to obtain such essential effects as staccato and a good "attack."

F. L. D.

Prof. Theremin with his apparatus; the vertical rod on the left influences the pitch of sound produced, while the loop on the right controls volume.

SCREENED VALVE FIVE.

Further Constructional Details and Operating Notes. By F. H. Haynes.

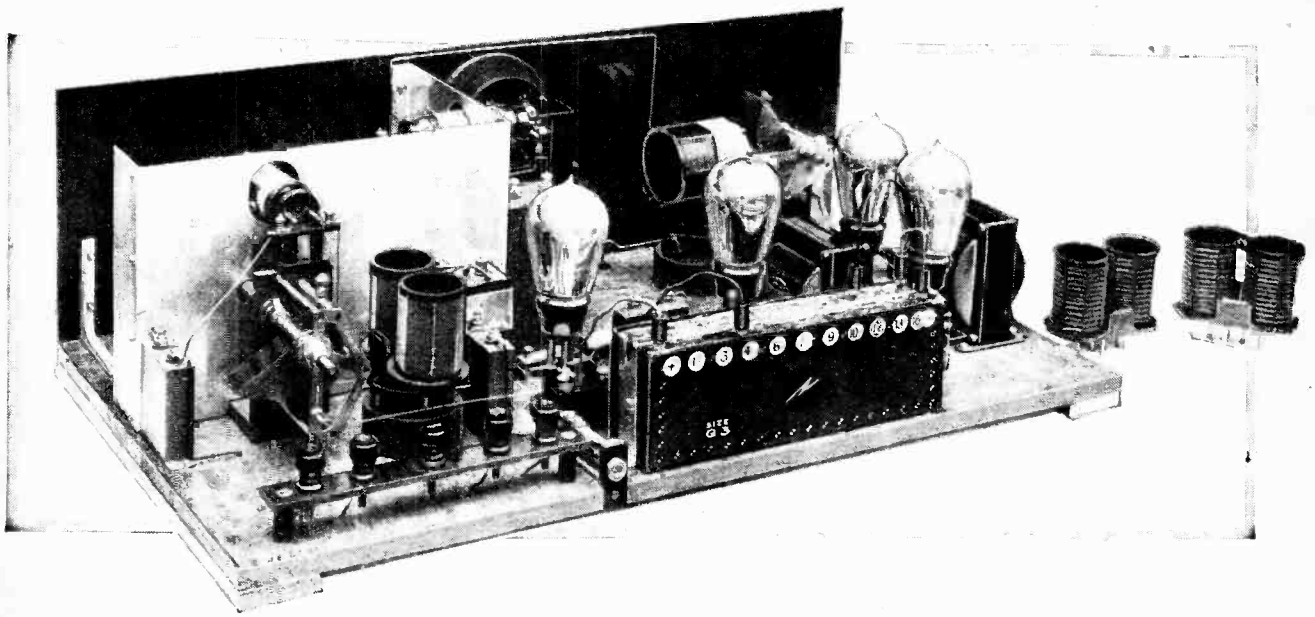
(*Continued from p. 781 of previous issue.*)

LAST week the general circuit principles of the H.F. and L.F. amplifier were discussed, with particular reference to the earthed mid-point on the binocular coils used in the screened valve H.F. stages, the method of critically adjusting the potential of the screening grid thus providing a control of the operation of the valve, the use of a single H.T. potential, and the introduction of a push-pull output amplifier. Continuing, it only remains now to make mention of certain practical points of construction.

The first step is the linking together of the two tuning condensers in the manner already described. Next, the baseboard and panel are constructed, the former from ½in. planed mahogany or oak. To provide the required width so as to sufficiently space the L.F. equipment from the H.F. stages, it may be necessary to build the baseboard from two boards glued together. If oak is used it should be thoroughly seasoned, or it may warp in spite of the ½in. battens. Complete constructional details of the screen are given, and, unless one is experienced in metal working, it is best purchased already made up. Several of the leads within the H.F. stage are fitted prior to setting up the screen in position. As the screen has, practically, only two sides, it is not sufficiently rigid to support the H.F. valves, and so, by clamping down the basepieces of two of the bridging condensers under its edge and linking across between screen and terminals with short brass strips or suitable tags, and with the condenser faces hard against the screen, a substantial bracketing is obtained.

On the general wiring little need be said except with regard to one very important point. For clearness in the practical wiring diagram spacing between the various leads is essential, though the wires running beneath the baseboard, which are, of course, only battery and earth leads, must be run side by side, and, so far as possible, bunched by binding together at intervals with, say, No. 28 tinned wire soldering the loops along a bare piece of No. 20, running in the wiring and connecting to the screen. For this reason finer wire than is usual may be used for the general connections, such as No. 24 tinned wire in sleeving.

Coming, now, to the operation of the set, one should carefully go over and verify all leads before inserting the valves joining up the L.T. first, so that with the filament on there will be no danger of contact with the H.T. potential. The valves actually used were the Osram S 625, followed by a D.E.5B detector, D.E.5 and two D.E.5A.s in the push-pull output stage. Other valves of approximately similar characteristic to these, though more economical in filament current, can be readily selected, the detector valve being of only moderate impedance, such as a typical H.F. valve, the first L.F. being of the 7,000 to 10,000 ohms class, and the push-pull L.F. valve 3,000 to 8,000 ohms.

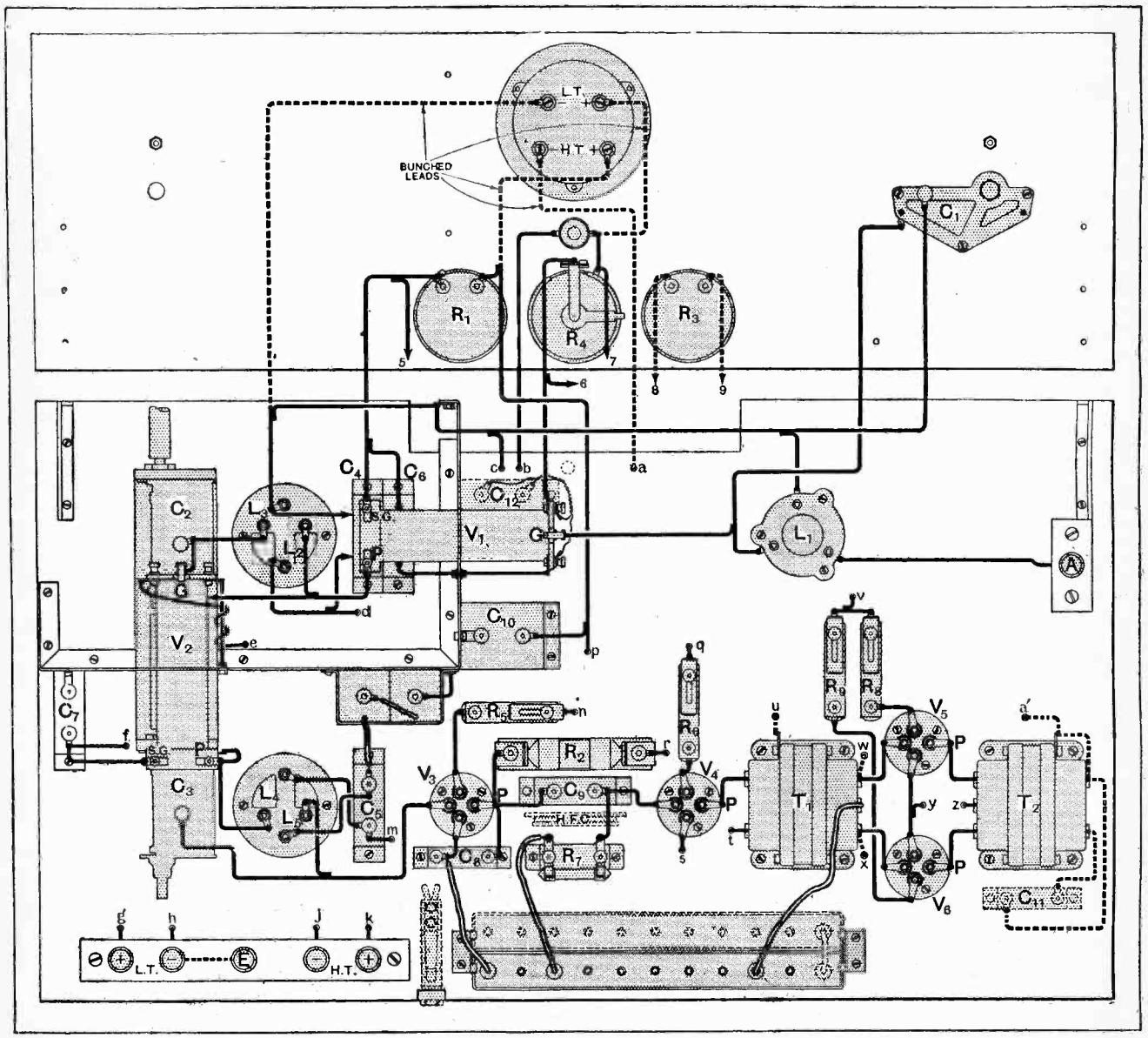


The H.F. transformers are elevated so as to render the screening more effective and to give better access for removal. Details of the detector stage wiring can be examined in this illustration.

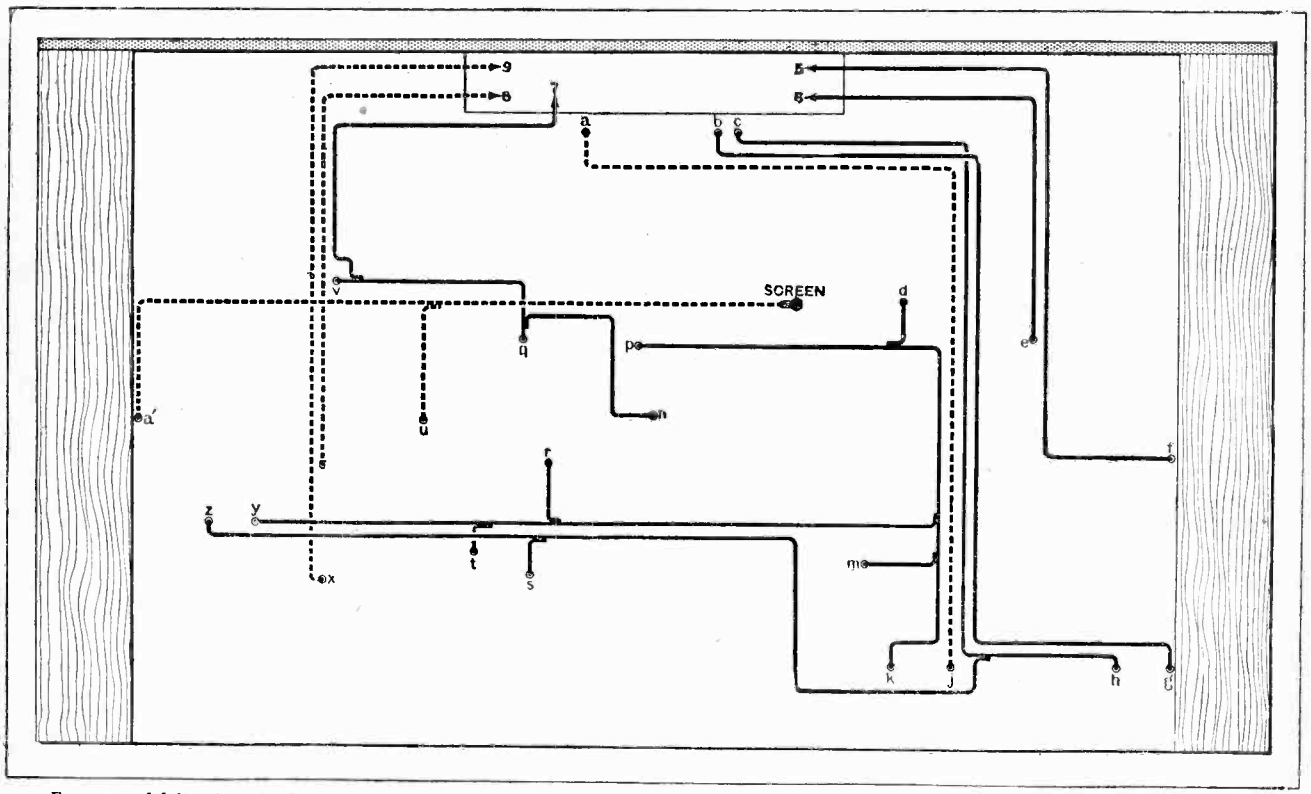
If a gramophone pick-up is available, it is as well to check the performance of the L.F. amplifier and suitably adjust the biassing potentials before bringing the H.F. into operation. Its connections are made at the junction between the grid cells and one of the sockets of the third coil holder. As the filament current of the S.625's is considerable, one should introduce these valves, turning

Screened Valve Five—

the filaments up to full brightness while still testing the L.F. amplifier. Coils covering the normal broadcast band are now inserted. As regards the aerial circuit, commence with the tight coupling, producing by the maximum number of aerial turns. For a start the two intermediate tuning condensers are set to exactly coincide. With an H.T. voltage of 130 to 150 the variable resistance used to control the screen potential is set to a moderately high value estimated at some 20,000 ohms so as to produce an appreciable drop in voltage. Thus the screen volts may be brought down to some 70 or 80, the value being judged by performance rather than measured. It must not be overlooked that for certain voltage differences between screen and anode an operating point on the valve characteristic will be obtained where the valve will produce a negative resistance effect giving rise to regeneration in the same manner as the application of reaction. This point is passed through as the value of the resistance is increased, after which the circuits cease to oscillate. If everything is correct as regards wiring, the local and high-power stations will at once be received at considerable strength, and, if the aerial is a large one, tuning will be flat. Before reducing the number of turns, however, it is worth while trying reception round the dials, and with the screen voltage control set to the maximum signal position, two or three stations will be received full blast during the evening with a reasonable aerial on almost all dial positions. As the performance of the amplifier varies with the inductance-capacity ratio of the tuned circuits, the continuous control of amplification afforded by the screen volts control proves exceedingly useful.



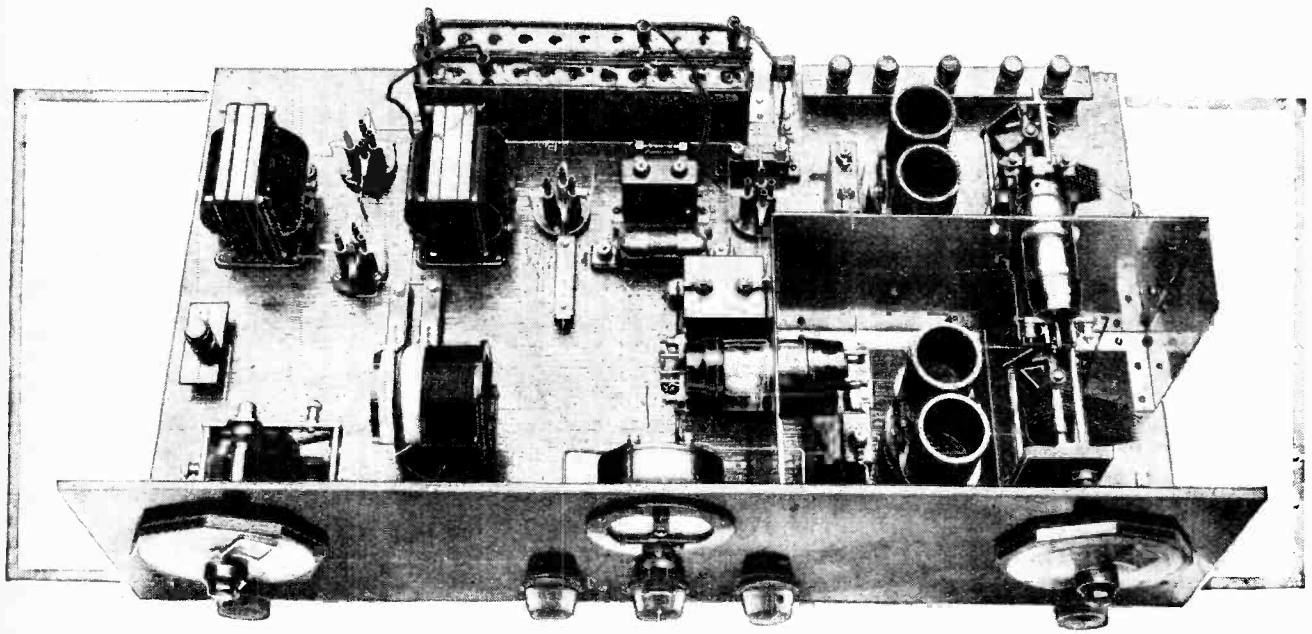
Practical wiring diagraph. All battery leads are bunched together so far as possible to prevent radio-frequency pick-up.



For ease of following the leads are shown spaced. Actually they should be bound together around a screen-connected earth wire.

The problem one now encounters owing to the enormous amplification is rather one of selectivity than sensitivity. Turns are, therefore, removed cautiously from the aerial circuit up to the point where the selectivity, as indicated by the tuning dials, appears to be the same on the aerial as on the intermediate amplifier. Taken beyond this point, the selectivity is only slightly improved and the station-getting properties of the receiver reduced.

It was found in the particular instrument constructed that the setting of the linked condensers exactly corresponded, though tests should be made while tuning to a distant station. By loosening the grub screw and attach-



Another view of the finished set.

Screened Valve Five—

ing an old type dial to the projecting end of the spindle, separate control of the condensers is obtained for determining the best setting.[1] The effects of such considerable H.F. amplification have already been referred to by way of H.F. oscillation in the L.F. amplifier reaching the loud-speaker leads. Although the output terminals may be directly earthed, it is advisable to avoid running the loud-speaker circuit near the aerial or earth wires.

A single voltage A.C. battery eliminator has been used with the set without difficulty. If "motor boating" should be experienced, the customary method of introducing anode resistances into certain of the H.T. distributing leads beyond the point of connection of the large reservoir condenser and the providing of other shunt condenser circuits on the anode end of these resistances should be tried first in the detector and then in the first L.F circuits. Owing to the many contacts, intermittent connection at the pins of the H.F. valves is not impossible. As a disconnection may not prevent the set from still functioning, and only impair its performance, the fitting of the valves in their holders should be watched. For local station reception the H.F. valves can be switched off by the filament resistance and the aerial transferred to the terminal of the third tuning condenser passing through a 0.0003 mfd. condenser if the aerial is large. As the L.F. volume control has no "off" position it should not be introduced into the circuit until the preliminary tests have been completed.

Cabinet design is not discussed. A cabinet can be constructed or purchased to suit the overall dimensions. The use of a complete copper foil lining is recommended to eliminate direct pick-up from the local station. Good electrical contact should be provided along all edges of the screen.

It might be suggested that, owing to its comparatively recent introduction, the present screened grid valve may be further improved. True, the grid plate capacity, still present, may be reduced, and valves may become available with new types of filaments. The present valve, however, is capable of such remarkable performance that for some while, and with present circuit systems and apparatus, better performance is scarcely called for. It has other applications, and with grid-plate capacity removed the possibilities of short-wave H.F. amplifier design are not being overlooked. Used in the intermediate amplifier of a superheterodyne, it should be capable of improving performance with simplified construction and giving amplification without bordering on regeneration. For the construction of wavemeters and other calibrated oscillating circuits, the removal of grid-plate capacity restricts feed back to that which is introduced into the circuit and is controllable, suiting it, in addition, therefore, to many applications in the laboratory.

[1] The value of the intermediate tuning condensers has been given in error as 0.0003 mfd. The condensers actually used, however, are of 0.00025 mfd. capacity.

ALLOCATION OF WAVEBANDS.

Agreed on at the International Radiotelegraph Conference at Washington.

Metres.	*kC.*	
3,000–30,000	(100–10)	Fixed stations; point-to-point services.
2,725–3,000	(110–100)	Point-to-point and mobile services.
2,400–2,725	(125–110)	Mobile services.
2,000–2,400	(150–125)	Maritime services. Public correspondence only.
1,875–2,000	(160–150)	Mobile services.
1,550–1,875	(194–160)	(*a*) Broadcasting; (*b*) Point to point; (*c*) Mobile; subject to agreement with regard to broadcasting stations already working on wavelengths above 1,000 metres. Regional agreements will respect the rights of one another in this band.
1,050–1,550	(285–194)	(*a*) Mobile; (*b*) Point to point; (*c*) Broadcasting, subject to regional modification as follows: *Europe.* (*a*) and (*b*) for aircraft services only; (*c*) 1,050–1,200 metres (285–250 kC.), point to point, not for general public correspondence. 1,340–1,550 metres (224–194 kC.), broadcasting. *Other Regions.* (*a*) Mobile, except commercial ships: (*b*) point to point, aircraft only. (*c*) Point to point, not for general public correspondence.
950–1,050	(315–285)	Radio beacons.
850–950	(350–315)	Aircraft service only, 900 metres being the International aircraft wavelength for calling and listening.
830–850	(360–350)	Mobile. Not for general public correspondence.
770–830	(390–360)	(*a*) Direction Finding; (*b*) Mobile where it does not interfere with D.F.
650–770	(460–390)	Mobile stations.
620–650	(485–460)	Mobile, except damped waves and radio telephony.
580–620	(515–485)	Mobile, 600 metres is the wavelength for International ship traffic and distress signals. May be used for other purposes when it will not interfere with calling.
545–580	(550–515)	Mobile, except damped waves and radiotelephony (not for general public correspondence).
230–545	(1,300–550)	*Broadcasting.* Mobile services may use this waveband provided that they do not interfere with the broadcasting service.
200–230	(1,500–1,300)	(*a*) *Broadcasting.* (*b*) Mobile, on 200 metres (1,364 kC.) only.
175–200	(1,715–1,500)	Mobile services.
150–175	(2,000–1,715)	Mobile, fixed and amateurs.
133–150	(2,250–2,000)	Mobile and fixed stations.
109–133	(2,750–2,250)	Mobile stations.
105–109	(2,850–2 750)	Fixed stations.
85–105	(3,500–2,850)	Mobile and fixed stations.
75–85	(4,000–3,500)	Mobile, fixed and amateurs.
54–75	(5,500–4,000)	Mobile and fixed stations.
52.7–54	(5,700–5,500)	Mobile stations.
50–52.7	(6,000–5,700)	Fixed stations.
48.8–50	(6,150–6,000)	Broadcasting.
45–48.8	(6,675–6,150)	Mobile stations.
42.8–45	(7,000–6,675)	Fixed stations.
41–42.8	(7,300–7,000)	*Amateurs.*
36.6–41	(8,200–7,300)	Fixed stations.
35.1–36.6	(8,550–8,200)	Mobile stations.
33.7–35.1	(8,900–8,550)	Mobile and fixed stations.
31.6–33.7	(9,500–8,900)	Fixed stations.
31.2–31.6	(9,600–9,500)	*Broadcasting.*
27.3–31.2	(11,000–9,600)	Fixed stations.
26.3–27.3	(11,400–11,000)	Mobile stations.
25.6–26.3	(11,700–11,400)	Fixed stations.
25.2–25.6	(11,900–11,700)	*Broadcasting.*
24.4–25.2	(12,300–11,900)	Fixed stations.
23.4–24.4	(12,825–12,300)	Mobile stations.
22.4–23.4	(12,350–12,825)	Mobile and fixed stations.
21.4 22.4	(14,000–12,350)	Fixed stations.
20.8–21.4	(14,400–14,000)	*Amateurs.*
19.85–20.8	(15,100–14,400)	Fixed stations.
19.55–19.85	(15,350–15,100)	*Broadcasting.*
18.3–19.55	(16,400–15,350)	Fixed stations.
17.5–18.3	(17,100–16,400)	Mobile stations.
16.9–17.5	(17,750–17,100)	Mobile and fixed stations.
16.85–16.9	(17,800–17,750)	*Broadcasting.*
14.0–16.85	(21 450–17,800)	Fixed stations.
13.9–14.0	(21,550–21,450)	*Broadcasting.*
13.45–13.9	(22,300–21,550)	Mobile stations.
13.11–13.45	(23 000–22.300)	Mobile and fixed stations.
10.7–13.1	(28,000–23,000)	Not reserved.
10.0–10.7	(30,000–28,000)	*Amateurs and experimenters.*
5.35–10.0	(56,000–30,000)	Not reserved.
5.0–5.35	(60,000–56,000)	*Amateurs and experimenters.*
Under 5.0	(over 60,000)	Not reserved.

By Our Special Correspondent.

The B.B.C. Van.—5SW Really Starts.—What of 5GB?—Continental Listeners.—In India and South Africa.—Bournemouth's Farewell.

Potters Bar.

The exposure of secrets always involves discomfiture for somebody, so I am not surprised that the B.B.C. has been a little "terse" on the question of the Potters Bar rumour. What they should remember is that the public has eyes as well as ears, and that the strain of trying to hear 5GB has not intensified the aural faculties to the detriment of the visual.

If, then, there are secrets to be kept, the B.B.C. engineers should make their peregrinations into the country in a plain van, even at the risk of vulgar deductions. If they choose to sport the Corporation's monogram they need not expect that the bucolic mind will merely associate them with, say, a movement to "Build Bonny Cows."

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The Mobile Transmitter.

It is difficult, of course, to disguise the functions of the three-kilowatt mobile transmitter with which the B.B.C. has been exploring the possibilities of the northern side of London. I believe that they are now at the end of their search.

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Call Signs and Sentiment.

Whether or not the new London regional station will assume the familiar 2LO call sign is a question which cannot be answered at present. It is rather surprising how much sentiment *can* cluster round such matters Most of the provincial stations exist in the popular imagination as call signs, and to change their signs would seem to many people like calling cheese chalk. An exception occurred, I believe, at Birmingham, where the old 5IT was generally regarded as having too much of the "It"!

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Bravo, 5SW!

From a state of intangible uncertainty 5SW has now definitely emerged into the province of regular transmitters. This important step, taken at the beginning of last week, should go far towards satisfying the Dominions that the Mother Country is making a determined effort to be heard. The transmissions are daily—from 12.30 to 1.30 p.m. and from 7 p.m. to midnight (G.M.T.), and consist of the ordinary programme from 5XX. The wavelength is still 24 metres.

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A Good Start.

Satisfactory reports have already reached Savoy Hill from Australia, the very first programme being received at such strength that 2FC was emboldened to re-transmit it in its entirety!

The evening programme was less satisfactory so far as Australia was concerned, nothing stronger than R4 being reported

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Pleasing Everybody.

At the time of writing no reports have come in from the other Dominions and Colonies, and this bears out the view that special arrangements as regards time and wavelength may be necessary for each country If the Empire is to be served, it must be served as a whole: anything savouring of preferential treatment for one particular Dominion must be avoided.

No doubt due recognition will at first be given to the technical vagaries of the short wave, but in time those portions of the Empire which have hitherto been unprovided, will want to know the reason why. India, it appears, has never heard 5SW, though 2NM on a slightly higher wavelength was picked up with rejoicing in Bombay

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A Preliminary Breakdown.

It was a pity that the Chelmsford aerial went wrong on the second day of the new experiment, necessitating a close-down. But the Colonies have waited so long that it must now be difficult to strain on their patience! And, anyway, the station resumed working on Wednesday.

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Wake Up, 5GB!

5GB is a little slow with its long-promised power increase and change of aerial. The engineers now tell me that the adoption of the new aerial may not coincide with the increase in power; most

FUTURE FEATURES.

London and Daventry (5XX).

DEC. 25TH.—Augmented Military Band and Vocalists.
DEC. 26TH.—Star Variety Programme.
DEC. 27TH.—Variety Programme.
DEC. 28TH.—Harry Lauder.
DEC. 29TH. Military Band Concert and Vocalists.
DEC. 30TH.—Symphony Concert.
DEC. 31ST.—Reminiscences of 1927. Watch Night Service from York Minster, with an address by the Archbishop of York.

Daventry Exp. (5GB).

DEC. 25TH.—Albert Sandler and the Grand Hotel, Eastbourne, Orchestra.
DEC. 26TH.—Symphony Concert from Birmingham.
DEC. 27TH.—Variety Programme.
DEC. 28TH.—Military Band Concert.
DEC. 29TH.—"The Lost Silk Hat," a play by Lord Dunsany.
DEC. 30TH.—International String Quartet.
DEC. 31ST.—Wireless Favourites of 1927. Watch Night Service from York Minster, with an address by the Archbishop of York.

Cardiff.

DEC. 27TH. — "Smilestones," a Christmas Radio Revue.

Manchester.

DEC. 30TH.—Play Night: "Fantasy," a new Lancashire Comedy, by J. C. Spence; "Thirty-one," a new play by H. W. Twyman.

Newcastle

DEC. 28TH.—"'Tilda's New Hat," a play in one act, by George Paston.

Aberdeen.

DEC. 29TH.—"Deeside," its music, legends and humour.
DEC. 31ST.—Hogmanay Night

Belfast.

DEC. 27TH.—British Music—Purcell to Holst.

probably the new aerial will be tried on the present output of 24 kilowatts. This will come about before Christmas.

When the improvements are completed, it is expected that 5GB's "service area" will cover a radius of some 75 miles, which just includes London. At all events, the Birmingham crystal user should be satisfied, and if the B.B.C. can achieve this happy consummation they will feel ready for anything! A subsidiary aim of the present tests is to secure equable distribution of signal strength, a highly desirable attainment.

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Listeners on the Continent.

The identification of distant stations, which is arousing so much discussion in the columns of *The Wireless World*, is causing interest but not excitement among officials of the B.B.C.

As regards British stations the question of identification chiefly concerns foreign listeners, and these, according to Savoy Hill records, are not a numerous class. Since the Continental broadcasting boom, the birth of so many new stations has rather diminished the keenness for British transmissions which prevailed two years ago.

The only British station which appears to excite attention is 5XX, still a favourite with listeners in France, Belgium, and Holland and Denmark.

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Gratitude.

After having heard a performance by the Newport Choral Society, broadcast from the Cardiff station, a listener sent the conductor of the society the price of two tickets to mark his appreciation of a performance which broadcasting had enabled him to hear without leaving his own fireside.

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Mabel Constanduros.

"Heart's Desire," a comic opera by Mabel Constanduros, will be relayed from Birmingham through 5GB on January 5th. Olive Groves and Harold Kimberley are among the artists taking part.

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Impasse in France.

French broadcasting developments are worth watching. During the past fortnight the situation has changed from good to bad in an extraordinary fashion.

At first it appeared that France was to have an imposing regional broadcasting system before the end of 1930. To enable this to be brought about, M. Bokanowski, the Minister of Commerce, announced a scheme of taxation whereby the annual licence fee would be increased from one to ten francs. Now the Chamber has shelved the issue, and as M. Bokanowski states that he has no money, either for the project or for the payment of authors' and composers' rights, the probability is that France, far from owning a regional scheme, may soon be denied most of the broadcasting stations now in operation!

It is difficult to imagine that French listeners will consent to this state of affairs.

Which is "Radio Night"?

Owing to the demands of modern civilisation, most of us have to live according to time-table. We bathe the dog on Tuesday, fetch back the accumulator on Wednesday, and so on. Arguing on these lines, American broadcasting interests have come to the conclusion that specially good programmes should be put out on Monday because Monday night is "radio night."

Monday night, they state, is the poorest night for theatres and other places of amusement. Therefore, if the people are not in the theatres, the "movies," or kindred institutions, they must be at home. Therefore they are "listening-in on their radios." Q.E.D.

o o o o

Indian Broadcasting Criticised.

Not all criticism converges on Savoy Hill, and it may interest the B.B.C. to know that other broadcasting concerns are now "getting it in the neck."

LISTEN FOR 5SW

Short-wave enthusiasts should make a point of picking up the transmissions from the Chelmsford Experimental Station on a wave-length of 24 metres.

The time schedule is 12.30 to 1.30 p.m. and 7 p.m. to midnight (G.M.T.). The programmes are relayed by line from London and consist of the ordinary transmission from 5XX.

In the *Indian Radio Times* there is a pathetic plea on the part of the Indian Broadcasting Company. "What do listeners want?" is their plaintive cry, and they proceed to print copies of letters which go to show that residents in India are just as hard to please as the denizens of Bolton and Glasgow.

"Can't you give us greater variety?" says one writer; but another remarks: "Just as you get to appreciate a singer's style he stops and something else starts."

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In South Africa.

Meanwhile, the African Broadcasting Company is being strenuously attacked on the score that it does not spend enough money. One journal is "amazed that absolutely nothing is being done" to bring about an improvement.

I think that Mr. Augustine Birrell's remark concerning minorities also applies to broadcasting organisations. They always suffer; it is the badge of their tribe.

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Bournemouth's Farewell.

To mark the finish of Bournemouth's work as a main station, a farewell concert is to be given by the station orchestra on December 30th, under the title "Ring Out the Old, Ring In the New." Bournemouth listeners will that evening have the opportunity of hearing many old favourites who have given them so much pleasure in the past. Eda Kersey will be heard in Wieniawski's "Romance and Finale" from the Concerto in D minor for violin and orchestra. Helena Millais will give some "Fragments from Life" and "Our Lizzie." Winifred Cole, the Bournemouth contralto, will sing the scena, "Fia Dunque Vero?" ("Can it be true, then?"), by Donizetti, and three songs by F. Keel. Another popular Bournemouth singer, Reg. Attridge (baritone), will sing Rutland Boughton's "Faery Song" from "The Immortal Hour." The station chorus, accompanied by the orchestra, will render selections from Elgar's "The Bavarian Highlands."

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Two Famous Pianists

Maurice Cole is to play Mendelssohn's piano works at 2LO throughout the week beginning December 26th; while on December 28th Mrs. Norman O'Neill will give a recital of Schumann's piano compositions. Students of Mendelssohn and Schumann should make a point of hearing these interpretations.

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A "Laughter Tourney."

Sir James Taggart, K.B.E., who was Lord Provost of Aberdeen during the war, and who is one of the outstanding personalities in the North of Scotland, may claim to be the originator of the "Laughter Tourney." On many occasions he has engaged in story-telling competitions with various opponents on public platforms, the palm being given to the raconteur who raised most laughter from the audience. Sir James undertakes the humorous aspect of the "Deeside Programme" from Aberdeen on December 29th. The musical side of the programme is in the capable hands of Alec Sim (violin) and R. E. Anderson (baritone); and legend is supplied by Mr. G. M. Fraser, the well-known authority on Deeside folk-lore.

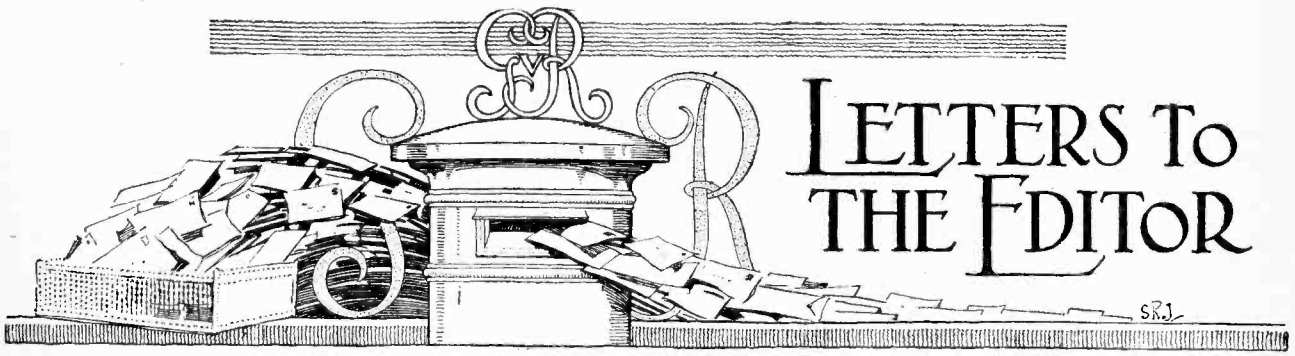
o o o o

Poetry.

For much of the poetry of to-day the microphone and the megaphone seem to be more appropriate vehicles than the printed page. This opinion is not affected by a perusal of "Close Downs: and Other Poems," by Ida Mary Downing (Birmingham: Cornish Brother, Ltd.), comprising a large amount of blank verse read by Mr. Percy Edgar from 5IT. The palpable sincerity of their author, aided by the elocutionary talent of Mr. Edgar, has doubtless won for these poems a measure of approval among listeners, but whether they will charm the reader is another matter. Redundancies like "dusky twilight" and "a dead and lifeless thing," *clichés* like "wondering awe" and "the golden glow of sunset," may miss the ear; they do not escape the eye.

In some of the poems the writer has risen above triteness; but too often one feels that, to use the poetess's own words:

". . . what should be a reproduction of the best
Falls somehow short in beauty or design."



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.

IDENTIFYING FOREIGN STATIONS.

Sir,—With reference to your remarks on the above subject, I am interested in any movement regarding the standardising of call signals, having experienced great difficulty in this direction. From practical experience I think that by far the best way of announcing a station so that all countries will recognise it is to cut out all codes and unnecessary words and in a short, terse manner give the name of the station. For example, "Hallo, Oslo," "Hallo, Hamburg," "Hallo, London," without any other words which divert your attention, given after every item or every two or three items would be most helpful. Phonetically, hallo and the name of the various stations sound very much the same in most languages and can easily be identified. Where there are more than one station to a town, as, for example, Daventry and Berlin, the name can be given followed by their call-sign, as, for example, "Daventry, 5XX," "Berlin, Koenigswusterhausen." FRED D. SNOWBALL.

Jarrow.
December 8th, 1927.

Sir,—While I agree that a more definite means of identification of the many European stations would be appreciated by DX enthusiasts, yet I feel that such a means must not be brought about to the detriment of the programme. It is only fair to bear in mind the fact that the transmission from one particular station is primarily intended for the enjoyment of listeners in the area served by that station. To those people frequent announcements are unnecessary. Apart from their superfluity, they are undesirable, as they spoil the continuity and detract from the artistic merit of the programme. Surely the nearer broadcasting is to the actual performance, the more hold it has upon the listener. What could be more banal than to hear, automatically repeated, that one is listening to "5GB, the Daventry Experimental Station, transmitting at a frequency of 610 kC. on a power of 14 kW."?

For broadcasting to develop into a serious rival of concert and theatre-going, the illusion must be kept up as far as possible. For this reason I feel that your suggestion for the installation of an automatic repeater, similar to that used by the Parisian telephone service, would not be popular if brought into operation.

From the above remarks it may appear that "reaching out" holds no fascination for the writer. The contrary is the case. Personally, I think that, since the introduction of the internationally agreed frequencies, identification is not nearly so difficult. The fact that each station has an allotted frequency should be almost sufficient for the DX enthusiast, for with the modern type of set, such as the "Regional," with sharply tuned circuits employing S.L.F. or log-mid-line condensers, calibration can be made with a high degree of accuracy. As a further guide, one can usually get some idea of the nationality from speech, which occurs at fairly regular intervals. With a very rudimentary knowledge of languages, it is fairly easy to recognise the difference between the commonest of the Europeans—French, German, Spanish, etc. This evidence, coupled with that of the list of frequencies of all the stations, which can be readily obtained in *World Radio*, is often enough for one to form a very good idea of the identity, especially as fairly detailed programmes are also available in that paper.

Call signs should be given in between definite sections of a transmission, or in transmissions where continuity and artistic merit are not of primary importance; but please do not let us have them between each item. A. SMITH.

Leicester, December 12th, 1927.

Sir,—I see in the Dec. 7th issue that you invite comment on your recent Editorial on the identification of stations. May I, therefore, as an old and appreciative reader give my opinion, which, incidentally, is shared by members of my immediate family circle, amounting in all to some ten or twelve adult listeners?

I read your suggestions with consternation and genuine alarm. I tried to imagine the effect on my mind of listening for five, ten, or twenty minutes to an item, the interval being filled up by a mechanical contrivance causing my loud-speaker to inform me that "This is 2LO, the London station, calling" or "This is 2OL, the Timbuctoo relay, calling," for about two or three minutes or so until the next item was due to be broadcast. I am afraid such a procedure would convert me from a serious listener into an irresponsible knob-twiddler. As it is, what do you suppose I do when in the middle of a pleasant little item by the Daventry quartet, shall we say, the music fades away and is replaced by the scream of that accursed "tuning note"? I step on my distant control switch and promptly close down, gnashing my teeth and foaming at the mouth. But, all joking apart, what purpose does the "tuning note" serve? And what purpose would be served by any adoption of special repeater signals to "facilitate" identification of foreign stations—which, I suppose, would mean *every* station, since one's own local station is a "foreigner" to someone a hundred miles away?

The only result I can see would be to hammer another nail into the coffin of those who *listen*—as distinct from those who *twiddle* and disturb the peace of the ether by their twiddling—and encourage lazy, slack habits in all of us. Wireless should *not*, in my opinon, be made too easy. If a man wants something in addition to his local and the experimental, encourage him in the idea that to get it will entail, first and foremost, a set capable of reaching out effectively, and, secondly, that he must learn to search and identify in a scientific manner. Nowadays, with straight-line tuners, balanced coils, etc., etc., to say nothing of the accuracy with which the majority of reputable stations maintain their wavelength, it is *not* a difficult matter to calibrate even a set like my own having three tuning dials. All that is necessary, in addition to a little method and patience, is some squared paper, a pencil, and a recent list of stations with their wavelengths.

Let me try to give a practical example. A few weeks ago I built a four-valve neutrodyne set for a relative. There were two tuning dials. The aerial dial, I knew, would present some difficulty as my aerial constants are not the same as those of the aerial to which the set was to be coupled. I therefore restricted my attention to the tuned transformer circuit. First, I carefully tuned in 2LO and 5GB. Then these readings (for the one dial only, viz., the transformer tuning condenser) were

plotted on squared paper giving wavelengths horizontally from 250-500 m. and condenser readings vertically from 0-100. These two points were then arbitrarily joined by a straight line and extended in both directions. Reference was then made to a list of stations and the principal ones of 1.5 kw. and over between 250 and 500 m. were marked on the graph with fine crosses, a ring being made around those of high-power stations which would probably present little difficulty in finding. In all nearly thirty stations were marked on the graph. Then, starting at the top with Vienna, I worked quickly right through the list, setting the dial of the condenser controlled by the graph to the various settings indicated and rotating the aerial condenser dial until the set was in tune. In about twenty minutes I had run through my list on this previously untried and uncharted set and had located eighteen main stations. Slight amendments were made on the chart and eventually a fresh graph drawn representing an average result. The main stations were then again marked in and all checked on the receiver without any difficulty. The whole thing took just about an hour and a half, and the set was calibrated in respect of one dial. Reference to programme items or the language used was a useful additional check on results, *but identification signals were quite unnecessary*, and judicious listening on the set for a few evenings confirmed the identification of every station received. Once that has been done with a given receiver, if the conditions are favourable and the station working, there is *no* excuse except slovenly methods for not being able to find one's way about the ether.

Incidentally, when the set referred to was put on its own aerial the prepared graph proved so sure a guide to the user, a tyro, once the system of tuning by careful adjustment of the calibrated condenser and the slow rotation of the aerial condenser had been explained, that he had not the slightest difficulty in tuning-in Brunn, Breslau, Toulouse, Hamburg, Newcastle, etc., etc., much to his astonishment and delight. Now, sir, why all this pother about the difficulty of identifying transmissions? I would say, first get a good set and then *look to your method of tuning.* E. H. PALM.

Ilford.
December 8th, 1927.

CHARGING H.T. ACCUMULATORS.

Sir,—There is a great deal to be said for and against the high cost of recharging high-tension accumulators. Five shillings is most certainly an outrageous price for an ordinary 60-volt H.T. accumulator recharge. If five shillings is to be the cost of recharging a 60-volt H.T. accumulator it will be cheaper for a wireless enthusiast continually to buy dry H.T. batteries. The cost of current used in recharging an H.T. accumulator is negligible.

The amount of space taken up by H.T. accumulators in a small shop is certainly a very important factor, but it is very seldom that a shop has as many as half a dozen H.T. accumulators to recharge at once.

An H.T. accumulator does not require any more attention than a low-tension accumulator when on charge, unless the cells are unequally discharged. If lamp resistances are used it is easier to recharge an H.T. accumulator, because only one lamp is necessary, whereas an L.T. accumulator requires several lamps in parallel, owing to the higher charging rate necessary.

Very few H.T. accumulators have more than 60 cells, and it does not take more than 15 minutes to remove the vent plugs and "top up" the cells. If, as mentioned in Mr. B. Curtis Elliott's letter, the cells are half empty, it shows that the acid level has been neglected on previous recharges, because, if the vent plugs are intact, no acid level will fall more than ½in. in three months; therefore, in the case of a very low acid level, enquiries should be made in case of the acid having been spilt.

No battery, if topped up before charging, requires topping up after charging; if it does it indicates excessive gassing during the charge, either by charging at too high a rate or overcharging. Similarly, no H.T. accumulator ever gets hot on recharge. Neither does the rate require adjusting every two or three hours, five hours or even more between each adjustment being quite sufficient. Adjustment is only necessary in the case where the voltage of the charging current is only a few volts above that of the battery, *e.g.*, a 60-volt H.T. accumulator being charged on a 100-volt circuit, the voltage of the battery will reach at least 75 when charged, therefore the current, when fully charged, will approximately be about two-thirds of that at which it started, which will not make any serious difference to the battery, except that it will take a little longer to charge.

Ammonia is not necessary to wash away the acid that gets between the cells; water is quite sufficient.

In recharging a battery note should be made to the customer as to what attention the battery requires. If the battery is already topped up, the cells in an equal state of discharge, and in a clean condition, 2s. 6d. should be quite sufficient for a 60-volt battery, and other batteries charged *pro rata*. If the battery requires topping up, cleaning, specific gravity of the acid adjusted, and in an unequally discharged condition, 6d. extra should be charged for each additional requirement. It is certainly not fair for a customer who takes reasonable care of the above requirements to be charged the same as a customer who neglects them all, which is of very frequent occurrence. JOHN A. HOCKEY.

London, S.E.11.
December 8th, 1927.

TELEVISION IN 1910

Sir,—I enclose a cutting from a provincial newspaper dated February 10th, 1910.

[COPY.]

TRUE COLOUR TELEVISION.

Remarkable Invention Perfected.

(From our own Correspondent.)

Brussels, Thursday.—Our correspondent has been granted the almost unique privilege of seeing in operation an extraordinary invention which effectively overcomes the problems of "television," and accurately reproduces over a single electric wire any object brought before the transmitter at the sending station. The technical details of the invention, which is the joint work of Belgian and German electricians, are being kept secret, but the apparatus will be on view at the forthcoming International Exhibition, to be opened here at the end of April.

The well-known properties of selenium form the basis of the invention, and the telegraphed image is reproduced on a screen. The image is perfect, not only in outline and general form, but in colour and shade. It is, in fact, as though the object telegraphed has been transmitted bodily through space. It is claimed that distance in no way affects the efficiency of the apparatus.

In view of recent correspondence on the subject of television I thought this might be of interest to your readers. F. C.

Liverpool,
December 7th, 1927.

COMPONENT DESIGN.

Sir,—With the designers of modern multi-valve sets persistently emphasising the necessity for careful wiring, especially where wires carrying H.F. currents are concerned, one wonders why the British manufacturer has not given more thought to the design of his components so that the wiring in a receiver may be cut down to a minimum.

In all modern American receivers the sub-panel method of mounting components has been adopted and components invariably have their terminals situated near their bases and the wiring carried underneath the sub-panel, thus avoiding the necessity of having to dodge in and out amongst the various components with connecting wires. Even so with the American system quite a number of wires have to be brought through the sub-panel to their destinations.

If the sub-panel method were adopted for use in this country and components, as far as possible, had their terminals underneath their bases, the terminals could be put through the sub-panel and serve the double purpose of terminal and mounting screw. By the use of this method practically all the wires in a receiver could be brought straight from point to point.

I think something along this line would be a very popular improvement both with designers and constructors.

Selby, R. W. KNEESHAW.
December 11th, 1927.

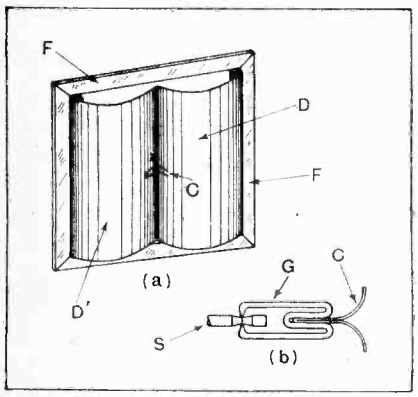
Some Recent Patents

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.

Loud-speaker Diaphragms. (No. 271,831.)

Convention date (France): May 31st, 1926.

A double diaphragm D, D′ of the shape shown in diagram (a) is connected to the magnetic unit by means of a clip C of paper or cardboard, secured in the first place to the centre fold of the diaphragm and then to a clamp attached to the vibrating armature. The outer edges of the diaphragm are gripped in the frame F. The centre connection is shown in detail



Lumiere loud-speaker diaphragm. (No. 271,831.)

in diagram (b). The doubled ends of the paper clip C, after being inserted between the folded parts of the clamp G, are held fast by pressure. The other end of the clamp is in the form of two knife-edges, which encircle a recessed portion of the stem S forming part of the vibrating armature. Patent issued to L. Lumiere.

oooo

Tuning Condensers. (No. 276,508.)

Application date: October 5th, 1926.

To increase the tuning range of a variable condenser, one or more of the plates are provided with a movable core of solid dielectric such as resin, while the remaining plates are separated by air as usual. The variation of both capacity sections may be simultaneous, or one knob may control the air-separated plates, whilst an independent knob may control the position of the resin dielectric. This allows of a practically instantaneous variation of from, say, 0.0005 to 0.005 mfd. on the same condenser. Patent issued to C. Hollins.

oooo

Dual Wavelength Receivers. (No. 276,830.)

Application date: September 1st, 1926.

The aerial is divided into two branch circuits, one of which C, L is series-tuned to the shorter of the two wavelengths to be received, whilst the other branch L_1 C_1 is parallel-tuned to a second station of longer wavelength. An additional condenser C_2 is inserted in series with the branch circuit L_1 C_1.

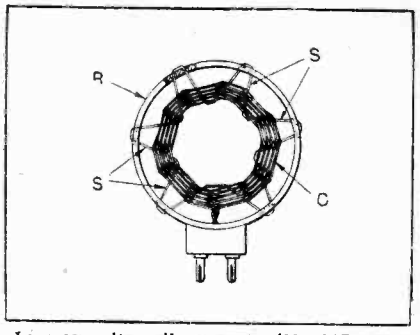
In operation the condenser C is adjusted until the signals from the long-wave station disappear. The circuit L_1 C_1 is then tuned by means of the condenser C_1 until the short-wave station signals are at maximum strength. Once these adjustments have been made, it is stated that all that is necessary to change over from one station to the other is to slowly rotate the condenser C.

When the signals to which the branch L_1 C_1 is tuned are being received, the branch L C is designed to act as a by-pass shunt for the undesired signals, and *vice versa*. The precise adjustments on the condenser C for the two alternative programmes are stated to be invariable, so that limiting stops can be arranged to give a convenient and definite change-over control. A reaction coil R is coupled with the coil L_1 of the parallel circuit, and the latter may be tapped to give a more selective coupling to the aerial. Patent issued to A. A. Harrison.

Coil Mountings. (No. 267,118.)

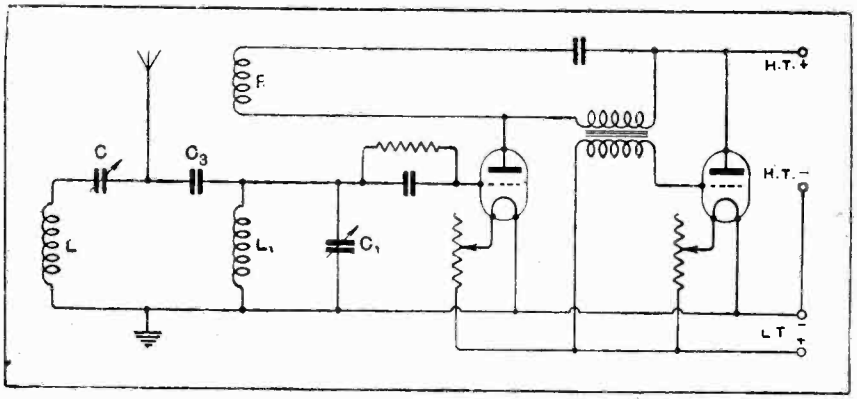
Convention date (Germany): March 2nd, 1926.

In order to reduce to a minimum the presence of "foreign" material, such as paper cores, cardboard supports, etc., which may give rise to undesirable capacity effects, the coil C is first wound on a central core with spokes as usual. After these have been removed the winding is attached to a ring support R by



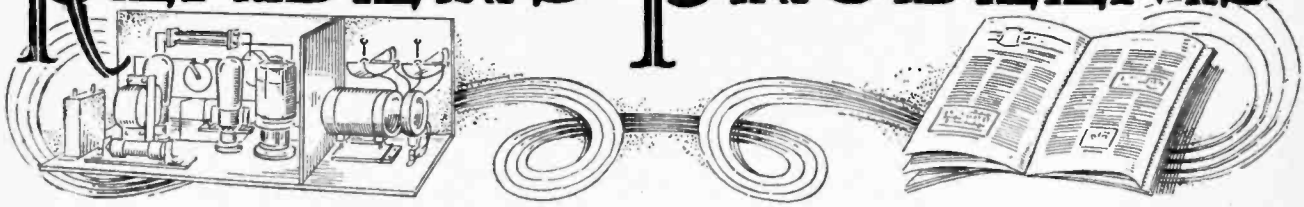
Low-capacity coil support. (No. 267,118.)

a binding thread S of silk which passes radially through slots in the ring, as shown. Alternatively the ring R may be provided with eyes by means of which coils of various sizes may be supported concentrically, there being no connection between the coil and the support, in any case, except through the suspension threads S. Patent issued to K. Koch and W. Klust.



Circuit for alternative programme selection. (No. 276,830.)

READERS' PROBLEMS



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

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

High-resistance H.T. Batteries.

My receiver, a detector and two L.F. amplifier, has lately developed a peculiar defect. About three to four minutes after switching on a high-pitched whistle commences, and this cannot be cured by adjustment of grid bias. The receiver has not been altered and has given satisfaction from the date of installation, eight months ago, to quite recently when this trouble developed. Can you advise me what steps to take to cure this? A. L.

It is quite probable that the whistle mentioned is due to low-frequency oscillation in your receiver, and this may be caused by a high resistance in the high-tension battery. After some months of use the voltage falls to quite a low value, and, of course, the internal resistance of the battery increases. We suggest you test the battery under working conditions, that is to say, with the receiver switched on, using a good voltmeter of the moving-coil type, and if it is found that one or more of the sections show a voltage very much below the marked value the battery should be replaced.

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Large Output with Limited H.T.

Can you provide me with a reference to a constructional article embodying three stages of L.F. amplification as I wish to use a coil-driven loud-speaker and my H.T. is limited to 120 volts. C. W.

We should be doing you a disservice by recommending a receiver embodying three stages of L.F. amplification, but suggest that you could not do better than construct a receiver comprising a stage of H.F. amplification and two L.F. stages in cascade. To obtain the output necessary to operate a coil drive loud-speaker with a limited H.T. voltage, the last stage should consist of two power valves connected on the push-pull principle.

We think that any of the four-valve receivers described in recent issues of *The Wireless World* complying with the above specification could be slightly modified and the output stage converted to a push-pull amplifier, and the circuit of this arrangement was described on page 589 in our issue of October 26th last.

RULES.

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

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

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

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

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

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

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

Safety Resistance for Battery Eliminators.

In a recent issue of "The Wireless World" I read that it is advisable to connect a resistance across the output of an H.T. battery eliminator in order to avoid excessive voltages being built up across the smoothing condensers when the L.T. is switched off before the H.T. I should be obliged if you could advise me on the choice of a suitable resistance and what value should this have. W. H.

A resistance across the output terminals of a battery eliminator will be necessary only when series resistances are incorporated for the purpose of obtaining intermediate voltages. When a potential divider is fitted this will function as a safety resistance and enable the charge on the condenser to leak away when the mains and receiver are switched off. In cases where a resistance is found necessary, a wire-wound component of about 30,000 ohms should be fitted.

Controlling Volume.

I have built the "Everyman Four" receiver, using the parts as specified, but find that the H.F. valve rheostat does not give me a sufficient reduction of volume on the local station. Can you tell me how to remedy this? N. T.

In the original design of the receiver a D.E.5B type valve was used in the H.F. stage, and, in conjunction with it, a 30-ohm filament resistance. This valve takes a current of 0.25 ampere, and since the fall of potential across a given resistance depends upon the current passing through it, the value of 30 ohms was found ample to reduce volume to a very small value, even on the local station. With the 0.1 ampere type of valve, however, which you may be using, the value of resistance is not really enough, as, owing to the much smaller current, the fall of potential across the resistance is less; 60 ohms would be a better value, and you would be advised to instal a rheostat such as the Burndept "Superdual" rheostat, which has a resistance of this value.

○○○○

High- or Low-resistance Coils.

In "The Wireless World" for August 10th last you describe a moving-coil loud-speaker with a low-resistance coil, and in a recent issue a similar type of speaker is described, but a high-resistance coil is recommended. It is difficult to reconcile these two statements, and I should be obliged for a definite opinion on this subject. H. J. R.

This is a controversial point, and it is impossible to differentiate between these two methods. The low-resistance coil is certainly the easier to wind, but this necessitates the use of an output transformer provided with a secondary winding having an impedance comparable with that of the moving coil. On the other hand, the high-resistance coil can be used with the usual choke-capacity output circuit and does not require a special transformer. Provided the above conditions hold good, there will be little to choose between the performance of two speakers, one of which has a high-resistance coil and the other a low-resistance coil.

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AN EVENT OF NATIONAL INTEREST.

IT has always been a matter of surprise abroad and regret in this country that, although Greenwich time is famous the world over, this country has up till now made no attempt to transmit a wireless time signal, in spite of the fact that several Continental stations and America have done so for many years past. Long before broadcasting was thought of, the time signals of the Eiffel Tower station were famous, and were the first transmissions that the wireless amateur sought for when he put up his first crystal receiver. Something must have occurred recently to stimulate activity on the part of the British Post Office, for within an interval of only a few days two most important announcements have been made. The first of these we commented upon in our issue last week, the announcement being to the effect that the new Humber wireless station had been equipped with continuous-wave apparatus as part of a general scheme to replace all the Post Office spark coast stations with continuous-wave apparatus. The second announcement is that commencing on December 19th a British time signal is being transmitted from the Post Office wireless station at Rugby twice daily during the five minutes terminating at 10 a.m. and 6 p.m. G.M.T., each transmission being controlled from the standard clock at Greenwich Observatory. The signals are of the type known as the International System of Rhythmic Wireless Time Signals, as proposed by the International Time Commission held in 1925. Those who make a habit of listening to time signals will be familiar with this system, as it has been adopted by the Eiffel Tower and one or two other transmitters. Complete details of the new Rugby transmissions are given elsewhere in this issue.

This new activity on the part of Rugby makes the station still more a service station. It already transmits news to ships at sea, in addition to private and Press telegrams. Why such a time signal has not long since been introduced is a mystery to those who have observed for so long this neglect of an important service, but, nevertheless, we feel that the Post Office is to be heartily congratulated on having ultimately taken this step.

PROGRAMME POLICY.

THE programme policy of the B.B.C. is a constant subject of criticism; there are those who clamour for more popular music and for a greater percentage of the programme time to be devoted to entertainment matter; as a contrast we have the avowed policy of those directing the destinies of the B.B.C. that the programmes should be largely educational in character and that entertainment should be a secondary consideration. The B.B.C. has, in their opinion, a definite mission to uplift and educate the public. The B.B.C. can adopt the view that the public must take what is given them, and that if the uplift character of the programmes predominates, the standard of education can be raised and cultured tastes developed, even perhaps in spite of resistance on the part of the listener. But is this effect really being produced? Are not the B.B.C. authorities, perhaps, being deluded into an over-estimate of their own capabilities, through broadcasting, to enforce upon the public what may be distasteful to them, in the belief that ultimately the masses will be raised to the level of their own high ideals and aspirations? Those who have a taste for culture are undoubtedly deriving benefit, but disastrous consequences may result from attempts at too forcible feeding. The ideal would be for the B.B.C., first of all, to make the programmes so popular and so indispensable to the masses that listening would become a national habit in every home, and then little by little there would be plenty of time to raise the standard by a very gradual process. As it is, we fear that the habit of regular listening is declining except with those who are in sympathy with the idealistic motives of the B.B.C., whilst the vast majority listen only spasmodically to what may appeal directly to them and shut down their sets whenever educational or other "uplift" matter is being broadcast

ALTERNATIVE PROGRAMME QUALITY RECEIVER

Output Power with Normal H.T. Voltage Sufficient to Supply a Moving Coil Loud-speaker.

By A. L. M. SOWERBY, M.Sc.

THE standard of reproduction, both in quantity and quality, that is expected from a receiver appears to be growing higher and higher as time proceeds. It is not so very long ago that the novelty of getting any signals at all made the quality a very secondary question, while if a loud-speaker could be worked audibly it was considered that all possible demands in the way of strength had been amply met.

Now all this is changed; we are no longer content to listen to music from which all true bass is missing, and which suffers from the introduction of various extraneous harmonics due to overloading the output valve. Nor are modern demands for volume satisfied by a small and tinkly noise, reminiscent, if a mixed metaphor can be forgiven, of an orchestra heard through the wrong end of a telescope. In place of these sounds, whose unfaithfulness to the original was only prevented from being actively offensive by their extreme quietness, the modern listener, if he be up to date, expects a volume not far inferior to that of a gramophone, together with freedom from all obvious distortion, and with no lack of bass notes.

The difficulty, from the point of view of the design and maintenance of the receiver, is that to fulfil these conditions properly it is necessary, in any receiver of ordinary design, to employ in the output stage a low-impedance valve (a "super-power" valve) with a grid-bias of not less than about forty volts. Such a value of grid-bias implies a plate voltage of well over two hundred volts, which in turn means that special high-voltage valves must be used, for the ordinary "super-power" valve would have but a short life under these conditions. If high-voltage valves are adopted a whole host of other difficulties at once crops up. These valves require a much heavier filament current than the ordinary modern valve, and are not available at all for two- or four-volt accumulators. Then the high-tension supply is expensive to install and to maintain, and if a mains unit is required the choice is very limited, for practically all those on the market will deliver only about 160 to 180 volts on heavy load. Finally, many of the condensers and other components designed for ordinary wireless use cannot be relied upon to stand up to high voltages, and special components have to be obtained. On the whole, the use of high plate voltages, although certainly in the long run the best way out of the difficulty of handling enough volume for modern requirements, is so expensive and so troublesome a proposition that it does not appeal to the average user.

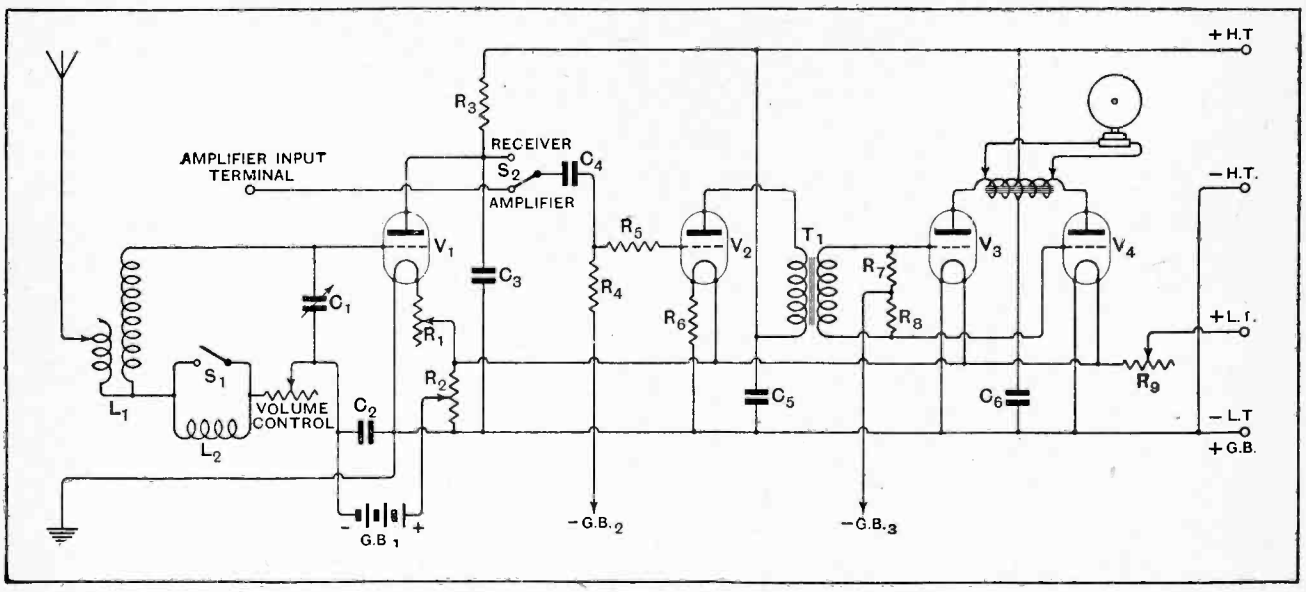
Push-pull Output Circuit.

In the present receiver a compromise is made. It is intended to use ordinary "low-voltage" output valves, but in order that results shall not fall too far short of the standards set by high-voltage valves the anode voltage is pushed up to the highest value compatible with long valve life, and the push-pull system is adopted.

The main principle of this method is that instead of using a large grid-bias on a single output valve, and adjusting the high-tension voltage to suit, the signals are divided between two valves in such a way that each is expected to deal with only half the signal voltage, and consequently requires only half the grid-bias to enable it to handle without distortion its share of the input. Thus, by using two valves instead of one to feed the loud-speaker, we can employ the normal value of high-tension, while at the same time obtaining a signal strength approximating to that usually associated with a high-voltage equipment. Further information, on the theoretical side, about push-pull amplification will be found in a recent article in these pages.[1]

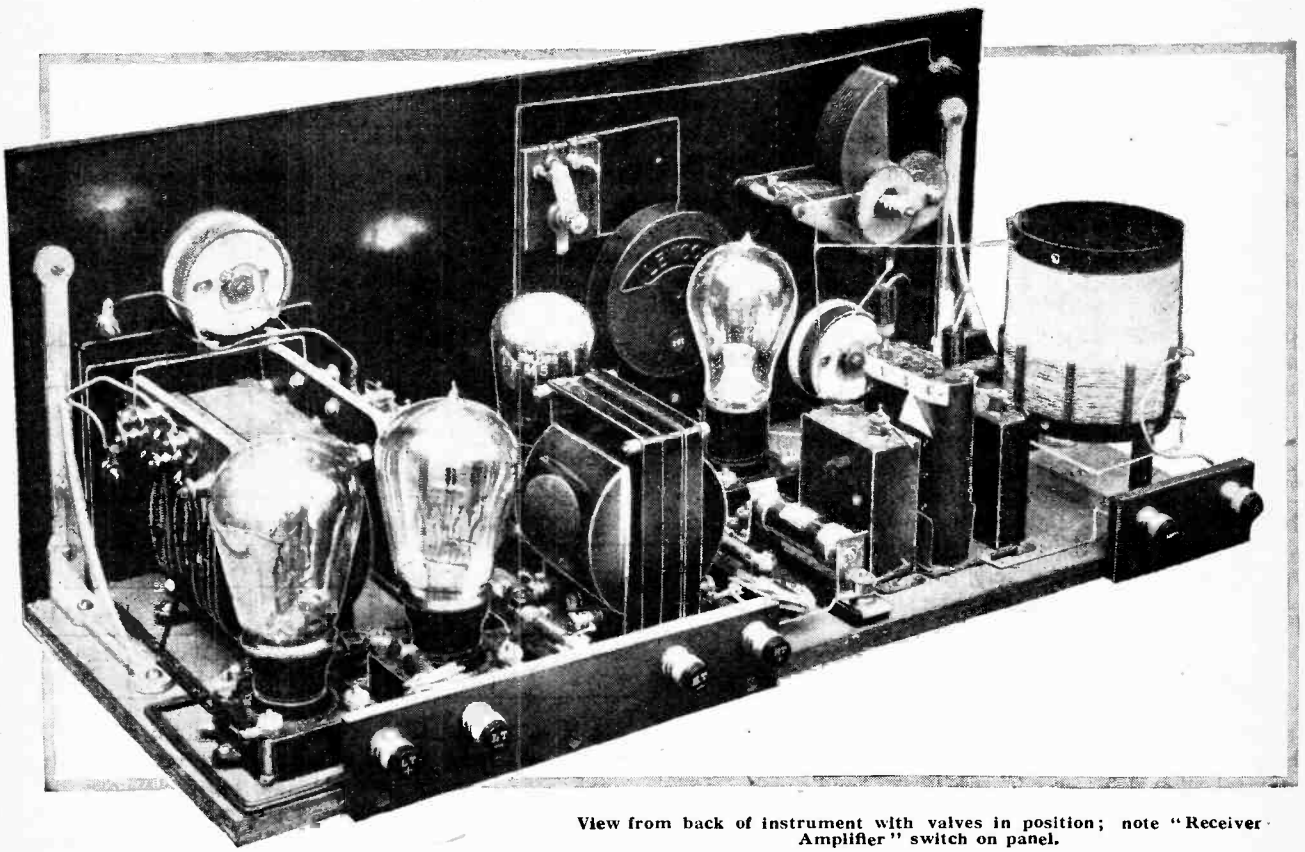
The chief drawback to this mode of dodging the

[1] *The Wireless World*, November 30th, 1927, p. 739.



CIRCUIT DIAGRAM OF COMPLETE RECEIVER. The following are the values of the chief components: $R_1 = 30$ ohms; $R_2 = 300$ ohms; $R_3 = 250{,}000$ ohms, wirewound; R_4, R_7, and $R_8 = 2$ megohms; $R_5 = 40{,}000$ ohms (grid-leak type); R_6, to suit valve used; $R_9 = 7$ ohms. Volume control, 30 ohms; $C_1 = 0.0005$ mfd.; $C_2 = 1$ mfd.; $C_3 = 0.0001$ mfd.; $C_4 = 0.005$ mfd.; C_5 and $C_6 = 2$ mfd.; L_1 = Everyman Four aerial-grid transformer; L_2 = Lewcos 200 plug-in coil; T_1 = Ferranti A.F.5 transformer; Output choke, special model—see text.

necessity for high voltage lies in the fact that we now have two output valves, each drawing a current of the order of ten or twelve milliamperes from the anode current supply, so that dry batteries cannot possibly be used as a source of anode current. High-tension accumulators, however, are now so widely employed where quality is considered necessary that the high plate current does not matter; indeed, it is an advantage, for it gives the anode battery plenty of exercise. It is a truism to say that more H.T. accumulators are ruined through being expected to last from three to six months on a single charge (see advertisements) than in any other



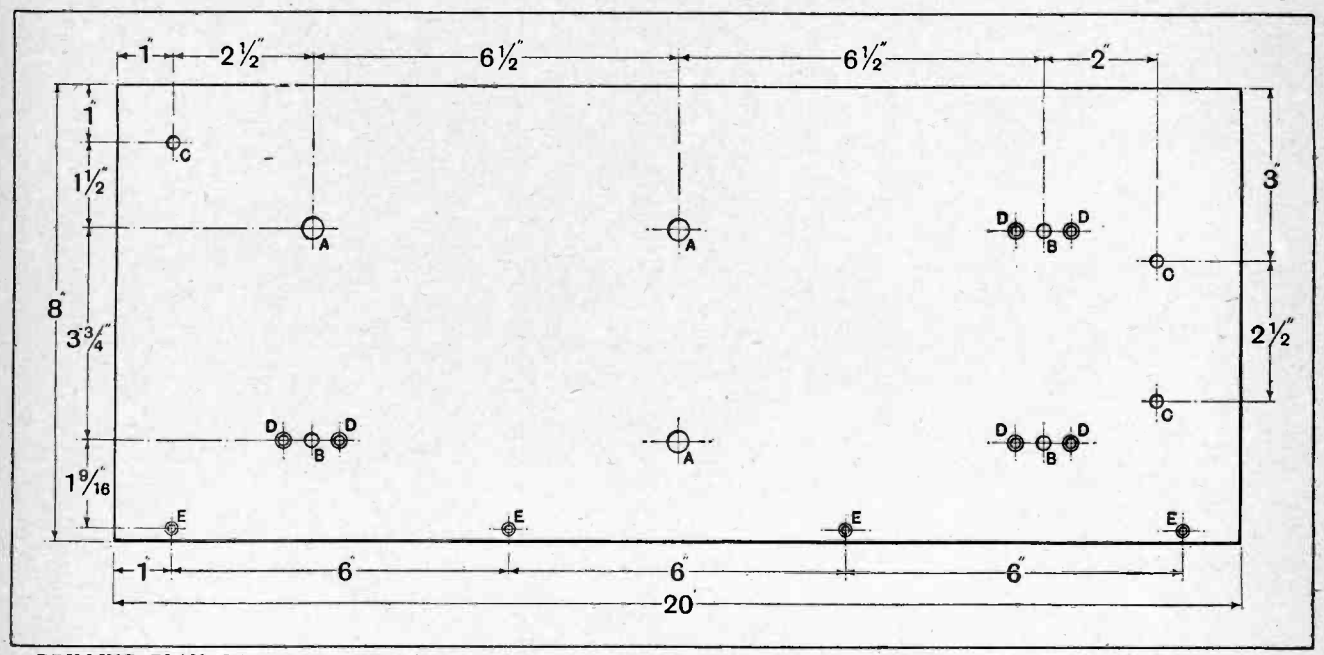
View from back of instrument with valves in position; note "Receiver Amplifier" switch on panel.

Alternative Programme Quality Receiver.—

way, so that the imperative need for recharging every four or five weeks that accompanies the use of two "super-power" valves may be reckoned as a blessing in disguise.

Since we have been discussing the output arrangements at some length, let us look first at that part of the circuit diagram.

The output from the secondary of the transformer T_1 is split into two equal parts by the use of a pair of grid-



DRILLING PLAN OF PANEL. When it is not desired to provide for the use of the instrument as an amplifier, certain of these holes become unnecessary. See text for details. Sizes of holes: A = 3/8in. diam., B = 1/4in. diam., C = 5/32in. diam., D = 7/32in. diam. for No. 4B.A. screws; E = 1/8in. diam. for No. 4 wood screws.

leaks shunted across it, the junction between the two being connected, through the grid-bias battery, to earth. One half of the voltage developed across the secondary is by this means applied to the grid of each output valve, while at the same time any possible tendency of the transformer to "peak" over a small band of frequencies is checked. Specially made push-pull transformers are available, the number of them having been considerably augmented at this year's Show, but the present method is preferred since it will enable any who are already in possession of a transformer of proved excellence to employ it. At the same time, the writer would remark that the Ferranti transformer shown in the receiver was chosen deliberately, and as the overall amplification-frequency curve of the receiver is practically that of the transformer, it is of the very first importance that this component should be the very best available.

The Output Choke.

In place of the output transformer with centre-tapped primary which is customarily employed in push-pull amplifiers, a choke with a number of tappings is used in the present receiver. To the centre point is connected, as usual, the H.T. supply, while the loud-speaker and the anodes of the valves are connected as required to the remaining terminals. This unusual output scheme has been adopted because it is thereby possible to step the output up or down to the loud-speaker, so that any type of speaker may be worked under the conditions most suited to it.

The chief effect of stepping down to the loud-speaker is to increase the output on low notes, which may or may not be an advantage, depending upon the loud-speaker in use.

As a matter of interest, 500 cycle and 50 cycle notes were generated and fed into the receiver, and the voltages for each frequency developed across the loud-speaker (a Western Electric "Kone") were measured by means of a Taylor voltmeter. The results obtained, using first D.E.5 and then D.E.5A valves in the last two sockets, are given in the Table.

D.E.5 VALVES (7,000 OHMS IMPEDANCE).

Frequency.	Ratio.			
	1 : 1	4 : 3	4 : 2	4 : 1
50~.....	10.3 volts	12.8 volts	14.6 volts	12.2 volts
500~.....	18.7 volts	19.5 volts	17.2 volts	11.4 volts

D.E.5A. VALVES (3,200 OHMS IMPEDANCE.)

Frequency.	Ratio.			
	1 : 1	4 : 3	4 : 2	4 : 1
50~.....	17.0 volts	19.0 volts	17.8 volts	11.6 volts
500~.....	16.6 volts	14.8 volts	11.4 volts	7.0 volts

It is to be noticed that these four sets of figures are entirely separate; no conclusions must be drawn from comparisons between 50-cycle and 500-cycle notes other than observing that the optimum step-down ratio is very different for the two frequencies.

Alternative Programme Quality Receiver.—

With D.E.5 valves, the higher note was loudest with a step-down ratio of 4 : 3, while the lower note required 4 : 2. Using D.E.5A valves, for which the receiver was intended, less step-down ratio is required on both frequencies, the loudest sound being obtained without step-down at 500 cycles, and with the 4 : 3 ratio at 50 cycles.

Optimum Output Ratio.

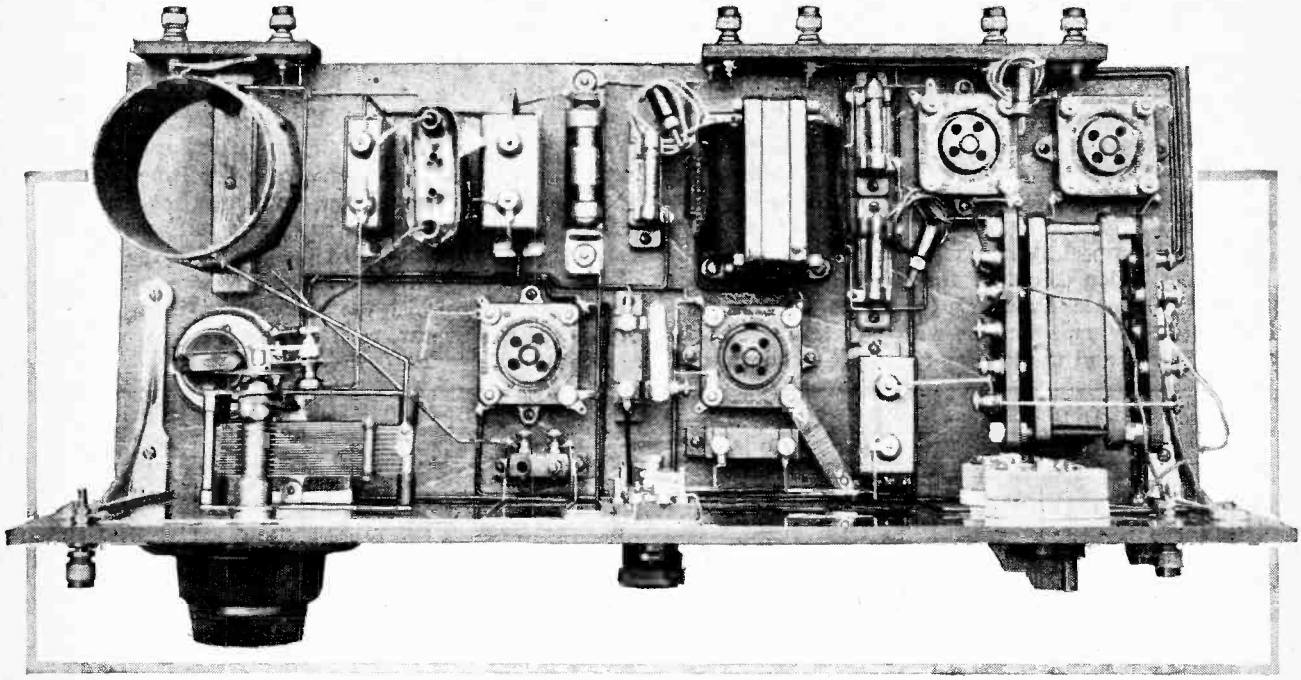
Adjusting the ratio while listening to broadcast music (full orchestra), which enables one to gauge roughly the general strength of music, as well as the relation between high and low notes, it was found that the most pleasing results were had with a step-down of 4 : 2 with D.E.5, and 4 : 3 with D.E.5A valves. But nothing much more can be deduced from this than that the writer evidently has a keen ear for low notes. In any case, quite different ratios are likely to be required with loud-speakers of other makes; it is even possible that it may be preferable, with some instruments, to step *up* instead of down.

It will be noticed that the condenser usually associated with choke feed is missing. It is not necessary with this arrangement, as the two terminals of the loud-speaker are connected to points at the same D.C. potential, so that no current will flow through the windings. If it is desired to isolate the speaker from "H.T.+" for any reason, a 4 mfd. condenser may be inserted into each lead.

The output choke is not a standard component, but may be obtained from Messrs. Rich and Bundy, 13, New Road, Ponders End.

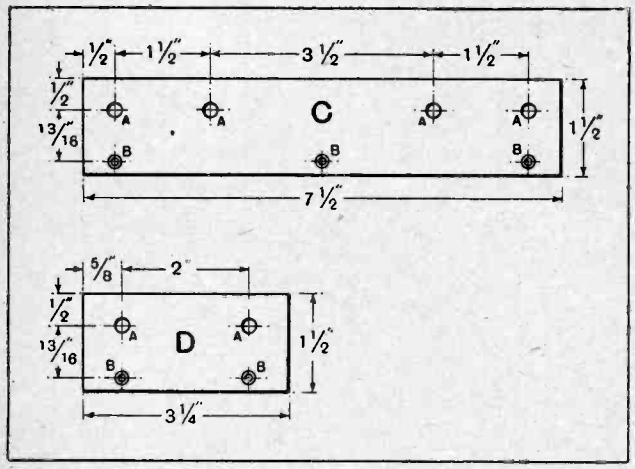
Turning now to the rest of the receiver, it will be seen that the circuit is of the simplest, consisting merely of an anode rectifier coupled by means of a resistance, to the L.F. amplifying valve. No attempt has been made to provide for the reception of distant stations, so that neither high-frequency amplification nor reaction have been incorporated. On the other hand, the coil has been designed to provide the maximum selectivity that can be expected from a single circuit, so that both the local station and 5GB can be received without mutual interference.

The whole design of the receiver has been directed to providing the very best quality possible from such stations as can be relied upon to give entertainment free from all interference. The range of the receiver is practically identical with that of a first-class crystal set, by which is meant that any station from which a crystal set will receive intelligible speech will work the output valves of the present receiver to the limit of their capacity. In practice, this means that at most places three stations can be heard; the local station, and the two Daventry transmitters. The receiver is therefore particularly suitable for placing in the hands of non-technical people who regard wireless reception purely as a means of entertainment, and care nothing for distant reception.



Plan view of the receiver showing baseboard layout.

But in order that it may be convenient also for those who desire to indulge, on occasion, in long-range reception on a multi-stage H.F. set, and yet require something simple that can be left in the hands of other members of the family for local station work, an extra terminal has been added so that the amplifier portion of the instrument can be connected up after any receiver. To meet this need it is suggested that two H.F. stages and an anode detector, with its plate resistance, might be made up as a separate unit and coupled to the terminal marked "Amplifier Input." No other connection, provided that a common battery or a common earth is used, is needed between the two units. The single-pole change-



TERMINAL STRIPS. Sizes of holes: A = 7/32in. diam., B = 1/8in. diam. for No. 4 wood screws.

over switch in the centre of the lower edge of the panel connects the grid-condenser of the first L.F. amplifier at will either to the output of the detector in the instrument or to the "Amplifier Input" terminal. The rheostat of the detector valve is situated on the panel, so that the detector valve may be turned out when the instrument is in use as an amplifier only.

The switch and the terminal may, of course, be omitted where the need for an amplifier after a long-distance receiver does not arise, and the detector rheostat R_1 may then be removed to the baseboard.

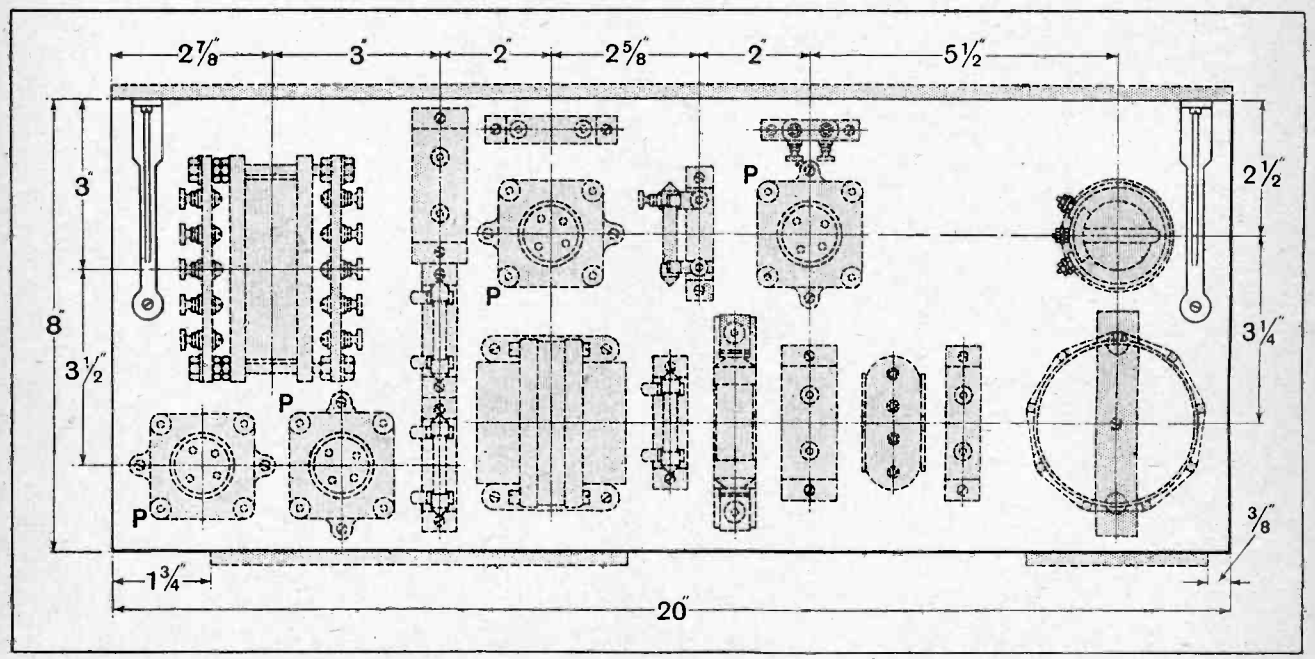
The second (upper) switch is provided to short-circuit the "Lewcos" 200 coil used for increasing the tuning inductance to enable Daventry (5XX) to be received. Reference to the circuit diagram will show that when this switch is closed, and the loading-coil short-circuited, the aerial is coupled to the tuning circuit only by the over-wound primary of the aerial-grid transformer. On opening the switch, the aerial circuit is completed through the loading-coil, so that to all intents and purposes the aerial is then direct-coupled. By this means the best operating conditions on both long and short waves are attained, together with simplicity both of construction and operation.

The aerial-grid transformer used for the lower waves is a standard "Everyman Four" component, and may be obtained ready wound from any one of a number of advertisers in the pages of this journal. Details of its windings have been given several times in these pages, and need not be repeated here.

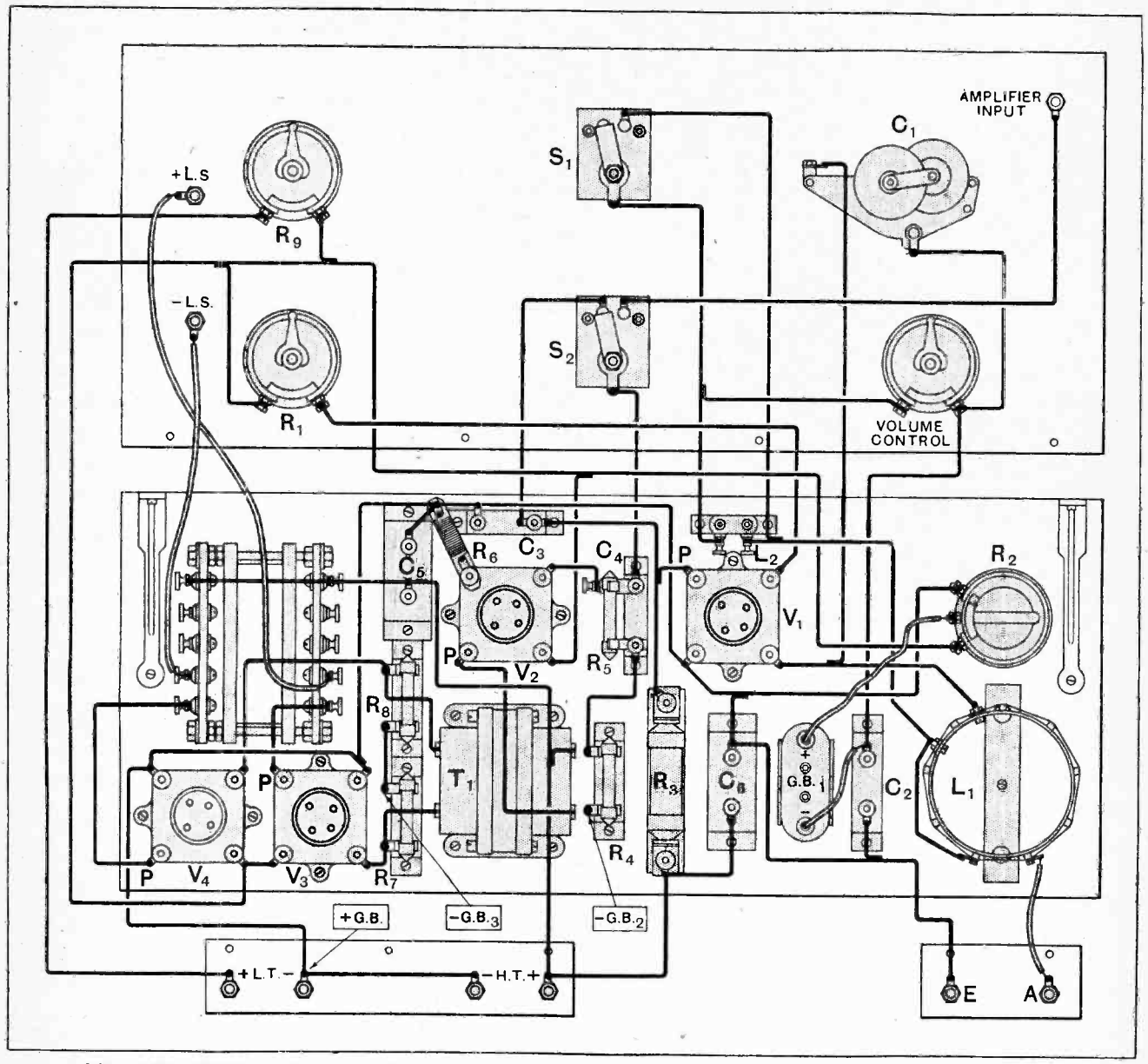
The aerial primary is tapped; if the aerial is connected to the tapping-point selectivity will be enhanced, though at the expense of a little signal strength. The best position of the aerial connection should be found by each user, and a permanent connection made.

Volume Control.

The problem of volume control has been met by means of a compromise. The obvious method is by detuning, but where there is only one tuned circuit this method is open to two objections. Either some other station may be heard faintly through the one that is required, or, if only a small degree of reduction in volume is required, a very unpleasant form of distortion may be introduced by tuning very slightly off the wave of the station being received. A 30-ohm rheostat has therefore been introduced into the tuned circuit, so that when required its resistance can be increased so that distortion from slight detuning does not occur. At the same time the sensitivity of the receiver is decreased sufficiently to ensure that any distant station to which the receiver may inadvertently be tuned will not appear, as it otherwise might, as a background to the station desired.



LAYOUT OF COMPONENTS ON BASEBOARD. The parts may be identified by comparing the complete wiring diagram with this and with the circuit diagram.



COMPLETE WIRING DIAGRAM. Note the insulated "series" clip, bearing a terminal, used for supporting R_5 on C_4.

Since the requirements of quality imply an anode bend detector, the coupling that succeeds it must of necessity be a resistance; the value chosen, 250,000 ohms, gives about the highest sensitivity that is compatible with the proper retention of high notes, having regard to the characteristics of V_1 and V_2 and the capacity, 0.0001 mfd., of C_3.

R_5 is inserted to protect the grid of V_2 from high-frequency voltages. It is to be noted that it is *not* connected in parallel with C_4 as a too hasty inspection of the practical wiring diagram might suggest. The clip shown as bearing a terminal is insulated from the condenser, and is a standard Dubilier component. The value of R_5 (40,000 ohms) is such that the loss of high notes due to its use is extremely small, and it might be wise to substitute a resistance up to three times this value if it is intended to use a battery eliminator to supply the anode current. Resistances of this type and value are made by the Ediswan and Loewe Radio Companies.

C_4 and R_4 have values of 0.005 mfd. and 2 megohms respectively, which provide for adequate amplification of low notes. Since C_4 has to protect the grid of V_2 from the voltage of the high-tension battery, it is necessary that a thoroughly reliable condenser be used here. Even slight leakage will result in giving the grid of V_2 a positive potential, resulting in very unpleasant quality, and a very short life for the valve.

There is little that need be said of the actual constructional work, for there is no component that cannot readily be purchased. The making of the receiver is thus reduced to drilling the panel according to the plan provided, screwing the components to the baseboard in

LIST OF PARTS.

1 Variable condenser, friction control, 0.0005 mfd., logarithmic (Jackson Brothers).
2 Rheostats, 50 ohms (Igranic, type P56E).
1 Rheostat, 6 ohms (Igranic, type P56A).
1 Potentiometer, 400 ohms (Igranic, type P56B).
1 Resistance, 250,000 ohms and holder (Dubilier, Duwirohm).
3 Grid leaks, 2 megohms, and holders (Dubilier, Dumetohm).
1 Fixed condenser, 0.0001 mfd. (Dubilier, No. 620).
1 Fixed condenser, 0.005 mfd. (Dubilier, No. 620).
2 Fixed condensers, 2 mfd. (T.C.C.).
1 Fixed condenser, 1 mfd. (T.C.C.).
1 40,000 ohms anode resistance (Ediswan).
4 Valve-holders (Benjamin).
1 Paxolin tube, 3in. × 3½in. (Wright & Weaire, Ltd).
20 yds. Litz (P. Ormiston & Sons, Ltd.).
1 200 Coil (Lewcos).
1 pr. Aluminium brackets (Camco).
1 Transformer, 3·5 : 1 (Ferranti, A.F.5).
1 Output choke of special design, tapped (Rich & Bundy, 13, New Road, Ponders End, Middlesex).
1 Semi-fixed resister (Peerless Bedford Electrical & Radio Co.).
2 Switches, 2-way (Ormond, No. R/143).
1 Baseboard, 20 × 8 × ¾in.
1 Ebonite panel, 20 × 8 × ¼in.
5 Wander-plugs (Lisenin).
9 Nickel-plated terminals (Belling-Lee, type "M.").
1 Single coil-holder.
1 Grid bias battery, 4½ v. (Siemens, No. G.1).
1 Grid cell holder ("Verona," Jabez Bate & Co., Newtown Row, Birmingham).
Screws, wire, Sistoflex, etc., etc.

(*Approximate cost £9 10s.*)

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

the appropriate positions, and wiring up. It will be found advisable to make all possible connections on both panel and baseboard before screwing the two together, so that soldering may be done under the most convenient conditions possible.

The valves which the writer had in mind when designing the receiver, and with which it was tested, were the following:—

Detector: Cosmos S.P.50/Blue Spot (55,000 ohms).

L.F. amplifier: Mullard P.M.5X (19,000 ohms).

Output valves: Marconi or Osram D.E.5A (3,500 ohms).

The figures represent the impedances of the valves according to the makers' catalogues; if for any reason it is desired to employ other valves than these, some care should be exercised in choosing those with impedances nearly equal to the values given. If there is to be any divergence, it is recommended that *lower* impedances should be chosen rather than higher. In all cases, the valve having the highest amplification factor should be chosen from among several of the right impedance.

Since it is intended that the highest safe value of anode voltage should be employed, it will be advisable, if it can be managed, to adhere in the output valves to those which have a thoriated rather than a coated filament, as the writer's own experiences have led him to the belief that these valves will, in general, stand a higher anode voltage than the maximum recommended by the makers without detriment. In testing, 180 volts were employed; this is a trifle on the high side for safety, but 160 volts can be recommended as being a good compromise between utmost valve life on the one hand, and utmost distortionless output on the other.

It must not be imagined that the receiver will not function satisfactorily on a lower voltage than this, but the volume obtained before overloading begins decreases fairly rapidly as the high-tension voltage is reduced.

With the valves specified, the grid-bias voltages required with 160 volts H.T. are 3 and 22 volts respectively, and the total plate current is about 25 milliamperes.

Adjustments.

It is to be noted that if any change in grid-bias voltage is to be made to either of the L.F. stages, the receiver should be turned off by the master rheostat to prevent the plate current from running up momentarily to a very high value, with possible damage to the valves.

The grid bias and filament current of the detector should be adjusted carefully by means of R_2 and R_1 while listening to faint signals (detune the local station for this) until the most sensitive adjustment is found. Neither of these controls will need to be touched again until the voltage of the grid battery GB_1 has dropped considerably.

On test on a full-size aerial about six miles from 2LO, it was found possible to overload the output valves with signals from 2LO, 5GB, and 5XX, while, using the least selective aerial tap, there was no background of 2LO when listening to 5GB. Aurally judged, the quality of reproduction was considered such as to do justice to the best loud-speaker on the market.

BOOKS RECEIVED.

Photograms of the Year 1927.—The Annual Review for 1928 of the World's Pictorial Photographic Work. Edited by F. J. Mortimer, F.R.P.S. About 100 fine reproductions of pictorial photographs printed in duo-tone on art paper, and representing the work of leaders in photography in Great Britain, the Colonies, and foreign countries. With an up-to-date directory of British Photographic Societies. Published by Iliffe & Sons Ltd., London, price 5s. net in stiff paper wrapper, or 7s. 6d. cloth bound.

Theory of Thermionic Vacuum Tube Circuits, by Leo James Peters, Assistant Professor of Electrical Engineering in the University of Wisconsin. Pp. 256, with about 100 illustrations and diagrams. Published by McGraw-Hill Publishing Co., Ltd., London, price 15s.

Close Downs and other Poems, by Ira Mary Downing, read by Percy Edgar from the B.B.C. Studio in Birmingham. Pp. 194. Published by Cornish Bros. Ltd., Birmingham, price 2s. 6d. net.

Simplified Aids to Better Reception.

DOUBLING H.F. AMPLIFICATION.

EVERY real wireless enthusiast is continually seeking greater high-frequency amplification, and few of us remain satisfied for long with the sensitivity of our receivers, excellent though they may be. Now, with a given H.F. transformer of good design, it is not far short of the mark to say that the amplification obtainable is directly governed by the "figure of merit" of the valve. As an example we may take the "Everyman Four" arrangement, which, with a valve having an impedance of 20,000 ohms and a voltage factor of 20, gives a magnification of the order of forty times. Substitute this valve by one having the same impedance and a voltage factor of 10, and the magnification obtainable will be halved. It is equally true to say that, if impedance remains unchanged and the voltage factor is doubled, amplification will be increased in about the same proportion.

It does not seem to be generally realised that valves having something approaching these greatly improved characteristics are now available. These are of the indirectly heated cathode type, which are intended to be operated on A.C. supply mains. Their use in this manner will not be discussed at the present, but it may be pointed out that certain types, notably the Cosmos A.C./G., may be made to serve in such *Wireless World* receivers as the "Everyman Four," the "All-Wave Four," the "Regional," or the "Standard Four" without any radical alteration to the wiring, always providing that it is possible to supply the heating current of 1 ampere at 4 volts which is consumed by the valve in question. This current may be derived from the L.T. battery, so we will, for the moment, ignore the normal method of operation from a step-down transformer, although there is no real reason why a single A.C. valve should not be thus used in conjunction with those of the ordinary type; the modifications necessary are both simple and obvious.

The method of connecting the A.C./G. valve is shown in Fig. 1. It is fitted with three pins, which are joined to cathode, grid, and plate, and with an adaptor disc carrying a twin flexible lead for heater current supply. If one of these leads is joined to L.T. negative, and the other to the positive L.T. terminal—direct if the battery is of 4 volts, and through a 2-ohm rheostat or fixed resistor if of 6 volts—the system of connection as shown will automatically result without further alteration, always assuming that the set is one of those mentioned above and that it is wired in accordance with the wiring plans which have appeared in this journal. This proviso is made because it is necessary that the valve-holder filament socket on the right-hand side of the anode socket (looking from the anode end) should be joined to L.T. negative.

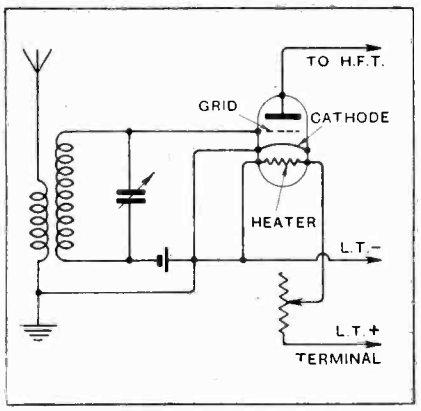


Fig. 1.—How to use an A.C. valve with accumulator L.T. supply.

The alteration under discussion is one which can be recommended to those who are working under unfavourable conditions and who consequently feel a need for greater sensitivity than is ordinarily obtainable. It should be realised, however, that the increased magnification is only obtainable at the expense of a very considerable increase in filament current; that consumed by the indirectly heated cathode H.F. valve alone may well be more than twice the requirements of the remaining valves.

It should be unnecessary to add that doubled H.F. amplification, unfortunately, does *not* mean that the range of the receiver will be increased in anything approaching a like proportion; unless this is fully realised, the amateur who goes to the expense of making the change may be disappointed. It is a fact, however, that conditions often exist under which an almost doubled H.F. amplification will make all the difference between sufficiently loud signals and an output which is ample for satisfactory loud-speaker operation.

○○○○

H.F. OR L.F.?

THE article entitled "Back Coupling in L.F. Amplifiers" (*The Wireless World*, December 14th, 1927) may well provoke a revival of the old controversy between the advocates of H.F. and L.F. amplification. It was shown that there is considerable difficulty in preventing that form of low-frequency reaction which is caused by incidental resistance in the H.T. battery (or eliminator), and which gives rise to uneven amplification in a multi-stage amplifier. This form of distortion may be so bad,

even when each individual stage is practically perfect, that one may well reach the conclusion that it is safest to restrict oneself to a single L.F. stage, any further amplification which may be necessary being provided before detection—in other words, at high frequency.

There is a good deal to be said in favour of a receiver on these lines, particularly now that effective H.F. circuits have been developed. High-frequency amplification automatically provides the selectivity which is becoming increasingly necessary and which will be essential for many listeners when the Regional Scheme comes into operation. Generally speaking, a receiver with an H.F. valve interposed between aerial circuit and detector is somewhat less susceptible to interference from power circuits in the vicinity. The tendency towards causing interference with others by oscillation is, at the worst, very considerably reduced, and, as far as many modern designs are concerned, entirely obviated. Important as are these advantages, it seems probable that the greatest benefit of all results from the fact that effective H.F. amplification allows us to obtain more than sufficient loud-speaker volume for *ordinary* requirements with one L.F. stage only.

The most serious limitation of the "single L.F." set is connected with the fact that it will not be possible fully to load an output valve of exceptionally large voltage-handling capacity without running into grid current in the detector valve. This trouble should not be encountered, however, with an ordinary super-power valve and an applied anode voltage up to the usual limit of 120 volts.

The foregoing must not be taken as implying that two (or even more) low-frequency amplifiers cannot be put into satisfactory operation; such a statement would obviously be absurd. It is, however, desired to emphasise the fact that inter-stage couplings are a very real source of trouble, and that reaction effects often give rise to poor quality, the cause of which cannot be readily traced by means of apparatus at the disposal of the average amateur. Clearly, such trouble may most easily be avoided by using a single L.F. stage.

PROTECTING H.F. TRANSFORMERS.

ALTHOUGH the plug-in H.F. transformers used in the "Regional" and "Standard Four" receivers are reasonably robust, due in part to the fact that protection is given to the fine wire primary and neutralising windings by the projecting ebonite ring on which the contact pins are mounted, there is some possibility of breakage if the coils are roughly handled. It is therefore suggested that those who are willing to devote a little extra time to constructional work would be well advised to consider the addition of a protective cylinder as shown in Fig. 2.

An ebonite, Paxolin, or Pirtoid tube, with an external diameter of 4in., the same length, and a wall thickness of $\frac{1}{16}$in., is suitable for the purpose. The ebonite ring on the

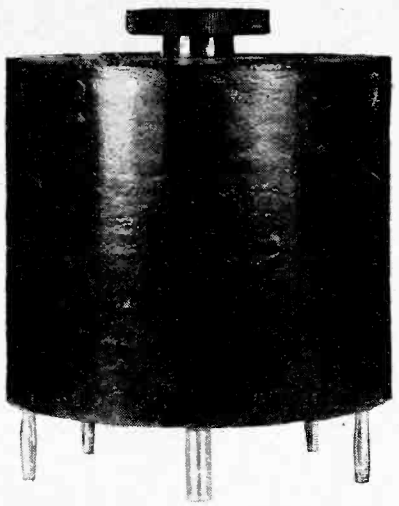


Fig. 2.—The windings of plug-in H.F. transformers may be safeguarded by fitting a covering tube of insulating material.

transformer should be suitably reduced in diameter (by about $\frac{1}{8}$in.) in order that the tube may fit closely over it, after which three or four small screws are passed through the tube into the ring.

The cylinder top may be filled in with a disc of ebonite or even dry wood, and a knob may be added for easy handling. Provided, however, that the windings are protected, there is little reason why the end should not be left open.

It is a good plan to paint a distinctive mark on one side of the tube or on the top; this should coincide with a similar mark on the base, and will facilitate the insertion of the transformer.

NEW YEAR RESOLUTIONS.

AT this season of the year a wireless journal may take certain liberties with its readers. The following suggestions are, therefore, offered without apology:

"I will learn to read theoretical circuit diagrams; without this knowledge it will not be possible to make much real progress, and it will be a difficult matter for me to keep my set up-to-date."

"I will obtain a reasonably good two-range voltmeter, or separate meters for H.T. and L.T. batteries; without measuring instruments the tracing of faults will remain largely a matter of chance."

"I already have a voltmeter, and will now obtain a milliammeter, which is almost equally necessary. With its help, the adjustment of valve operating conditions will be greatly simplified, and, moreover, it will be an easy matter to decide if poor-quality reproduction is due to overloading or to other causes."

"My detector-L.F. receiver is sensitive, although as the more distant stations are only heard after dark I take it that it depends to a certain extent on favourable freak conditions. Reaction control is the best of its kind, but I confess that the set not infrequently goes into self-oscillation, thus interfering with my neighbours. *The Wireless World* has shown me how to get real H.F. amplification; as I am keen on long-distance reception I will re-model my circuit to include a high-frequency stage, which will give me greater range without the need for fine adjustment, better selectivity, and, above all, will enable me to do my share in abolishing the oscillation nuisance."

"When carrying out adjustments which may possibly involve the production of oscillation, I will tune to some wavelength other than that of the local station."

"I realise that the perfect set does not exist, but will adopt a somewhat more critical attitude towards the quality of my own reproduction, and will endeavour to improve it. My efforts will eventually react to my own advantage in more ways than one, as my friends will be induced to install receivers; larger consumption will lead to lower prices for components, and more listeners will mean more money for better programmes."

RECTIFIERS AND SMOOTHING CIRCUITS.

An Experimental Study of Input and Output Wave Forms by Means of the Duddell Oscillograph.

By FREDERICK RECORD, B.Sc., and IDA N. HOLMES, B.Sc.

THE use of rectifying systems instead of high-tension batteries in receiving sets is growing at an increasing rate and will probably continue to do so owing to the development of valves which are of suitable dimensions and output. The behaviour of such systems is therefore of considerable general interest.

The tests described below were made on an experimental unit employing a U.5 valve which is a full-wave rectifier. The energy was obtained from a small transformer of standard make which was connected to mains supplying alternating current at 110 volts and of frequency 50 cycles.

The oscillograms were taken by means of a Duddell oscillograph, having two loops and a third fixed mirror to mark the zero. They all show slightly more than two complete cycles, so that the curves represent the course of events in an interval of a little more than $\frac{1}{25}$th second. One loop was slightly more sensitive than the other, but

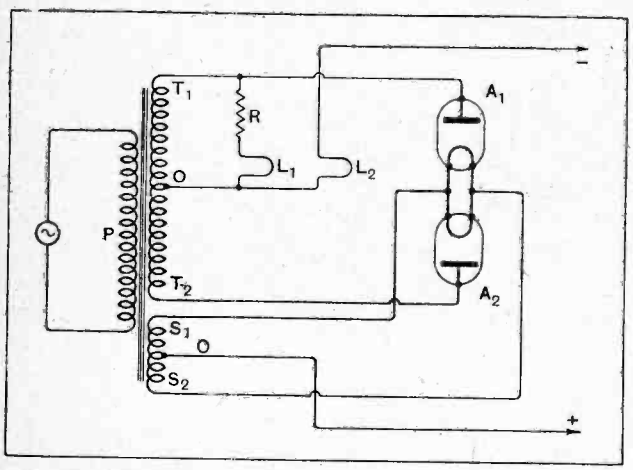


Fig. 1.—Circuit diagram of apparatus used in the investigation of transformer and output wave form. The oscillograph loops are represented at L_1 and L_2.

it was not thought necessary to equalise them as qualitative results were sought.

Using the arrangements shown in Fig. 1, three oscillograms were taken. The sine curve in oscillograms (I.), (II.) and (III.) shows the form of the alternating output from the high-tension secondary of the transformer: it was recorded by the loop L, which was joined in series with a resistance of 3,000 ohms across one half of the winding. It was connected thus in order to ensure that there should not be an appreciable potential difference between the loops. The second curve shows the form of the output from the system, the load being a resistance of 5,000 ohms. (I.) gives the current through one valve element, the anode A_2 being disconnected from its supply terminal T_2; (II.) gives the current through the other valve element, the anode A_1 being disconnected from T_1; (III.) gives the current through the complete valve, both anodes being connected. The mean current was about 10 milliamperes in the case of oscillograms (I.) and (II.), and about 19 milliamperes in case (III.).

It is somewhat surprising to find that, when the valve is acting as a full-wave rectifier, the output current does not become zero. An examination of the circuit diagram, however, indicates that the effect is probably due to the variation in potential along the filament. When no potential difference exists between the anode and the centre of the filament transformer, a small potential difference may exist between the anode and one end of the filament.

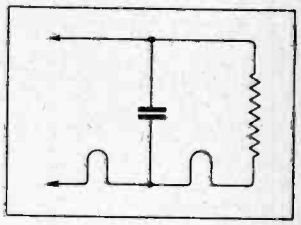


Fig. 2.—Arrangement of loops to show the effect of smoothing condensers on the output wave form. The resistance represents the output load.

The addition of a condenser produces a very striking change, even though the capacity be only small. To observe this effect a slight rearrangement of the circuit

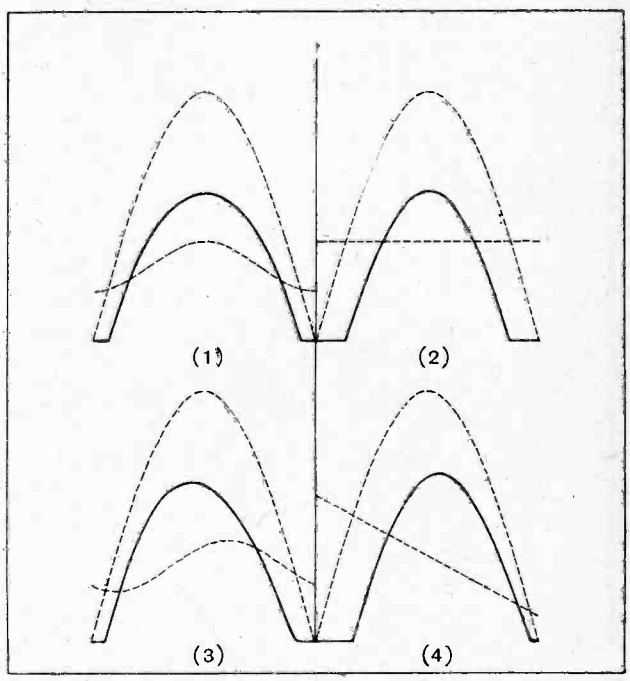
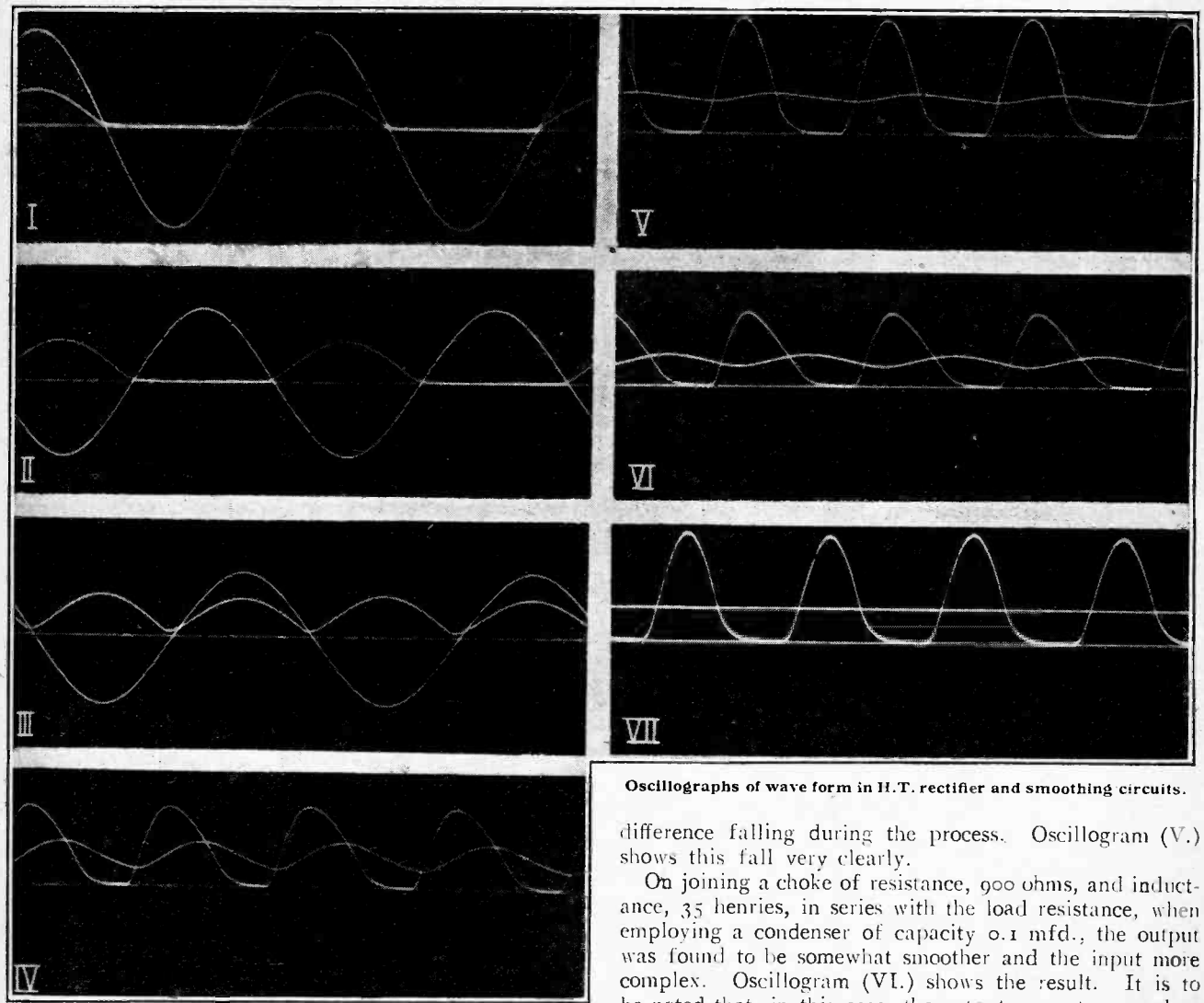


Fig. 3.—Calculated input curves for various types of output; (1) unsmoothed output; (2) smoothed output; (3) unsmoothed output with a phase difference; (4) falling output.

Rectifiers and Smoothing Circuits.—

is necessary, the oscillograph loops being arranged to record the input to the system and the output from it in the manner indicated in Fig. 2.

Oscillogram (IV.) was obtained when a condenser of capacity 0.1 mfd. was employed, the resistance load being 3,000 ohms and the output current about 30 milliamperes. The curve with the smaller variation shows the form of the output current, while the more angular one shows that of the input.



Oscillographs of wave form in H.T. rectifier and smoothing circuits.

On increasing the capacity to 5 mfd., oscillogram (V.) was obtained, the output in this case being more nearly uniform.

As the load is a resistance, the output current is proportional to the applied voltage, which is, in this case, the potential difference between the condenser terminals. The alternating voltage applied to the valve is opposed by the potential difference between the condenser terminals. Hence the current flowing into the system is determined by the difference between these voltages, there being no input if the applied voltage is less than the condenser voltage. Although the valve current is proportional to the $3/2$ power of the applied voltage, the approximate form of the input current may be found by plotting the difference between a sine curve and the output. In Fig. 3 this has been done for several types of output, two of which (3 and 2) correspond very nearly with two of the oscillograms (IV. and VII.).

During the period when there is no input current, the condenser supplies the whole of the output, its potential difference falling during the process. Oscillogram (V.) shows this fall very clearly.

On joining a choke of resistance, 900 ohms, and inductance, 35 henries, in series with the load resistance, when employing a condenser of capacity 0.1 mfd., the output was found to be somewhat smoother and the input more complex. Oscillogram (VI.) shows the result. It is to be noted that, in this case, the output current curve does not give the shape of the condenser voltage curve owing to the phase difference introduced.

The behaviour of the complete rectifying unit was investigated by arranging a smoothing circuit consisting of two 10 mfd. condensers and the choke previously mentioned. The oscillograph loops were connected to record the current flowing into the system and the output to the resistance load as shown in Fig. 4.

Oscillogram (VII.) was obtained with an output of about 30 milliamperes. The wavy line gives the input

Rectifiers and Smoothing Circuits.—

and the straight line parallel to the zero line represents the output. It is not possible to detect any want of uniformity in the output, although an inspection of the curves shows that the condenser alone is in action for about $\frac{1}{200}$th second, so that a fall of about 7.5 volts is to be expected.

By regarding the output line as the zero, the manner in which the condenser current varies with the time is indicated by the input curve. This is so because the current flowing in the condenser is the difference between the input and the output.

The input to the system was found to be approximately in phase with the applied voltage, there being possibly a slight lead. A photograph was not taken, so that this cannot be definitely stated.

The characteristic of the system was determined by joining a known variable resistance between the terminals of the complete rectifying unit and measuring the current, the output voltage being found by multiplying the current by the resistance. On plotting the voltage against the current a slight curve was obtained, so that the system behaves like a cell having a resistance which is not quite constant. An empirical formula was deduced from a set of readings obtained when using a choke of resistance, 390 ohms, and inductance in the neighbourhood of 400 henries. This formula is $V = 157.9 - 2254I + 7006I^2$, or $V = 157.9 - 2254\ (1 - 3.109I)I$, I being the output current and V the terminal voltage.

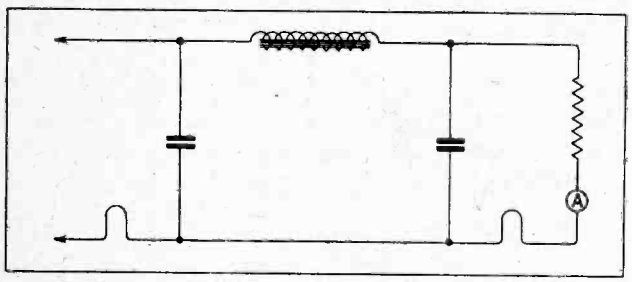


Fig. 4.—Arrangement of loops for comparing input and output waveform of choke-condenser filter circuit.

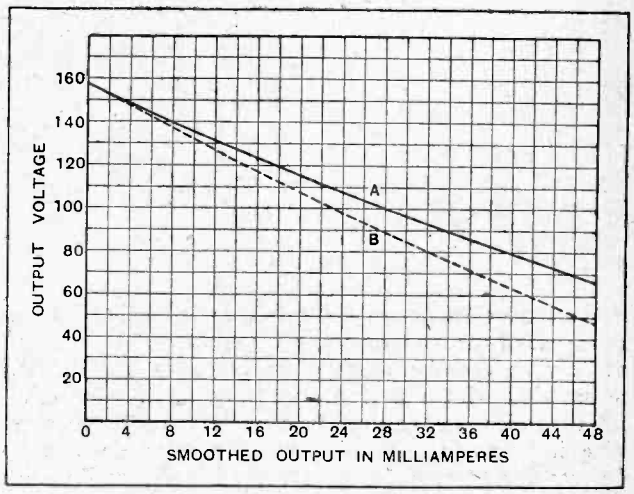


Fig. 5.—Output characteristic plotted from empirical formula: A, low-resistance choke; B, high-resistance choke.

The curves in Fig. 5 were drawn from values calculated by the use of this formula: they agree very well with the experimental results.

A simpler formula may be employed if a limited range of current be considered. $V = 157.9 - 2114I$ gives values in good agreement with the experimental ones for currents less than 20 milliamperes.

The unit may therefore be regarded as having an E.M.F. of 157.9 volts and a resistance of about 2,200 ohms, the precise value of the latter depending on the current.

On substituting condensers of 5 mfd. and 20 mfd. capacity for the two 10 mfd. ones, the output current was unaltered, but on replacing the choke by one of higher resistance (that used in the oscillograph tests) the terminal voltage was reduced. This reduction was exactly accounted for by the additional resistance introduced.

The high effective resistance of the system appears to be responsible for the trouble experienced with low-frequency oscillations when a rectifying unit is used for the high-tension supply to a receiving set.

BRITISH TIME SIGNALS FROM RUGBY GBR.

A New Service to Navigators, Astronomers and Geographical Expeditions.

THE International Rhythmic Time Signals transmitted from the Post Office Wireless Station at Rugby have been in operation since Monday, December 19th, and mark an addition to the services by which this station maintains contact with the most distant parts of the world and with ships on every sea.

The signals are of the modified rhythmic type recommended by the International Time Commission of 1925. They comprise a series of 306 signals emitted in 300 seconds, and equally spaced at intervals of 60/61 parts of a second. They are transmitted on a wavelength of 18,740 metres twice daily, beginning at 9.55 a.m. and 5.55 p.m., and terminating with a dash at exactly 10 a.m. and 6 p.m. G.M.T. The first signal at 9.55 a.m. and 5.55 p.m. is a dash, which is followed at regular intervals by 60 dots, another dash at the even 56th minute, another 60 dots, followed by a dash at the 57th minute, and so on, until the hour is indicated by the final dash. Each dash is $\frac{2}{5}$ second in duration and begins at the exact minute. These times of transmission have been selected with a view to reach the largest possible portion of the globe at suitable periods of the day.

For ordinary navigational purposes a comparison obtained by disregarding the dots and using the first sound of the dashes only will be sufficiently accurate, but for geographical surveys, astronomical work and other purposes where extreme accuracy is necessary, the intermediate dots, if recorded side by side with the local impulses, afford a means of correcting chronometers to 1/60 of a second.

NOTES ON THE "EVERYMAN FOUR."

Some Helpful Hints to Constructors.

IN spite of the fact that many thousands of "Everyman Four" receivers have been built by more or less inexperienced amateurs and some by raw beginners, *The Wireless World* postbag proves that the majority of constructors have succeeded in obtaining the results of which the set is capable. However, some readers have encountered difficulties, as is inevitable even in the case of the simplest set, while others, whose number can only be guessed, as they are generally inarticulate, are satisfied with a performance very much inferior to that of which the receiver is capable. They probably judge it by comparison with ordinary sets; we of *The Wireless World* staff know its potentialities, and would ask the reader to set the same high standard as we do in judging the performance of his own apparatus. It is hoped that the present article will help to dispel uncertainty on several points which do not seem to be generally understood, and which are sometimes responsible for poor results.

It is advisable at the outset to correct a misapprehension which still seems to exist regarding the reception of long waves; so far as these are concerned, no use is made of H.F. amplification, regeneration, or the properties of a coupled aerial circuit, and therefore a high degree of selectivity and sensitivity cannot be expected. At distances of up to a hundred miles—sometimes considerably more—the long-wave adaption gives good signals from Daventry 5XX, but interference from a medium-wave transmitter in the immediate vicinity may be experienced unless selectivity is improved by connecting a fixed condenser of some 0.0001 to 0.0002 mfd. between the aerial lead-in and aerial terminal A_3. It should thus be clear that the set is not a suitable one for those living in coastal districts who have to depend largely on the Daventry station; for these conditions one of the later sets with H.F. amplification on the long waves is recommended.

Detector Grid Bias.

Detector grid bias is another source of misunderstanding. In the receiver as originally described a two-volt detector was used in conjunction with six-volt valves elsewhere; thus four volts was available for application to the grid, and a suitable proportion of this voltage was obtained by taking the low-potential end of the tuned circuit to the junction between two resistors connected in the *negative* filament lead. By suitably varying the value of these resistors, any negative voltage up to a maximum of four may be applied. Clearly, therefore, if we use valves of the same voltage rating throughout, there will be no surplus available for this purpose, so the "free" grid bias arrangement must be abandoned. Alternative methods will be discussed later. When the original arrangement is retained, a "high-magnification" two-volt detector, such as the Cossor 210 R.C., Marconi D.E.H.210, or Mullard P.M.1A., should be used; all these valves vary slightly in their characteristics, and there is no harm in trying resistors of 20 and 25 ohms in the sockets R_3 and R_4 respectively, in place of those of 15 and 30 ohms as recommended in the booklet.

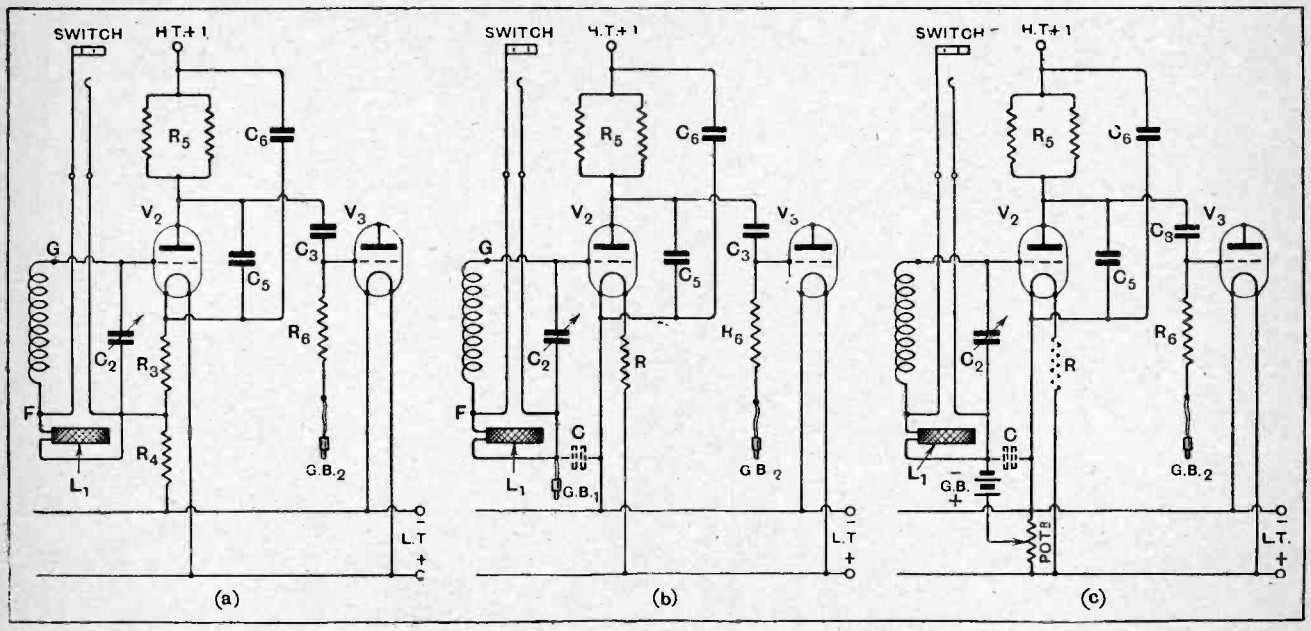


Fig. 1.—The original detector grid bias device (or the "Everyman Four" is shown in circuit (a); alternative methods are indicated at (b) and (c).

Notes on the "Everyman Four."—

There are exceptions to the general statement made above to the effect that "free" grid bias is only obtainable with a six-volt L.T. battery and a two-volt detector. Due to the presence of a very high resistance in the detector anode circuit, it is not necessary (or even desirable) to run the filament at full brilliancy, and if a six-volt 0.1 amp. "R.C." valve is used in this position it will almost invariably be found that approximately correct bias combined with sufficient emission will be obtained if R_4 is short-circuited and a 30-ohm resistor inserted in the socket marked R_3. Furthermore, as the average detector requires two volts negative (or slightly less), it is obviously possible to obtain free bias if the detector filament is rated at four volts with a six-volt L.T. battery, or at two volts in conjunction with four volts L.T. In either case, and always assuming 0.1 amp. valves, the resistors R_3 and R_4 should be of 20 and 5 ohms respectively.

All this may seem rather complicated, and possibly the beginner will find it easiest to omit "free" grid bias and to adopt a more conventional arrangement. In Fig. 1 (*a*) is shown the original connections discussed above, and in (*b*) the modification for obtaining bias from the common battery. It will be seen that the resistors R_3 and R_4 are omitted, being replaced by a resistance R (if required) in the *positive* filament lead. The low potential end of the tuned circuit, previously joined to the junction between the resistors, is joined to a wander plug for insertion into a socket of the bias battery supplying the L.F. valves. Generally speaking, 1½ volts negative will give the best results. The H.T. tapping supplying the detector should be adjusted for loudest signals. A by-pass condenser C, of some 0.1 mfd. upwards, may be connected between the low-potential end of the tuned circuit and negative filament.

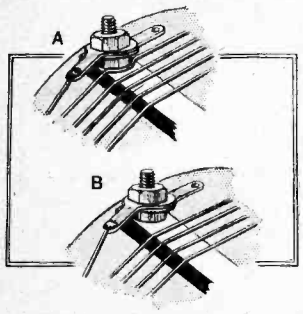


Fig. 2.—Incorrect (A) and correct (B) methods of winding the primary-neutralising sections of the H.F. transformer.

This arrangement does not permit of very fine voltage adjustment, although variation of anode pressure enables the lower bend to be located with sufficient accuracy for ordinary purposes. Where utmost sensitivity is required the arrangement shown in Fig. 1 (*c*) is recommended, particularly with modern valves. As will be seen, the winding of a potentiometer (generally of some 250 to 500 ohms resistance) is connected across the L.T. supply to the valve, and the low-potential end of the tuned circuit is removed from the junction between the resistors, and joined to the potentiometer slider through a three-volt bias battery G.B. As in circuit (*b*), the resistors R_3 and R_4 are removed, and the leads connected to their outer ends are short-circuited. Any resistance which may be necessary is inserted in the positive lead at R. As stated above, it is rather an advantage than otherwise that the detector filament should be below full brilliancy, so with two-, four-, and six-volt 0.1 or 0.075 valves operating on the L.T. voltage for which they are intended, it is customary to use resistors of respectively 5, 10, and 15 ohms, although they are by no means essential. It should be observed that the by-pass condenser C may be retained.

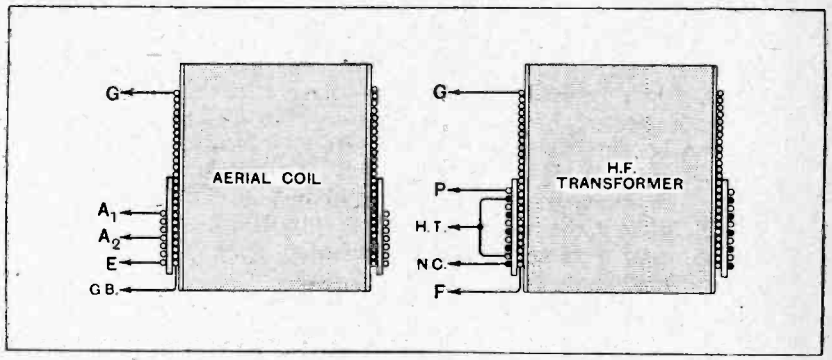


Fig. 3.—Sectional diagram showing the correct connections of the H.F. transformers; the neutralising winding is indicated by black dots.

A few failures to neutralise properly are sometimes reported; here it may be stated definitely that this indicates a very serious fault either in the windings of the H.F. transformer or in the connections to it. The circuit is inherently stable, and no difficulty whatsoever should be encountered, provided that instructions are followed implicitly. Some difficulties have been traced to partial or complete short-circuits in the neutralising winding, and in this matter the reader's attention is called to Fig. 2, which shows a part of the parallel primary-neutralising windings. Great care should be taken to see that no wire, other than that actually connected to it, is in contact with any one of the terminal screws mounted on the ebonite spacing strips.

H.F. Transformer Connections.

The matter of connections to the H.F. transformers is of the utmost importance. Some failures to obtain a balance have been traced to the fact that primary and neutralising windings are wound over the high-potential end (that joined to detector grid) of the secondary, instead of over the low-potential end (joined to filament). Attention is drawn to Fig. 3, which shows the correct connections of both aerial-grid and H.F. transformers; the lettering corresponds to that in the "Everyman Four" booklet. It should be noted that the last turn of the neutralising section should be immediately over the last secondary turn, and that all windings should occupy a length closely approximating to that specified.

Difficulties due to microphonic action are now comparatively rare, thanks to improvements in valve construction. Where they are encountered, it is advisable to mount the detector valve holders on a block of sponge rubber, making connections to it with light flexible leads. At the same time, the loud-speaker should be mounted at some distance from the receiver.

Taking into consideration the fact that the "Every-

Notes on the "Everyman Four."—

man Four" receiver has but two tuned circuits, its selectivity is of an extremely high order; indeed, it is very doubtful if it could be increased without introducing complications or sacrificing amplification. This does not mean, however, that a powerful station can be completely eliminated at a distance of a mile or two; even at three or four miles such a transmission will occupy a comparatively wide band, which can best be reduced in width by taking advantage of the filtering effect of an additional stage of high-frequency amplification. Where the utmost selectivity is necessary it is strongly advised that an "R.C." valve, with an impedance of not more than 70,000 ohms, should be used as an H.F. amplifier. Such a valve will not need much more than about 0.5 volt grid bias; this can be obtained (with 6-volt valves) by connecting the rheostat R_2 in the negative L.T. lead and returning the low-potential end of the tuned circuit to negative L.T. without the use of a bias cell. It should be emphasised that a valve impedance somewhat lower than that mentioned above is, strictly speaking, desirable, and that the figures relating to many types can be reduced by applying an H.T. voltage slightly in excess of the usual manufacturers' rating.

The rheostat R_2 is intended to act as a volume control; as specified, it has a resistance of 30 ohms. Now this was perfectly adequate for the 0.25-ampere valves which were in general use when the set was first described, but it is hardly sufficient to give a very considerable decrease of intensity with modern 100-milliampere valves, for which a value of 50 or 60 ohms is more suitable. The trouble of L.F. oscillation is bound to arise with any set giving high magnification; the "Everyman Four" is no exception to the rule, but as its circuit arrangement from the detector onwards is conventional, general advice on the subject which has appeared in this journal from time to time is applicable. The first step to take is to fit either an output transformer or an output choke-filter (which *must* be of the type in which one side of the loud-speaker is joined to L.T. negative). This addition may be regarded as almost essential when a battery eliminator is used. In addition, the effect of an experimental reversal of the L.F. transformer secondary connections should also be tried.

Earth Noises.

An important point arises when the set is used with a D.C. battery eliminator. If the negative main is earthed there will very probably be a difference of potential between the company's earth and the "wireless" earth; this may lead to noisy operation, and it is recommended that the connection between the screen and terminal E should be omitted. This will have the effect of isolating the filaments from the open aerial-earth circuit.

For reception of the local medium-wave station it will often be found desirable to eliminate the H.F. amplifier; this may easily be done by connecting the aerial to terminal A_3, replacing the long-wave loading coil with one having some 12 or 15 turns, and opening the short-circuiting switch.

General Notes.

Mr. Le R. W. Johnson (NU3AFW), 216, Irving Street, Allentown, Pa., asks us to state that he is transmitting on 37.5-38.5 metres and wishes to get into communication with British and other European stations. He listens on the 45-metre waveband and also on wavelengths below 41 metres.

Mr. F. C. Mason (2BXM), 80, Forbay Road, N.16, is standing by at the following times: Sundays, 10.00-24.00 G.M.T., Saturdays 16.00-24.00 G.M.T. Other days 20.00-24.00 G.M.T., or at other times by arrangement to report on amateur transmissions on wavelengths below 5 and 200 metres.

A Correction.

In our note on page 786 of the issue of December 14th the words "Experimental Radio Society" should read "Experimental Radio Station." We trust the error has not caused any inconvenience to Mr. A. S. F. Berry, who is operating 2BDP at Haut Croix, St. John's, Jersey, C.I.

Concerts from Japan.

A correspondent in the Federated Malay States writes that JFAB, Taipeh, Formosa, Japan, transmits concerts irregularly, on 39.5 metres, which come in well, but with a pronounced generator hum, at 09.00 G.M.T., and asks if these have been heard by English listeners.

South American Stations.

We are indebted to our Argentine contemporary, "Revista Telegrafica," for the following list of amateur transmitting stations which supplements and corrects the lists previously published in the R.S.G.B. Diary and Log Book and *The Wireless World*:—

TRANSMITTERS' NOTES AND QUERIES.

7ZG, a Danish station well known to English amateurs, is owned and operated by Mr. H. T. Petersen at "Fribo," Ostergade, nr. Sundby. The input is 60 watts at 600 volts from a motor-generator, and the wavelengths used are 44–45 metres.

Argentine.

DN2	A. Bonald, General Roca 741, Bernal, F.C.S. (Mr. Yzaguirre's station is DU2 not DN2).
HG4	M. J. Cintra.
DQ4	—— Espana 214, Bahia, Blanca. (Change of address).
AL3	D. Orzali, General Urquiza 1624. (Change of address).
BW2	R. Schoss, Mejico 3230, Buenos Aires.

Brazil.

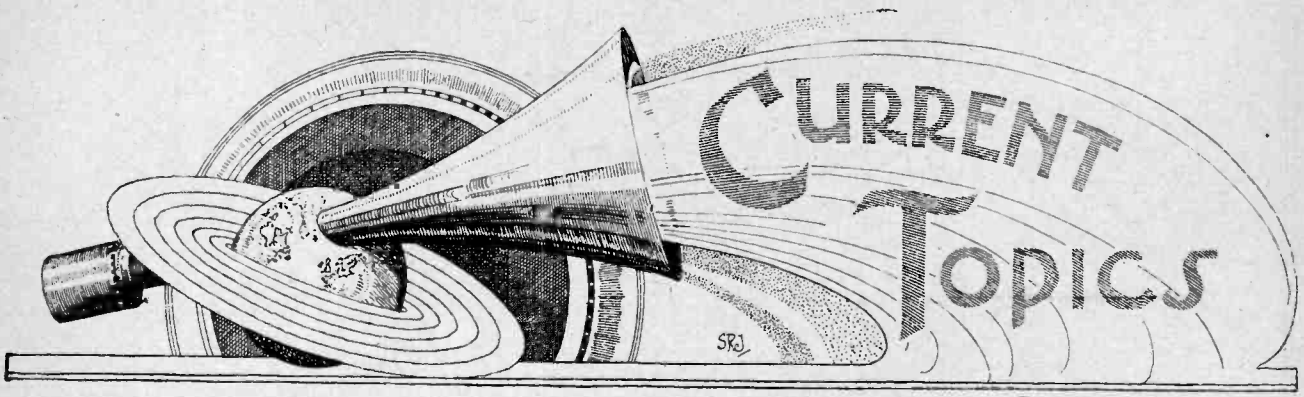
1AH	A. Pimentel, Diamantina 24, Riachuelo, Rio de Janeiro.
1BE	M. Macedo, Caixa postal 294, Rio de Janeiro, (Change of address).
2IC	O. F. Ribas, Aven'da Silva Jardim 218, Curityba.
2ID	O. Peixoto, Caixa Postal 103, Curityba.
2IH	A. F. de Castilho, Av. C Abreu 109, Curityba.
1CD	A. Fernandes, Paysandu 188, Rio de Janeiro.
1BL	R. Bicard, Laranjeiras 267, Rio de Janeiro.
3AA	P. C. Schuck, Dona Laura 45, C. Postal 26, P. Alegre.
2IK	A. Wendler, Caixa Postal 100, Curityba, Parma.
9AB	B. Ramos de Lima, Bello Horizonte, Minas Geraes.
3AC	A. Heinz, Vasco da Cama 94, Porto Alegre, Rio Grande.
2AY	Samuel de Toledo, Filhom Caixa Postal 182, Sao Paulo.
1BN	N. J. Botelho, Gral, Polydoro 104, Rio de Janeiro.
1CL	O. S. Masson, 24, de Maio 359, Rio de Janeiro.
1CM	V. Guerrero, Perseverança 16, Riachuelo, Rio de Janeiro.
1JB	J. Norberto, Caixa Postal 1253, Rio de Janeiro.
2QA	A. Castro, Caixa Postal 333, Florianopolis, Sta. Catharina.

Urnguay.

1PC	J. Amoros, Colina del Hospital, Rivera.

Chile.

C3BD	A. Pastor, Casilla 336, Santiago.



Events of the Week in Brief Review.

THE COMPLIMENTS OF THE SEASON.

We take this opportunity to wish all our readers a Happy and Prosperous New Year. May Leap Year signify a leap towards still better transmission and still better reception.

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WIRELESS FOR LEAGUE OF NATIONS?

The League of Nations will, we understand, set up a committee next month to discuss the desirability of erecting a League wireless station at Geneva, principally for use in times of crisis.

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QUALITY, NOT QUANTITY.

Few people surveying the world of wireless at the present moment would suspect that the stream of inventive genius was drying up. Yet, according to the patent agents, there is a tendency in this direction, a marked decline in the number of wireless patents being noticeable during the last two or three years.

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WIRELESS BEACONS.

Three papers on rotating beam transmission and direction finding will be read at the Wireless Section of the Institution of Electrical Engineers on Wednesday next, January 4th. Particulars will be found under "Forthcoming Events."

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NEARING 2½ MILLION.

Although the number of new wireless licences during October amounted to only 4,000, the smallest increase in any one month during 1927, there was a remarkable accession of new licences in November, when the increase amounted to 18,137. The total number of wireless licences now in force is 2,366,520.

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A DOUBTFUL SLOGAN.

The idea that any slogan is better than none at all must have begotten the following: "It is better to have heterodyned than to have never heard at all." The Cambridge retailer sporting this notice should ponder over the ethics of such an exhortation. What would Captain Eckersley say?

TELEPHONING TO ASIA MINOR.

Experiments are taking place between London and Angora for the establishment of a wireless telephone service.

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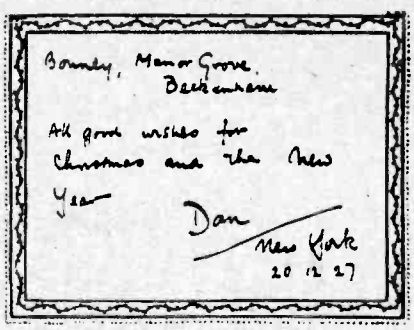
BOLSHEVIK PROPAGANDA?

Reports from Copenhagen state that search is being made by the Danish Government for a station which is broadcasting Bolshevik propaganda in the Danish language. It is believed to be situated either on the Baltic coast or on a ship.



A GREETING BY WIRELESS. During the Christmas season the Marconi Co., in collaboration with the Radio Corporation of America, introduced a service of photo-radiograms for seasonable greetings. Above is a typical specimen.

BEAM TO NORTH AND SOUTH AMERICA.

Marconi short-wave beam services are now in operation to New York, Rio de Janeiro, and Buenos Aires. The New York beam service augments the long wave services which have been operated from Radio House, London, for some years.

The South American beam services are entirely new, and place Brazil and the Argentine in direct wireless communication with London for the first time. The beam service operates both to and from Rio de Janeiro, but at present Buenos Aires has no beam aerials, so that while messages are sent from London by beam to Buenos Aires there is at present no beam in the reverse direction.

AN EXPENSIVE UNTRUTH.

An additional fine of £1 was levied in the Glasgow Sheriff Court last week on an offender under the Wireless Act who denied having a wireless set when the inspector called.

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AUSTRALIAN CHILDREN AND WIRELESS.

School wireless has probably achieved greater acceptance in Australia than anywhere else. It is estimated that 20,000 children listen regularly to the educational broadcasts from 3LO, Melbourne

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BROADCASTING ON 40 KILOWATTS.

Germany's new high power broadcasting station at Zeesen, near Koenigswusterhausen, began its first official tests on Tuesday, December 20th. With a rated power of 40 kilowatts the new station promises to be one of the most powerful in Europe. It will shortly act as a national relay station, picking the best programme each evening from one or other of the main stations and rebroadcasting it for the benefit of listeners who would otherwise be restricted to the programme of their local station.

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REDUCING INTERFERENCE BY SHIPS.

The Marconi equipment of the new motor liner *Bermuda* reveals a departure from the standard ship installation. The spark transmitter, whilst fully complying with all Government regulations, is of comparatively low power, and for long-distance communication there will be an entirely new type of valve transmitter apparatus using a power of 1½ kW. The great advantage of the valve transmitter is the long distance which can be covered with a moderate input and also the sharp tuning, which reduces interference with other services to a minimum.

The installation of the *Bermuda* is of additional interest in view of the fact that the Post Office authorities are installing valve transmitters in place of spark transmitters at their coastal stations, thereby increasing the efficiency of the stations and reducing considerably the interference with broadcast listeners

CLUB REPORTS AND TOPICS

Secretaries of Local Clubs are invited to send in for publication club news of general interest. All photographs published will be paid for.

Test Your Components!

"Practical Amateur Radio Experimental Work" was the title of a valuable lecture delivered by Mr. Bevan Swift at the last meeting of the Croydon Wireless and Physical Society. The lecturer advised the testing of all components before use and referred to the adulteration of ebonite and defects in intervalve transformers. Useful advice was given as to the use of accumulators, the proper arrangement of wiring, etc.

Hon. Secretary: Mr. H. T. P. Gee, 51-52, Chancery Lane, W.C.2.

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Wigan Wireless Society Formed.

Following an open meeting at the Wigan Mining and Technical College on December 2nd, a society has been formed known as the Wigan and District Technical College Radio Society. An attractive syllabus of fortnightly lectures, demonstrations and discussions has been arranged and the College authorities have kindly assisted the society by providing a room for meeting, laboratory facilities for experimental work by members, and use of a lantern and cinematograph. The membership list already stands at over 50, and further applications are being received daily. The list is still open, and candidates are asked to communicate with the Hon. Secretary, Mr. M. M. Das, B.Sc., Technical College, Wigan. The subscription for the current session is 2s. 6d. (members under 18, 1s. 6d.).

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Dr. Smith-Rose on Direction-finding.

Direction-finding enthusiasts were amply rewarded for their attendance at the last meeting of the Golders Green and Hendon Radio Society, when Dr. R. L. Smith-Rose showed how the best could be got out of a direction-finder and described recent research on night variations in D.F. work. The all-important factor for successful D.F. work, said Dr. Smith-Rose, was effective screening, depending upon the thickness and kind of metal used.

In the second half of his lecture Dr. Smith-Rose dealt with the variations from true bearings between sunset and sunrise and related some interesting tests made in a hut strung in mid-air and surrounded by Hertz aerials.

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

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Loud-speaker Demonstration.

A demonstration of wireless apparatus and the electrical reproduction of gramophone records was given on December 6th at the meeting of the Ministry of Agriculture and Fisheries Radio Club by Mr. Burgess, of the Mullard Wireless Service Co., Ltd. The respective merits of the horn and cone type loud-speaker were dealt with, and the lecturer then demonstrated the Mullard loud-speaker both on broadcasting and with an electrical gramophone pick-up.

Hon. Secretary: Mr. C. T. Stock, 10, Whitehall Place, S.W.1.

FORTHCOMING EVENTS.

THURSDAY, DECEMBER 29th, 1927.

Golders Green and Hendon Radio Society.—Club dance at 8 p.m.

Leyton and Leytonstone Radio Society.—At 8 p.m. At Haydn House, Fairlop Road, E.11. "What Station was That?"

FRIDAY, DECEMBER 30th, 1927.

Leeds Radio Society.—At the University. Open Night and Exchange and Mart.

WEDNESDAY, JANUARY 4th, 1928.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (light refreshments at 5.30). At the Institution, Savoy Place, W.C.2. "Rotating Loop Radio Transmitters," by Messrs. T. H. Gill and N. F. S. Hecht; "Application of the Rotating Beacon Transmitter to Marine Navigation," by Dr. R. L. Smith-Rose and Mr. S. R. Chapman; "A Theoretical Discussion of Various Possible Aerial Arrangements for Rotating Beacon Transmitters," by Dr. R. L. Smith-Rose.

A Wavemeter Evening.

At a meeting of the Q.R.P. Transmitters' Society on December 8th Mr. Page (2AFG) gave a talk on Heterodyne wavemeters and checked the wavemeters of members who had brought their instruments for the purpose. The evening concluded with a demonstration by Mr. Abbott (6TA) of a moving coil loud-speaker in conjunction with a gramophone pick-up.

Hon. Secretary: Mr. C. D. Abbott, 120, Cavendish Road, S.W.12.

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Tottenham Society's Annual Dinner.

The first annual dinner of the Tottenham Wireless Society, held on December 6th, was the occasion for an interesting retrospect. Mr. H. T. Winter, one of the founder members, referred to the band of enthusiasts who first launched the Society five or six years ago. Other speakers, including Prof. Low, Mr. R. F. G. Holness, Mr. A. W. Howes, and Mr. F. E. R. Neale, touched upon the advances made in wireless over the last few years, particularly the enormous progress made since the inception of broadcasting.

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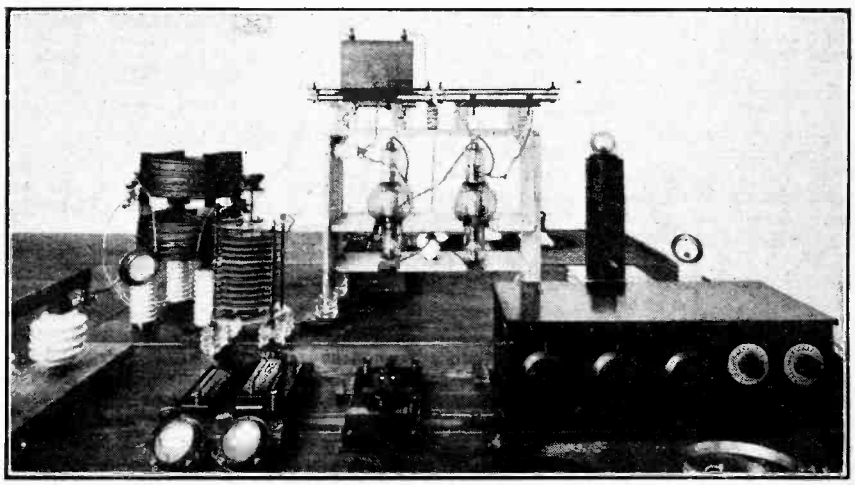
"Wireless World" Lecture.

At the Tottenham Society's meeting on November 30th Mr. F. H. Haynes, Assistant Editor of *The Wireless World*, demonstrated his moving coil loud-speaker. Mr. Haynes, after dealing with the theory and construction of the moving coil loud-speaker, gave many useful tips regarding the winding of the coils. He advised members when purchasing drawing paper for the diaphragm to take with them a micrometer. He had found that a thickness of .01in. gave the best results.

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



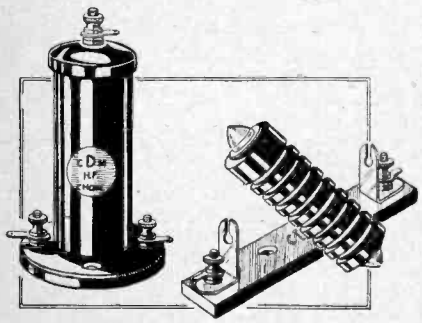
AN ITALIAN SHORT-WAVE TRANSMITTER. Dr. Giulio Salom's 2kW transmitter installed in his station EI 1MT at Palazzo Spinelli, Venice. The plate voltage is supplied from a 500-cycle alternator and stepped up to 8,000 volts by a transformer. The valves used are Philips, Type Z14.

Latest Products of the Manufacturers.

C.D.M. H.F. CHOKES.

There is a tendency in modern receivers to make a more extended use of H.F. chokes than heretofore; the choke-feed method of coupling H.F. valves as is exemplified in the 2 H.F. Everyman Four provides a separate path for the D.C. and H.F. anode components which is a distinct advantage militating against lack of stability, moreover should a short-circuit develop in the neutralising condenser the primary windings of the H.F. transformer are not burnt out. H.F. chokes are also needed for capacity-controlled reaction and as a means of preventing any H.F. components from entering the L.F. amplifier.

The C.D.M. H.F. chokes marketed by C. D. Melhuish, 8, Great Sutton Street, Goswell Road, London, E.C.1, are wound with fine gauge silk-covered wire and the formers with 8 slots are machined from solid ebonite of ⅜in. diameter. The end-contacts are of the grid leak type, thus giving provision for interchangeability in a suitable holder which is supplied.



C.D.M. radio frequency choke.

A tapped-choke giving an alternative inductance is also manufactured, but is suitable for baseboard mounting only.

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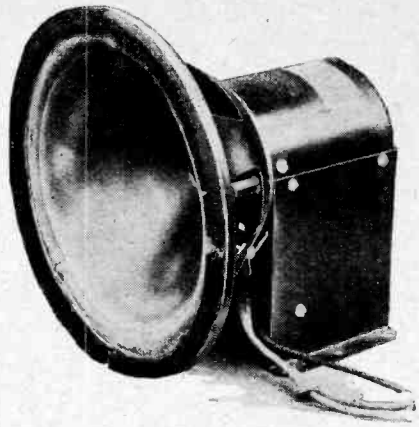
MAGNAVOX MOVING COIL LOUD-SPEAKER.

Possibly the first moving coil loud-speaker unit to be offered in this country, apart from a complete loud-speaker equipment, is the new Magnavox movement which has recently become available from the Rothermel Corporation of Great Britain, Ltd., 24-26, Maddox Street, Regent Street, London, W.1.

To the scrutinising amateur with advanced ideas on moving coil loud-speaker design there may be a little reluctance to accept a commercial product unless it correctly follows his own specialised ideas. A specimen Magnavox loud-speaker was tested from this viewpoint, and in comparison with a specially constructed instrument there was little to choose between them as to the quality of reproduction. The diaphragm is perhaps a little smaller than usual, being some 6in. across, and is constructed from a supple form of treated paper. It is mounted on a leather rim built up in four pieces, probably to compensate for the uneven stretch which results if the ring is cut from a single piece of leather as well as being more economical. The electromagnet is, of course, appreciably smaller than many of the designs which we have recently seen, but this is due to the fact that an exceedingly small air gap is employed so that the watts required to produce a high flux density comes within the scope of those who have no electric supply mains. A centring device is employed behind the diaphragm. In the metal support is housed the output equipment, and it is intended that this loud-speaker shall be connected directly in the anode circuit of the output valve, thus avoiding the need for modifying present receiving sets.



The new Magnavox moving coil loud-speaker ready for mounting.

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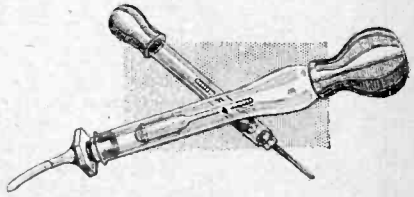
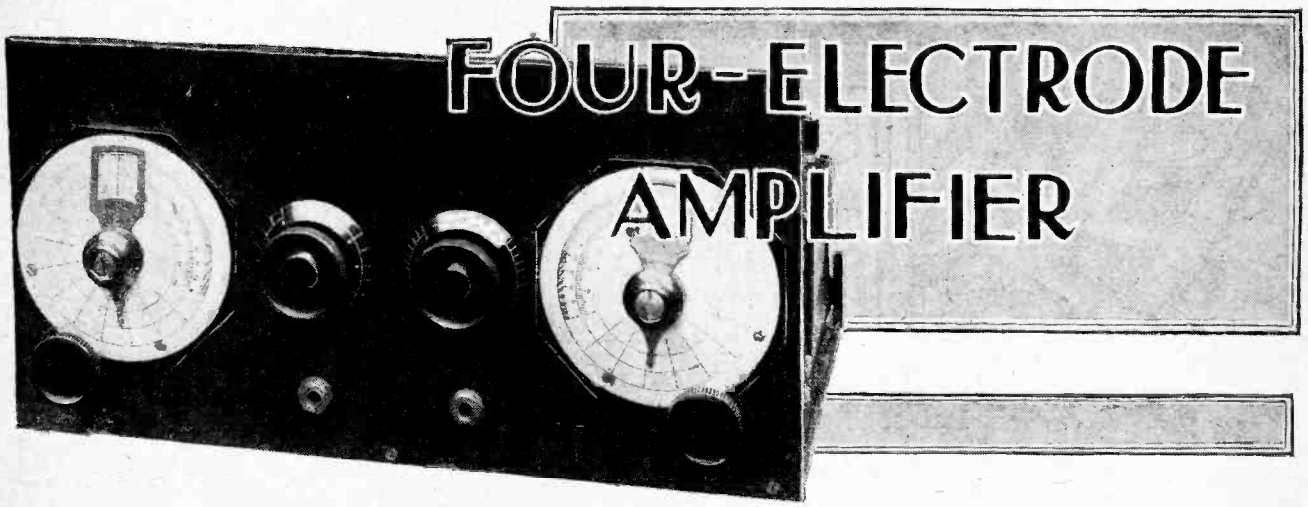
HUNT'S HYDROMETERS.

It is surprising how few accumulator battery users possess hydrometers. The condition of a cell is usually determined with the aid of a voltmeter, and although this may serve as a rough guide when the battery is tested in use, a better knowledge of the state of discharge of a coil is gained by means of a tested hydrometer. A wide difference of acid density in a small cell when in a charged and discharged state is a definite indication that the battery is giving its maximum ampere-hour discharge. There is no better means, moreover, of verifying that a battery has received a full charge than by regularly noticing the specific gravity both before and after charging. Water may be added to a battery to bring up the level of the electrolyte, but here again a hydrometer is almost essential in order to make quite sure that water is not being introduced to take the place of acid which may have been spilled, thus tending to reduce the gravity.



The "Ala" testing hydrometers of Messrs. A. H. Hunt, Ltd.

To pour out the acid from a battery for test purposes is not advised, and A. H. Hunt, Ltd., H.A.H. Works, Tunstall Road, Croydon, are now marketing an extensive range of battery testing hydrometers, varying in price between 2s. and 6s. 6d. Acid is readily withdrawn from the battery by suction, and with the aid of a floating hydrometer the specific gravity is easily read off with accuracy. It is noted that, should the floating hydrometer become damaged, it can be replaced at a small cost. These hydrometers are also useful for adding water to cells.



FOUR-ELECTRODE AMPLIFIER

Adding a Low-frequency Stage to the Single Four-electrode Valve Receiver.

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

IN a recent issue of *The Wireless World*[1] the writer described the construction and performance of an experimental single four-electrode valve receiver which employed centre-tapped coils and condenser variation of reaction. As was stated in the article referred to, space was left on the baseboard for the addition of an amplifier if this was desired.

In response to several requests for a detailed description of a suitable arrangement of components for the L.F. amplifier, the present article gives both circuit details and photographic illustration of the actual layout of components on the completed set.

Fig. 1 shows the complete circuit of the set. The type of L.F. amplification chosen as being most suitable for general use is by means of transformer coupling between the two valves, and in order to retain in full the previous experimental capabilities of the set, jacks have been utilised so that either one or two valves may be used at will—a suitable arrangement of contacts on the jacks ensuring that only the first valve filament is alight when one valve only is being used, while both valve filaments will be lighted when the telephone plug is inserted in the output jack of the second valve.

When the set is used with an average aerial in a locality where two or three stations come in at *good* phone strength on the single valve, then these stations should operate a small loud-speaker at quite reasonable strength when two valves are employed.

The transformer actually used on the set illustrated is a Gecophone, but any transformer of about $3\frac{1}{2}$: 1 to 6 : 1 of reputable make will be equally suitable.

The valve holder for the L.F. valve will require the brass or phosphor-bronze strip for connection to the terminal for the fourth electrode on the side of the valve. This strip and the method of mounting it is shown in the sketch on the opposite page.

The alterations to the panel of the original single valve set are very few—the two telephone terminals should be removed and the two jacks inserted in their place when

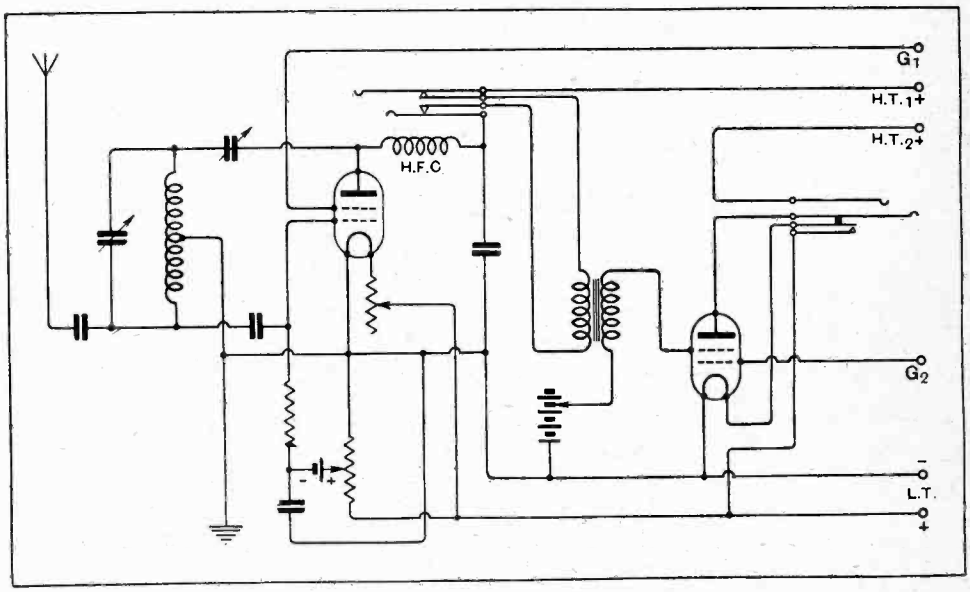


Fig. 1.—Complete circuit diagram of the four-electrode receiver with the addition of a L.F amplifier.

[1] September 7th, 1927.

Four-electrode Amplifier.—

ADDITIONAL PARTS REQUIRED.

1 "Triumph" Valve Holder (A. H. Clackson Ltd.).
1 L.F. Transformer 4 : 1 (General Electric Co. Ltd.).
1 "Lotus" Jack No. 4 Filament Single Control.
1 "Lotus" Jack No. 3 Double Circuit (Garnett Whiteley & Co. Ltd.).
1 "Lotus" Plug.
1 G.B. Battery, 9 volts (Siemens Bros. & Co. Ltd.).
2 Wander Plugs (Lisenin Wireless Co.).
2 Terminals, N/P (Belling & Lee).
2 "Verona" Battery Holders (Jabez Bate & Co.).
Flex, etc.

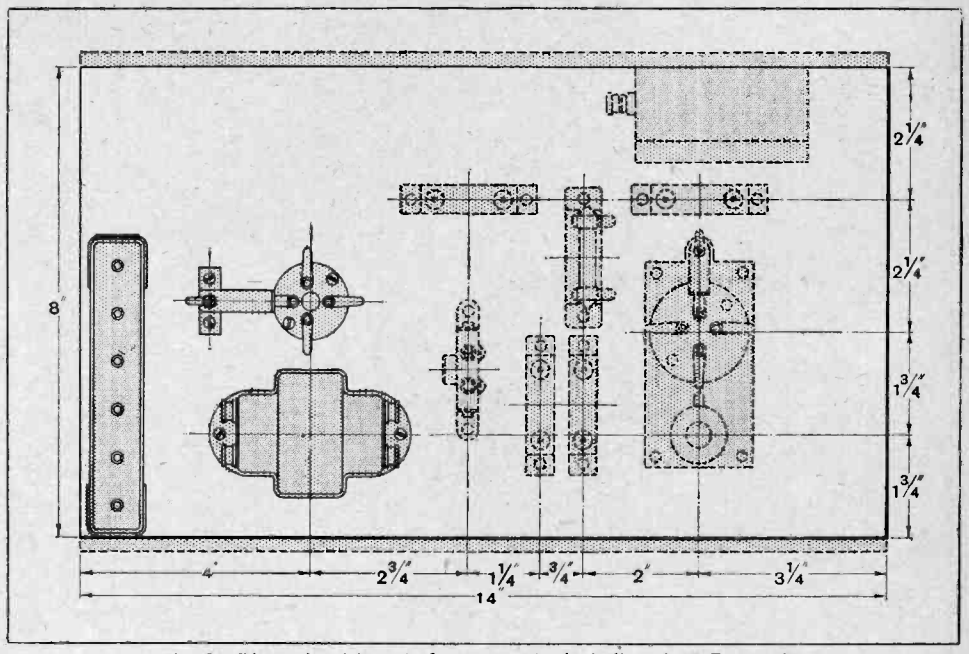


Fig. 2.—Dimensional layout of components, including the L.F. amplifier.

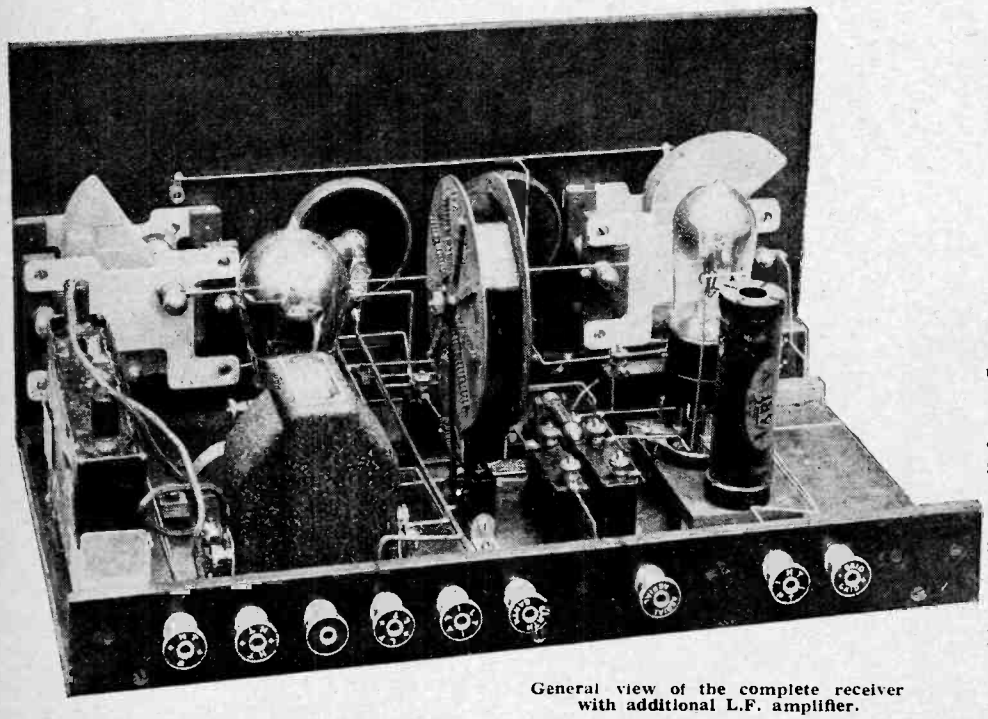
the holes have been suitably enlarged. Two extra terminals—one for H.T. on the second valve and one for the inner grid of this valve—are all that is required in the way of additions on the terminal panel. Grid-bias terminals have not been allowed for, as there is plenty of room for a nine-volt grid-bias battery on the baseboard, fixed in the usual clips, as shown in the photograph.

Choice of Valves.

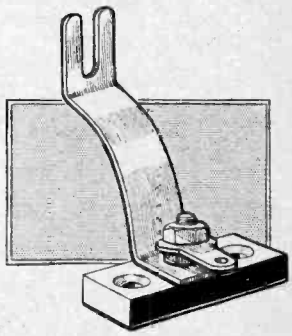
If the local station is not really powerful in the phones on one valve, or if a loud-speaker is not going to be used in any case, the best valve for the L.F. stage is the A.P.412 L.F. valve, which has an amplification factor of about 8.

The extra grid voltage (*i.e.*, the voltage to the terminal on the valve) on this valve should be from +4 to +12, according to the H.T. voltage used. For telephone work only, 24-volt H.T. will be found very suitable, with the extra grid voltage +4 to +6 volts, while with 40 to 50 volts H.T. and extra grid voltage +6 to +12 volts quite good results will be obtained with a small loud-speaker. With 24 volts H.T. the grid bias should be $-1\frac{1}{2}$ volts, and with 40-50 volts the bias should be −3 volts.

If a loud-speaker is going to be used, and if the local station is very loud in the phones with a single valve, it is better to use the A.P.412P for the amplifier. This valve has a lower amplification factor (about 5) and therefore will success-



General view of the complete receiver with additional L.F. amplifier.



Phosphor bronze or brass contact strip for the inner grid terminal.

Four-electrode Amplifier.—

fully handle a larger input than the A.P.412 L.F., and besides has a much lower A.C. resistance, so that larger outputs are possible with this valve, with, of course, suitable input voltages. Suitable H.T., inner grid terminal voltage, and grid-bias values are +60 volts, +12 to +15 volts, and $-4\frac{1}{2}$ volts respectively, and these may be used as a basis for experiment.

However, for most purposes the A.P.412 L.F. valve will be found the most suitable for use in the L.F. stage of the set described.

It will be found that the addition of an L.F. amplifier to a single valve set, when telephones are used, not only increases the loudness of stations received on the single valve, but makes possible the successful reception of stations which were too weak to be enjoyed or even understood when one valve only was used, so that the effective *range* of the set will be increased.

A NOTE ON VOLUME CONTROL.

Simultaneous Variation of Filament Temperature and Grid Bias.

IT is generally considered that one of the best and simplest methods of volume control for any receiver where a stage of high-frequency amplification is used is that in which the input to the detector is varied by altering the filament current of the high-frequency amplifying valve, as indicated in Fig. 1. Sometimes, however, it is found that the range of variation obtained in this simple way is not great enough, even when a rheostat of fairly high resistance is used. A 30-ohm rheostat, used with a 625 type valve, permits of reducing the filament voltage to less than $2\frac{3}{4}$ volts, which usually provides plenty of control, but if the same rheostat be used with a valve of the more modern 610 type, the minimum filament voltage which can be applied to the valve is about 4 volts, and at this voltage most valves of this class still give quite considerable amplification. It is therefore with the new 0.1 ampere valves that volume control by filament alone proves so often to be unsatisfactory.

Increased A.C. Resistance.

The decrease of volume obtained by lowering the filament voltage is due, primarily, to an increase in the impedance of the valve, so that we shall supplement the effect of the filament resistance in decreasing volume if we can arrange to increase the impedance in any other way. Either a decrease of high-tension voltage or an increase in (negative) grid voltage will have this result,

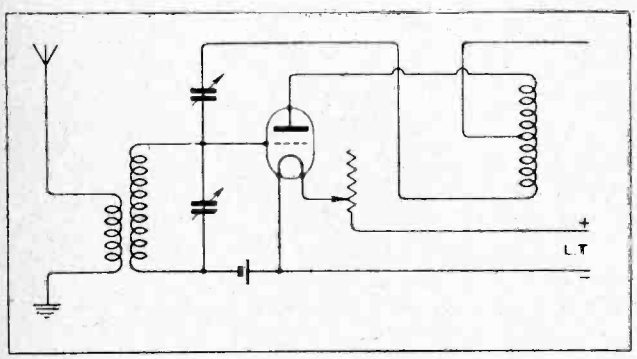


Fig. 1.—Usual position for filament rheostat of H.F. valve

but neither of these methods appears, at first sight, very convenient. But if the rheostat be removed from its normal position in the positive filament lead, where it is shown in Fig. 1, and placed instead in the negative lead, and if, further, the grid return be taken, not to the negative end of the filament, but direct to L.T.−, as shown in Fig. 2, then any increase in the resistance of the rheostat will increase the grid-bias applied to the valve at the same time as it dims the filament. As a result, the impedance of the valve of Fig. 2 will rise much more rapidly as the filament is dimmed than that of the valve of Fig. 1, so that a more extensive control over the amplification given by the valve is secured.

Practical experience indicates that where the circuit of Fig. 1 is used the filament rheostat should have a resistance not less than that of the filament of the valve with which it is to be used, whereas with the arrangement of Fig. 2 the rheostat need not have more than one-half of the resistance of the valve filament.

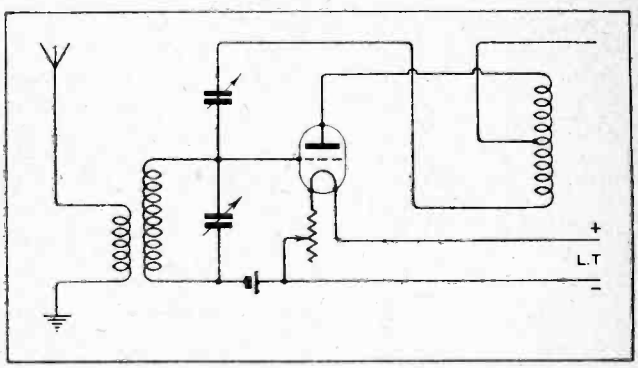
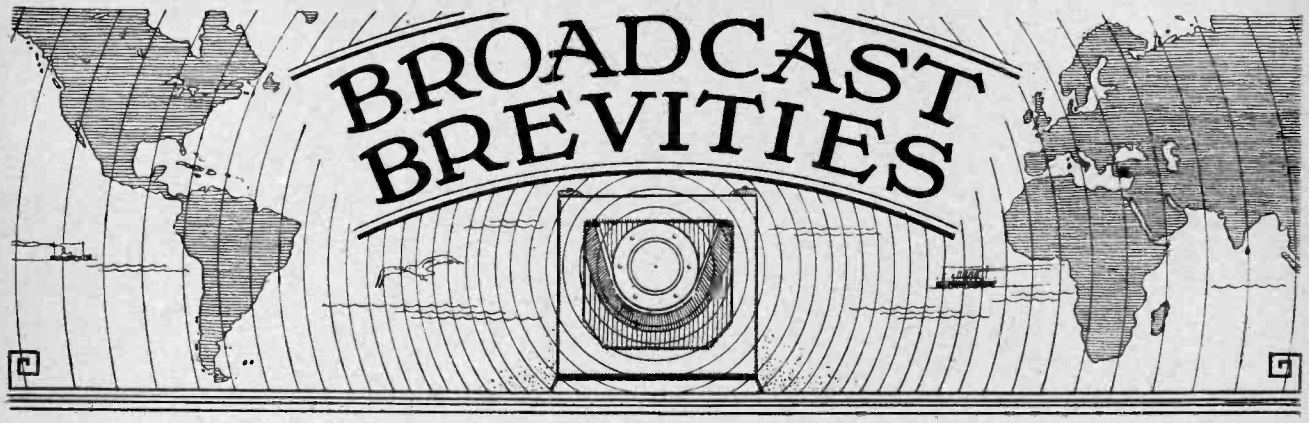


Fig. 2.—By connecting the filament rheostat in the negative lead the grid bias is increased as the filament temperature is lowered; both these factors increase the valve resistance.

In conclusion, suitable values for the rheostat for a few types of valve are given in the following table:—

Valve Filament.	Minimum rheostat resistance (Ohms).	
	For Fig. 1.	For Fig. 2.
210	25	10
410	50	20
610	90	30
225	10	4
425	20	8
625	30	12

A. L. M. S.



By Our Special Correspondent.

Colonial Office and 5SW—Oscillating on the "Silent Point"—International SOS Scheme—The Year's Favourites—Nine Microphones at York.

A New Empire Broadcasting Problem.

Australia is undoubtedly getting the best share of the present transmissions from 5SW, and it is interesting to observe that, the novelty having worn off, the question of programme material has been raised. A few weeks ago everybody was happy if the Mother Country was heard at all, so it is a pleasing tribute to the efficiency of 5SW that our Australian cousins are now growing blasé.

As regards broadcasting material the B.B.C. finds itself in an awkward position. Nothing exclusively for the Dominions can be considered, for obviously the expenditure of money for this purpose would provoke immediate criticism from licence-holders in this country. On the other hand, programmes from 5XX, especially at the time when Australia hears best, viz., mid-day, are no better than anything Sydney and Melbourne can put out.

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Colonial Office Interested.

What the average British settler seems to want most of all are programmes giving him sounds of home—the hubbub of Piccadilly Circus, free speech in Hyde Park, "lights out" at the Tower of London, and so on, *ad infinitum*.

I understand that the Colonial Office is showing an interest in 5SW, and as this is the department most intimately concerned in strengthening the ties between the Mother Country and her Colonies, perhaps something will be done towards providing a financial basis for developing the service.

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The Silent Oscillator.

Can there be anything more maddening, soul-destroying, demoralising, than living next door to a persistent "howler"? "Oh, yes," says an acquaintance, "my case is worse than that! I live next door to an oscillator who doesn't 'howl.'"

This case is certainly as bad as the other, if not worse. Oscillating on the "silent point" is probably one of the commonest of vices, especially in remoter districts where loud-speaker reception is only possible on small sets in which reaction must be pushed up to the uttermost limits.

It seems that the Post Office and the B.B.C. are about as helpless in the matter of silent oscillation as they are in dealing with the offender who brazenly howls.

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International SOS Scheme.

It will not be until February, when the next meeting takes place, that the Union Internationale de Radiophonie at Geneva will consider the B.B.C.'s proposal for the establishment of an international exchange for SOS broadcasts. As the B.B.C. remarks, an SOS is often addressed to a person known to be abroad, where the chance of picking up a message direct from 2LO is fairly remote. A rebroadcast of the message from a foreign station might make all the difference. Incidentally, the scheme would lead to some interesting SOSs from British stations on behalf of stations abroad.

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American Programmes.

Despite some intelligent anticipation in the daily Press, the B.B.C. is not at present planning any special relays from Continental broadcasting stations. What they hope to concentrate on is spaced-aerial reception from America, and if real success is to be attained in this respect I think their hands will be pretty full for the next few months.

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Favourites of 1927.

Many reputations go into the melting-pot when the B.B.C. takes stock of the opinions of listeners as revealed in the past year's correspondence. Frankly, I had some surprises when I was permitted last week to glance through the list of 1927 "favourites."

The promenade concerts were deemed the most acceptable of all classical broad-

FUTURE FEATURES.

London & Daventry (5XX).

JANUARY 1ST.—Religious Service relayed from Holy Trinity Church, Folkestone, conducted by Canon W. H. Elliott.
JANUARY 2ND.—Chamber Music.
JANUARY 3RD.—Variety Programme.
JANUARY 4TH.—"The Merry Wives of Windsor," a comic opera in three acts by Nicolai.
JANUARY 5TH.—Royal Philharmonic Society Concert relayed from the Queen's Hall.
JANUARY 6TH.—Song Recital.
JANUARY 7TH.—Variety Programme.

Daventry (5GB), experimental.

JANUARY 1ST.—Religious Service conducted by the Lord Bishop of Birmingham (the Right Rev. Ernest William Barnes, M.A.). "Dido and Æneas," an opera by Henry Purcell, from Birmingham.
JANUARY 2ND.—Ballad Concert.
JANUARY 3RD.—Military Band.
JANUARY 4TH.—Popular Orchestral Programme.
JANUARY 5TH.—"Heart's Desire," a comic opera *en casserole* by Mabel Constanduros.
JANUARY 7TH.—Old Favourites, from Birmingham.

Cardiff.

JANUARY 2ND.—"First Footing," a New Year's Revue.

Manchester.

JANUARY 2ND.—"The Two Elizabeths," a play by Netta Syrett.

Newcastle.

JANUARY 7TH.—The Marsden Colliery Prize Band.

Glasgow.

JANUARY 2ND.—A Grand Panto-radioptimime.

Aberdeen.

JANUARY 3RD.—Memories of 1927, presented by the Radio Concert Party.

Belfast.

JANUARY 6TH.—A Novel Game of Chess.

casts, while Albert Sandler and his orchestra headed the list of most popular orchestral items. In the opera and oratorio class the favourites were "The Messiah" and "Martha."

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Variety.

On the lighter side listeners found "The Roosters" the most entertaining of concert parties, while individual variety artistes achieved popularity in this order:—Mable Constanduros, A. J. Alan, Muriel George and Ernest Butcher, Tom Clare, Ronald Gourley, Clapham and Dwyer, Florence Oldham.

Concert artistes show the following order:—Rex Palmer, Dora Labbette, Hubert Eisdell, Ann Liddell, Solomon and Laffitte.

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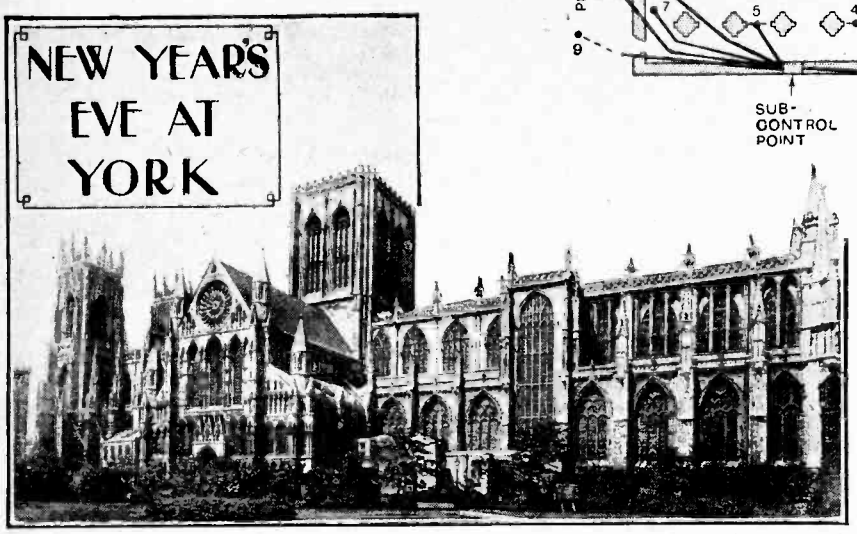
The Popular Boat Race.

The boat race was an easy first among outside broadcasts, being followed by international football, Royal Command variety, the nightingale, the Grand National, American relays.

The most popular play was "Lord Jim," followed by "Trilby," "R.U.R.,"



"Julius Cæsar," "The Arcadians," and "Miss Hook of Holland."

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Talks.

The three most popular "talkers" present a peculiar combination. They were Santos Casani, Sir Walford Davies, and Sir Oliver Lodge, in the order given!

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Reginald Foort.

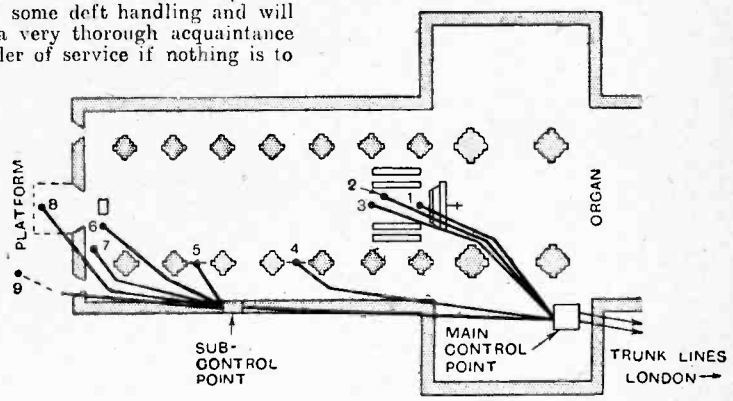
It was announced a month ago that Mr. Reginald Foort was severing his connection with the New Gallery Kinema, but that he would broadcast in the New Year from another cinema in the West End. He will broadcast his first organ recital from the Plaza Theatre on January 4th, and will continue on all following Wednesdays from 6 to 6.20 and 6.45 to 7 p.m. until further notice.

Nine Microphones at York.

If we judge by the number of microphones in use, one of the biggest "outside broadcasts" yet attempted will be the Watchnight Service from York Minster on Saturday next. No fewer than nine microphones will be in operation, necessitating the use of about three-quarters of a mile of twin lead-covered cable. Owing to the extreme length of the microphone cables the line will have to be broken for the insertion of a sub-control and amplification point.

The engineers will have very little elbow-room during the service, as the job of control and amplification will have to be done on a balcony 50ft. high and 2ft. wide!

The control of all these microphones will call for some deft handling and will necessitate a very thorough acquaintance with the order of service if nothing is to be missed.



A BIG "O.B." EVENT. No fewer than nine microphones, with three-quarters of a mile of cable, are being installed in York Minster for broadcasting the Watch-night Service on New Year's Eve. The above plan shows the arrangement of microphones and wires. Nos. 1, 2 and 3 will pick up from the choir stalls and organ; Nos. 4, 5 and 7 will be switched on while the clergy and choir proceed down the nave to the west door while No. 6 microphone is specially placed to enable listeners to hear the ceremony of striking the Remembrance Stone. Nos. 8 and 9 will pick up the Archbishop's Address and the Minster Chimes.

Broadcasting a Procession.

The need for so many microphones arises from the fact that the ceremony will include a processional hymn from the choir stalls to the west front. Just before the west front is reached the Archbishop of York will strike the Stone of Remembrance thirteen times to signify that the Minster has stood for thirteen centuries. A microphone will be specially placed so that listeners can hear this part of the ceremony.

Outside the cathedral the Archbishop will address the large crowd which invariably gathers on New Year's Eve, and the broadcast will conclude with the Minster bells.

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A Programme Experiment.

Cardiff will give the first of a new venture in broadcasting entitled "Radiologues" on January 12th. A radiologue is a new form of story-telling, the narrator holding a place analogous to the chorus in Greek drama, the actors supplying the dialogue. This form is intended to be an improvement upon the reading of a short story by one person, for it will preserve the story in its original form, but will not need the usual stage settings of acts and scenes. The first of the series will be prepared by Mr. E. R. Appleton, station director.

Cardiff has always been one of the most enterprising of the B.B.C. stations; let us hope the new venture will be a success.

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Next Week's Variety.

Cicely Debenham, who made her theatrical reputation in such plays as "Oh! Oh! Delphine!" "Mrs. Gorringe's Necklace," "My Lady Frayle," "The Cousin from Nowhere," and "Patricia," will appear in the variety programme at 2LO on January 3rd. Other artists in the bill on that evening are Rex Evans, Coram (who shares with Arthur Prince the premier honours of the halls as a ventriloquist), and Esther Coleman.

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Prepare for the Steel Guitar.

Joe Termini, of the Kit Cat Orchestra, and who has been one of the chief attractions at the Alhambra, Leicester Square, will appear before the microphone with his steel guitar and other instruments on January 11th.

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Round the Stations.

Newcastle has arranged a programme "round the stations" on January 10. Portions of the programmes from London, Manchester and Glasgow will be relayed.

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.

THE EXPONENTIAL LOUD-SPEAKER.

Sir,—I have made an exponential horn as described by Mr. Dinsdale in your issues of November 11th and 23rd, and would like to thank you for the resultant pleasure. As Mr. Dinsdale truly says, "the results are a revelation," even when compared with the best cone speakers.

Perhaps the following remarks would be useful to other readers who contemplate making one of these horns :—

(1) I would beg to disagree with Mr. Dinsdale when he says that this horn "may be undertaken by anyone possessing an elementary knowledge of wood working." I suggest that this construction is quite a skilled job.

(2) The heart-shaped blocks are, in my case, made up of fourteen laminations in each block, and foreign ash is used. This is much lighter than English ash, and just as suitable. These laminations should be cut by band saw, by an *experienced* saw man, and before cutting out anything at all, patterns should be made for guidance.

(3) The front and back W blocks were by far the hardest part of the whole horn to make, as it will very likely be found necessary to build these up also from laminations. This especially refers to the front centre W block.

(4) I used 7-ply for the top and bottom, and when I screwed the 3-ply sides in position I found that the front edge warped inwards considerably, necessitating an ash batten on the outside of the mouth of the horn from top to bottom, screwed from the inside.

(5) It is advisable to countersink the insides of the small heart-shaped blocks so as to let the inside surface of the input metal tube come flush with the sound conduit.

(6) Use *dry* timber.

As to results additional to those mentioned by Mr. Dinsdale. Tone is wonderful, and every instrument of the orchestra can be distinguished, even to the "bowing" of the strings of the double bass. For dances, this horn with a suitable pick-up and amplifier is ideal, volume being enormous.

I used this combination yesterday in a very large school building, and with a 3-valve amplifier (transformer input and two resistance stages, with a D.E.5A in last stage), it would have filled a hall twice the size. I used a Brown U/G.A. unit.

The divided opening of the horn also gives a stereoscopic effect, and when listening the orchestra seem to be grouped all round instead of at one point, as is usual with the ordinary speaker or horn.

I apologise for the length of this letter, but if any other reader contemplates making this horn, they will never regret it if they do so.

FRANK D. BERRIDGE.

Farnham.

December 11th, 1927.

DATE OF THE ANNUAL RADIO EXHIBITION.

Sir,—Might I be permitted to take up some of your valuable space to suggest that the National Radio Exhibition should be held in June or July next year, instead of in September as hitherto?

The progress of development in broadcast receiving apparatus is now becoming much more regular and gradual, and at the same time commercial sales factors are making the publication of these developments in finished form an annual event, hence the popularity and importance of the Exhibition, which can now be compared from every point with the Motor Show.

The purpose of the Wireless Exhibition, like the Motor Show, is, I take it, to show to the public and the trade the coming season's models embodying the new developments and inventions brought out during the past year, and the modifications found necessary from the use of the previous year's models.

Now the most popular time for buying cars is in the spring, yet the Motor Show is held in the autumn! I will not disgrace the intelligence of the radio manufacturers by pointing out the reason for this, but the result is that the public is able to obtain delivery of what it wants *when* it wants it. With wireless, however, the Exhibition is held merely a month or six weeks before public demand is at its height, with the result that the public has to wait a long time for what it wants. Two actual personal experiences spring to mind, and one hears of other similar and worse instances every day. Immediately after the Olympia Exhibition the writer ordered a pair of push-pull transformers. He has just had delivery of *one* of them, and it seems as though he will be unable to handle the noise he was hoping to be able to put out during the coming Christmas festivities. More recently he recommended a friend a five-valve receiver, and a local dealer demonstrated the *only one* he had obtained out of several ordered at the Exhibition with A.C. mains equipment. This was not judged satisfactory from the hum point of view, and now the set is standing idle awaiting an eliminator and trickle-charger demonstration, because a *patent battery cable essential to the set* is unobtainable!

One would think that a manufacturer could produce a cable for each receiver and another for each A.C. unit before December. The firms mentioned are no worse than the others producing high-class articles, and one is forced to appreciate the difficulties a manufacturer must have to face in getting into full production in a week or two, and it proves the necessity of holding the Show earlier next year.

A June exhibition would give the manufacturer a longer time to meet public demand; it would also shorten the slack period in the summer. It would enable the dealer to attend the Show when he is not otherwise busy, and plenty of time would still be allowed for the experience and the developments of the past winter to be assimilated.

I must apologise for taking up so much space, but there is more chance of the Exhibition promoters giving consideration to a long letter. May they think this matter over carefully from all points of view in time to prevent a recurrence of delivery trouble next autumn.

J. MAURICE TOULMIN.

Preston,

December 8th, 1927.

IDENTIFICATION OF FOREIGN STATIONS.

Sir,—I have read the various letters now appearing in *The Wireless World* on this subject with considerable interest, as I made an attempt to "butt in" with what I considered to be a quite practicable suggestion in one of the early numbers of the B.B.C.'s *World Radio*.

Briefly, it amounts to this: That every station should use the word "Radio" immediately preceding their station name so that, as soon as the word radio is heard by a listener, he knows

instinctively that the *next word* is the one he is waiting for, thus :—

Hello !—Here Radio London.
Hello !—Hier Radio Berlin—Voxhaus.
Hello !—Ici Radio Paris—Emission Eiffel.

As it appears to me a knowledge of any foreign language would be quite unnecessary except in so far as it applied to the pronunciation of the place name, and surely the listener's acquirement of this pronunciation by the announcer in his own tongue, one of the little "international" pleasures of radio, would, with very little practice, cut out any of those prosaic complications that must inevitably arise when one has to disentangle the particular number of strokes on a gong or bell, relation of notes in a musical scale, reference to a numerically classified directory, etc., etc.

The word "Radio" and the place name would, of course, be spoken rather more slowly than is generally customary at the moment, and, as a concession to the majority, taking Europe as a whole, would there be any great objection to British announcers pronouncing "Radio" with a long "a," as is almost universal on the Continent?

While one listens to the male or female announcers in Paris, Moscow, Berne, or Madrid, one's mind trips lightly through the Place de la Concorde, lingers under the towering walls of the Kremlin, soars to the glistening summit of the Jungfrau, or, maybe, mingles with the sombreros and mantillas in some shadowy arcade, but listening to a mechanical sequence of gongs, bells, or recital of letters and numbers . . . . !

No, in our announcements let us preserve at least a little of the local atmosphere and avoid, so far as is practicable, a gradual absorption into the drab world of "R.U.R."

I would like to anticipate a possible line that criticism of these remarks might take by making the confession that English is the only language with which I am conversant.

Bramhall. V. I. NORBURY WILLIAMS (2APM).
December 18th, 1927.

Sir,—It is interesting to note that *The Wireless World* has again decided to take up the subject of station identification signals. At the same time it is curious that in this week's Editorial review there is no reference to the article which I contributed to the issue of November 17th, 1926, containing an explanation of my own system of international call-signs. Yet this is the only system which has in any way received the approval of the Union Internationale de Radiophonie at Geneva. In view of this fact, I would suggest that my system, which will be found to have evoked more correspondence in its immediately succeeding issues—most of it approving the system—than any other proposal mooted in its columns, should be re-examined. It is one, too, which can be naturally linked to the suggestion of regular automatic announcements.

This simple and *international* system overcomes all the difficulties which are present in the other proposals which have been put forward. Briefly, it was this : Each station would announce its identity in Esperanto and each would have a serial number. Thus Daventry would announce "Brita stacio unu" (British station one); Daventry Junior, "Brita stacio du" (British station two), and so on. German stations would announce "Germana stacio unu, du, tri, or kvar," as the case might be. This is H. A. B.'s suggestion with the language difficulty knocked out of it. All that would need to be learned would be the Esperanto names of the countries (which, by the way, everyone can recognise without learning them) and the numerals up to 10 or 12 (which are also easily recognisable at first sight). The numbers allotted to the stations in the various countries would not occupy half a page of *The Wireless World* or any other wireless organ.

My scheme was put forward at Geneva—it was backed, by the way, by the International Radio Association, which has members in practically every country in the world—and at the meeting of the Union Internationale de Radiophonie at Lausanne on May 11th, 1927, the following resolution was *unanimously* passed :—

"Considering, that the Union Internationale de Radiophonie desires to promote intercourse and direct contact among the nations;

"Considering, that broadcast speech contributes to this *rapprochement*, in that it knows no frontiers; and considering that in the difference of languages it finds its chief barrier;

"Considering, that the spread of an international auxiliary language would lessen this difficulty and facilitate universal intercomprehension;

"Considering, that the International Congress of Radio Amateurs, meeting in Paris in April, 1925, studied this problem and adopted Esperanto as an international auxiliary language;

"Considering, that the League of Nations has recommended all States to recognise Esperanto, a practical language for international relations, as a 'clear language' for telegraphic purposes;

"Considering, that the Universal Telegraphic Union in its Conference in Paris, October, 1925, gave effect to this resolution, mentioning Esperanto in article VII of its regulations.

"Considering, finally, that the use of Esperanto has greatly increased in recent years, and that it has been regularly taught for three years in some thirty radio stations of Europe and America, and in the public schools of certain States;

'*The Union Internationale de Radiophonie recommends stations to endeavour to arrange regular transmissions in Esperanto once a week of from 10 to 15 minutes, in order to announce to listeners at a distance the chief points of their weekly programme, and thus make known events in the artistic, intellectual, or economic life of their nation.*

"*It further recommends them to announce the name of their station in Esperanto once in each evening programme.*"

I submit that my own scheme places the clearly expressed desire of this resolution on a systematic basis, and that it is the only scheme which can be said to have met with the approval of the Union Internationale de Radiophonie authorities. Some Continental stations have given practical effect to this resolution, and Breslau, Stuttgart and Danzig particularly, with their relay stations, regularly explain their forthcoming programmes in Esperanto. In addition, one station gives a daily weather forecast in Esperanto and another a news bulletin.

In further support of my suggestion, and to meet possible prejudice, here is the opinion of Mr. A. R. Burrows, the secretary-general of the Union Internationale de Radiophonie :—

"One can but admire the persistence and the confidence of Esperantists as they press forward against prejudice and apathy to secure for their language the reward of world recognition. If nothing better is forthcoming when the nations are called upon to give their verdict, *and one hears very little in these days of a serious rival*, I hope that the reward may be theirs. It is hardly the business of broadcasting organisations to decide for the public a matter of such far-reaching importance, but once a definite decision has been given by a tribunal of world authorities on the several interests involved, the international language of the future may, I feel certain, be sure of support by the broadcasting services."

(*Vide* "International Language," October, 1925.)

It seems to me that the obvious objection to a system of musical notes is that one would have to be continually dashing to the piano or the ukulele to decide what notes had been heard. Not everyone has a musical ear. C. F. CARR.

Southampton.
December 15th, 1927.

OPTIMISTIC PERFORMANCE CLAIMS.

Sir,—It seems time to register a protest against the indiscriminate advertisement (and presumably, sale) of standardised sets of parts for 3-valve wireless receivers, which are inadequate over very large areas of the country.

Owing to intensive advertisement very large numbers of these are being constructed every day by novices chiefly. The result is that there is on all hands a continual increase of oscillation in districts such as this, which lie far beyond the effective range of any such set from a main or relay station.

It must be obvious that the bulk of Devon (with the exception of Plymouth and its immediate vicinity) and the whole of Cornwall lie far outside the loud-speaker range of any three-valve set, and that these particular sets are even more impossible than a 1-v-1 type would be.

Would it not be advisable for makers to give very definite data regarding the limitations of the design, as otherwise there seems every possibility of all reception in outlying districts being swamped in a sea of oscillation. S. G. BLACK.

Torquay.
December 14th, 1927.

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

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

Self-stabilising H.F. Circuit.

I am contemplating adding an H.F. amplifying valve to my present receiver, and understand that the new screened grid valve possesses certain advantages over the ordinary three-electrode valve. Can you explain the advantages of this valve and indicate what special precautions to take when incorporating it in a receiver? L. H.

The screened grid valve has a very low internal capacity between the working, or inner, grid and the anode, and this is achieved by applying a positive potential to the screen, or outer grid. Under working conditions, very little energy is transferred *via* the internal electrode capacity, from the plate circuit to the grid circuit, so that neutralising circuits are not required. However, precautions must be taken to prevent magnetic coupling between these two circuits, and it becomes necessary totally to enclose, in a copper box, one of the tuned circuits. A general idea of the arrangement can be obtained from the illustrations which appeared in *The Wireless World* for August 31st last, when the "Everyman Four" receiver, incorporating a screened grid valve, was described.

When this valve is used in conjunction with suitable circuits, it should result in an improvement in the selectivity of a receiver, but the amplification obtained from the H.F. stage may be slightly less than with a three-electrode valve and an efficient H.F. transformer.

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Screens.

I have a quantity of sheet zinc of suitable gauge, and would prefer to use this in place of copper for the screening boxes in a "Wireless World" receiver. However, if this is going to prove detrimental to the receiver I shall use copper, but I should like your advice on this matter. B. D.

There would be no objection to the use of zinc in place of copper for screening boxes in a receiver, and we may add that any non-magnetic metal would be permissible. It will be necessary to exercise great care when soldering zinc, as if the soldering iron is too hot the zinc will melt.

RULES.

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

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

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

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

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

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

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

Short Waves and Long Aerials.

Can you give me details of the most suitable aerial to erect for the reception of the very short wavelengths in the order of 30 metres? D. P.

The dimensions of an aerial are of little importance for the reception of the short-wave stations. However, it is advisable to employ a loose coupling between the aerial circuit and the closed circuit, the former being aperiodic.

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Parallel Valves or Push Pull?

Will you kindly explain the true function of two power valves in parallel? I have been led to understand that the available grid volts are equally divided between these two valves; is this correct? C. R. P.

When two power valves are connected in parallel as a last stage, the output from the preceding valve is not equally divided between these two valves. The impedance of the two valves in parallel is half that of one so that a greater wattage is dissipated at the anode and accordingly this stage will now be capable of delivering a bigger output. By adopting the push-pull principle, the output voltage from the valve immediately preceding this stage will be divided equally between these two valves, so that medium-power valves with anode potentials of about 120 volts will give an output equal to a good super-power valve with an H.T. voltage of the order of 200 or more.

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Unnecessary Precaution.

I understand that it is necessary to earth the metal casings of Mansbridge type blocking condensers and the casings of L.F. chokes. Does this apply also to the condenser in a choke-capacity filter circuit? A. L.

It is not necessary to earth the metal casings of Mansbridge type condensers for the reason that there is no magnetic field to screen. In the case of L.F. chokes and L.F. transformers this precaution is often to be recommended, and certain manufacturers fix a terminal on these components to facilitate this.

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False Economy.

I have a number of iron-cored coils which I think were used as induction coils in motor cars, and wish to use one as the anode choke in a filter output circuit. Do you consider this a suitable component to employ? V. C.

The type of iron-core inductance mentioned is not recommended for the purpose you suggest, as, owing to the large D.C. resistance of the winding, a big drop in voltage will take place and the anode potential will be very much lower than the potential at the H.T. positive end of the choke. To compensate for this large resistance, it will be necessary to increase the value of H.T. to the last valve. In addition, the inductance of an open-core choke is much lower than one of much fewer turns wound on a closed iron core. It would be advisable to use a component more in keeping with recognised wireless practice.

Double Impedance Coupling.

I am building the "Everyman Four," but in place of the transformer in the last stage I propose, if permissible, to use a "double impedance" coupling unit, which is of American origin. Can you indicate the method of connection? R. H. N.

It should be possible to substitute this instrument in place of an L.F. transformer. If it is of American origin the four terminals are probably marked "P," "B+," "G," and "C−." All you need do is to make the following substitutions in the connections:—"P" terminal of unit in place of "IP" terminal of L.F. transformer; "B+" terminal in place of OP terminal; "G" terminal in place of "OS"; and "C−" terminal in place of "IS." We think that it is our duty to inform you that since this instrument has, of course, no step-up ratio you will get considerably less overall amplification. The instrument is similar to an ordinary choke coupling unit except that an L.F. choke is substituted for the grid leak.

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Filament Resistances.

I am using a 6-volt accumulator, and wish to experiment with 2-volt and 4-volt valves. Please tell me the correct values of resistances to use. G. R. P.

You are evidently under the impression that if a certain value of resistance is correct for one type of 2-volt valve using a 6-volt accumulator, then the same resistance is correct for all types of 2-volt valves. The value of resistance does not depend upon voltage alone, but also on the current flowing through it. Thus, if you are using a 2-volt valve consuming 0.1 amperes, the value of resistance with a 6-volt accumulator will be 40 ohms. If on the contrary you are using a 2-volt 0.15 ampere type of valve, the value of resistance will be approximately 26.3 ohms.

The method for finding resistance is to take the volts to be dropped across the resistance (which in the case of a 2-volt valve and a 6-volt accumulator will obviously be 4-volts) and divide this value by the normal current in amperes taken by the valve. The answer will be in ohms. In this manner you can work out any value you require.

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A Frequent Fault.

I have a four-valve set, and make use of the choke-filter output system. I notice that when tuned-in to the local station the programme can be distinctly followed even with the loud-speaker disconnected, the noise apparently emanating from the set. Can you tell me what is the cause of this, and, if detrimental to the set, how to remedy it? M. K. L. N.

The cause is probably loose laminations in your output choke, and this is detrimental to good quality, and we advise you to return the choke to its makers for adjustment. We presume, of course, that you are using a choke which is properly designed to act as an output choke, and to pass a current of 15 milliamperes or so through its windings. Many chokes are designed for use in a choke-coupled unit, and since they are intended to follow a high-impedance valve they are wound with a large number of turns, and are not intended to carry more than three or four milliamperes through their windings. We should advise you first to make sure that your choke is intended to be used after a power valve.

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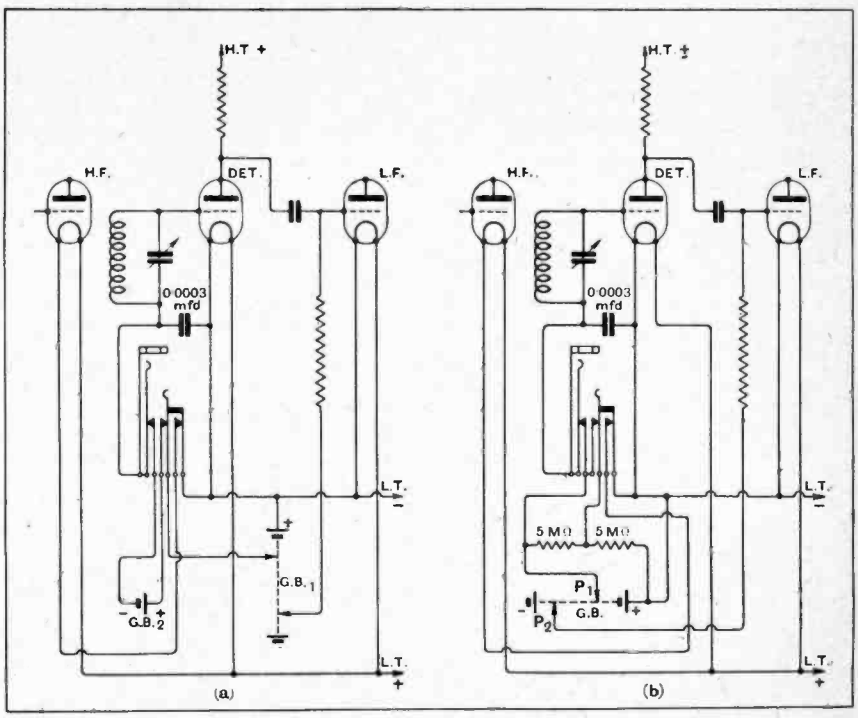
Wireless and the Gramophone.

In the article on adapting the wireless set to the gramophone published on page 592 of your November 2nd issue, should not the same type of jack be used in Fig. 5 (b) as is used in Fig. 5 (a)? If so, can you give me the correct connections using this jack? Also I am having difficulty in obtaining this type of jack, and shall be glad if you can tell me the maker's name. E. B.

It is correct, as you suggest, to use the same type of jack in both cases, and we publish the diagram herewith, showing the correct connections with this jack. When putting this "automatic" arrangement into your set do not forget that the wander plug P_1 must be adjusted so that normally it will cause the valve to rectify on its bottom bend, that is to say, the negative grid bias value will be twice the value of that required when using the valve as an amplifier.

With regard to the latter part of your query, we would say that the Igranic P.70 jack is of this type, although other manufacturers of jacks also produce it.



Methods of connecting a gramophone "pick-up," a modification of the diagram on page 597 of the November 2nd issue.

The Problem of 25-cycle A.C. Mains.

I desire to build the H.T. charger described in your August 3rd issue, but since my mains have a periodicity of 25 cycles I should like to know whether I must purchase a special transformer. L. A. G.

These transformers are sold mainly for use on ordinary household A.C. lighting circuits, and if the supply in your district is 25 cycles, then your local electrician should be able to supply an instrument from stock, but, failing this, we should advise you to write to one of the large electric companies, such, for instance, as the General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.

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Long-wave Transformers.

I desire to construct long-wave coils for the "Regional Three," and require these to cover the wavelength of Eiffel Tower. I should be obliged if you would advise me on the number of turns required, and if the present long-wave formers could be used.

It would be advisable to modify the construction of the formers for this purpose, and the secondary winding on the H.F.T. should consist of 12 sections instead of 16, each wound with 25 turns of No. 30 D.C.C. wire. The primary and neutralising windings can remain as already described, but with the addition of five extra turns on each.

The aerial-grid coil should be wound in the same manner as the secondary winding of the H.F.T., but with the aerial tapping at the 50th turn from the earth end.