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

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

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THE VALVE.

If one asked what is the most useful component in wireless communication to-day there could be but one reply—the valve. From small beginnings the valve has grown in a comparatively short period of years until to-day it is justly regarded as the soul of wireless. Considering the unpretentious start which the valve made and the fact that wireless at that time appeared to be getting along quite well without it, it is the more remarkable that to-day we are so completely dependent upon it in its various forms and applications. Not only is the valve used in the actual transmitter or receiver, but in many auxiliary directions, especially in connection with broadcasting and telephone transmissions.

When will the valve reach finality in its development? Probably at no time in its history will such a stage be reached, for so many new roads are open to development which have limitless horizons. The possibilities of multiple electrode valves have been developed only to a small extent, though there is much to be done in this field. Substitutes for incandescent filaments will, no doubt, be developed in the future to enable us to obtain electronic emission, and already we have the valve with an indirectly heated cathode, although this is probably only in an early stage of development; but whilst we look forward to the future we must not neglect the present, and the valves we have at our disposal to-day are unlikely to become obsolete for some considerable period. Our concern should be to make the best use of them, being careful that each type is made to function under conditions most favourable for its best performance.

The present issue of *The Wireless World* has been prepared with the object in view of supplying this necessary information, and, in particular, details are given of the receiving valves now available to the public. Looking through this formidable list one is almost forced to the conclusion that there are too many types made by nearly every valve manufacturer, and in very many cases the characteristics of valves are so nearly similar that the necessity for the two types seems doubtful. One might, of course, go much further with the plea for standardisation, and say that the time has really come when greater attention should be paid to this subject, especially in view of the fact that an association of valve manufacturers exists which can do much to facilitate standardisation.

In many directions it is obviously impossible to limit the number of types, but different classes of filament voltages must surely be an exception. Here it would seem that it would be possible to dispense with alternative filament voltages and base our requirements, say, on 4-volt valves and so gradually eliminate the 2- and 6-volt types as time goes on. These additional voltage types can have comparatively little in the way of advantages, and yet they account for approximately two-thirds of the total number of valves which are really required.

One final plea, which must not be overlooked, is that for a standard method of valve nomenclature which is surely many years overdue.

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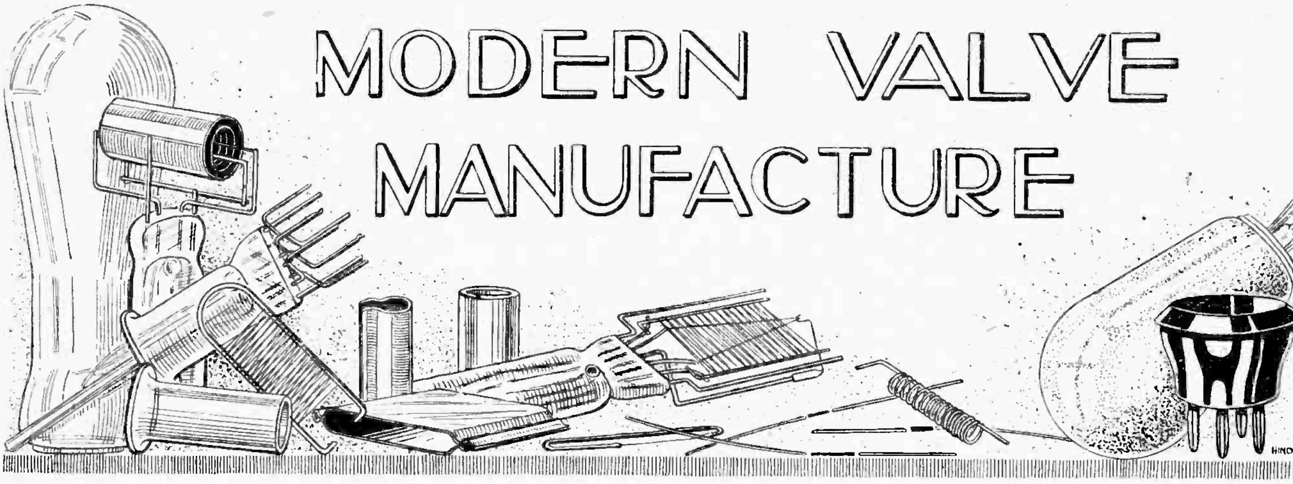
MODERN VALVE MANUFACTURE



Constructional Details of Receiving and Transmitting Types.

By J. J. GRACIE.

EVENTS move rapidly in the world of wireless, but it is doubtful if anything has changed more often than the design and methods of manufacture of thermionic valves, and more particularly receiving valves, during recent years. It seems only a short time since the "R" valve was generally accepted for all purposes of reception, and no other type was seriously contemplated; to-day there are, at a modest estimate, something like 150 different kinds of receiving valve on the market, and during this period of approximately four years there have also been many other valves which have sprung up, had a brief existence, and died a natural death.

It can easily be appreciated that the valve manufacturer has had his hands pretty full all this time; his job has been twofold, first to improve existing valves and to develop new ones to give better characteristics, in order to meet the public's ever-increasing demand for quality with power, and secondly to improve his manufacturing technique so as to reduce costs and thereby permit a corresponding reduction in selling prices.

Manufacturing Methods—A Comparison.

The "R" valve of four years ago took 2½ hours to make; the same valve nowadays is made in rather less than half an hour. The old D.E.R. (then known as the L.T.1) took about five hours to make, and required a high degree of skill in electrode assembly, exhaust, and electrical treatment; this valve is now made in about one-tenth of the time, and the labour involved can be classed as unskilled throughout, a result which has been achieved largely by the introduction of automatic machinery and the use of electro-chemical means of creating vacuum, known as "getters."

Anyone visiting a modern valve works would recognise very few of the operations in use four years ago. Practically everything has been radically altered; anodes that used to be blanked out and rolled by hand are now turned out by automatic machines at several hundreds per hour; grids that used to be wound by hand and laced with great care to a damping wire are now wound, spot-welded at every turn, and cut off continuously at high speed; exhaust by bombardment, lasting for two hours or more, has given way to machine pumps fitted with high-frequency gear to volatilise the "getter," which produce highly exhausted valves at the rate of 300 an hour or so, and what is perhaps more interesting to the reader is the fact that these changes, which tend all the time toward faster production and the elimination of the "human element," tend also to an unmistakable improvement in the quality of the finished article. The fine clearances common enough to-day between grids and filaments, the closeness and evenness of the grid turns in a modern high "*m*" valve, the uniformity of characteristics between valve and valve of the same type, could not be approached if one had to depend upon manual labour, however skilled or conscientious.

Nearly all receiving valves are similar in general construction, that is to say, they consist of an electrode system, mounted on support wires which pass through a glass seal, the whole arrangement being contained in a glass bulb which is exhausted as completely as possible. The electrodes are usually three in number—the filament, anode, and grid. The cathode emission is obtained either from the filament itself, as in the case of a bright emitter, by raising it to a state of incandescence, or from a coating on the filament, in which case the filament acts merely as a heater of the coating. Quite recently a new type has been marketed in which the cathode is a nickel cylinder coated with an emissive substance and heated purely by radiation from the filament, which is inside, but not in contact with, the cathode.

The glass operations are similar to those of lamp-making. A length of glass tube is fed into a machine which simultaneously cuts the tube into short lengths and forms a flange at one end, Fig. 1 (A). This "flange" is placed in another machine, together with the exhaust stem and the requisite number of leading-in wires (B), which may number from four to nine, and the wires are fused into the glass pinch as in (C). During the fusing operation air pressure applied to the exhaust stem blows a hole through one side of the pinch, thus leaving an exit for the gases during exhaust. This is how the

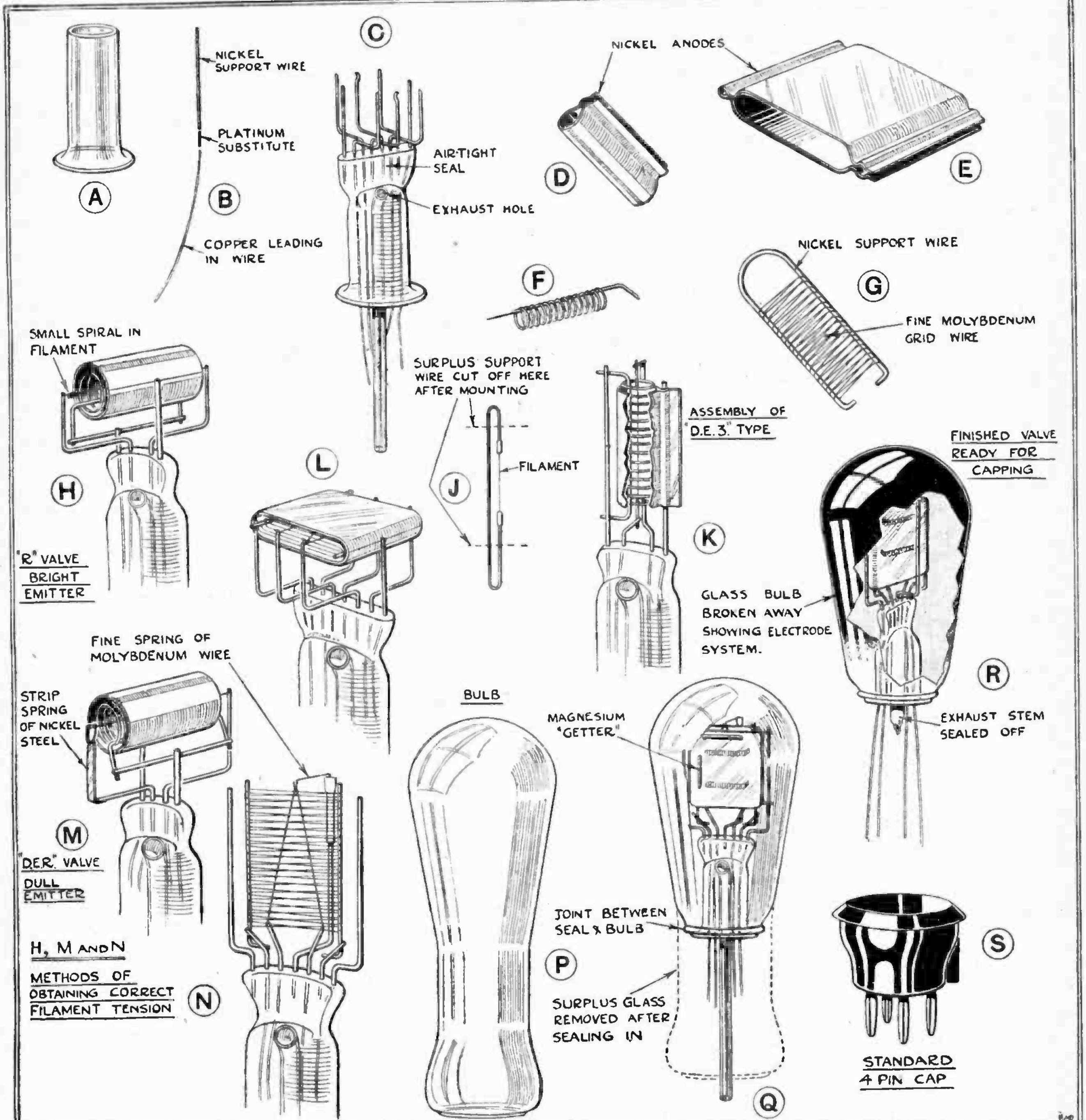


Fig. 1.—Types of receiving valves and processes in their construction. (A) glass flange; (B) construction of leading-in wires; (C) complete assembly of foot with wires fused into "pinch" and exhaust stem attached; (D) cylindrical anode; (E) "flat" or oblate anode; (F) cylindrical grid with single support wire; (G) "flat" grid with "hairpin" support; (H) electrode assembly in bright emitter valve, showing spring tension on filament; (J) .06 filament and support prior to assembly; (K) electrode assembly of .06 valve; (L) low temperature filament supported without spring tension; (M) method of springing straight horizontal filament; (N) springing of inverted V filament; (P) original shape of bulb; (Q) valve ready for exhausting; (R) "gettered" valve ready for cementing to standard 4-pin cap (S).

"pipless" effect is obtained, the stem being subsequently sealed off below the flange and hidden inside the cap. The four external wires are of copper and are subsequently attached to the valve legs; the inner wires are usually of nickel and carry one or other of the electrodes; the small central portion, which is sealed into the glass, consists of a nickel-iron core plated with copper and borax, designed to have the same coefficient of expansion as the particular kind of glass of which the tube is made. The whole thing is known as the "seal" or "foot," and it now remains to assemble the electrodes on it. The manner of doing this depends considerably on the type

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of valve under consideration. The electrodes may be cylindrical or oblate, upright or vertical; the grids and anodes may be so large as to require two supports each; whilst the filament may be straight, "V," "N," or even "W" shaped, requiring two, three, four, and five supports respectively. Some filaments require springing to avoid displacement on to the grid, in which case the tension has to be carefully controlled; too much tension may cause the filament to stretch and break when heated up; too little leaves it loose and liable to sag. In a valve of the 0.06 ampere class the margin is necessarily very small indeed.

The anodes are usually made from nickel strip 0.1 to 0.15 mm. thick, fed into a machine which folds it into the required shape, (D) and (E). The overlap can be joined by welding or riveting.

The grids can be made in several ways, all of which are automatic or semi-automatic. Small cylindrical grids (F) may be made continuously by a machine which winds the fine molybdenum grid wire round a straight-moving nickel support wire. A roller follows each revolution of the grid wire and spot-welds each turn as it passes over the support wire. Suitable interruption of the spot-welding current leaves unwelded gaps along the spiral, so that grids of the correct length are wound in rapid succession, cut off, and discharged by the machine. Flat oval grids are usually made rather differently, as in this case there are two support wires (G). A "hairpin" of nickel is clipped to a mandrel of the correct shape and the grid wire wound over it and subsequently welded by a roller. The pitch of the grid turns is regulated by a lead-screw, and it is possible by this method to get as many as 100 turns to the inch accurately spaced and securely welded.

Filaments.

There are various ways of making up and mounting filaments, which vary in size from the D.E.3 class, taking 0.06 ampere, to the L.S.5, which takes 0.8 ampere, or the new K.L.1, which carries as much as 2 amperes. In general, however, there are certain laws to be observed, which govern the method of mounting, which leave very little choice as regards any particular valve. In the first place, as much of the hot portion of the filament as possible must be contained inside the grid to prevent the passage of stray electrons from filament to anode outside the control of the grid. The cooling effect of the support wires varies with the current carried by the filament, so that in the case of a bright emitter such as the "R" (H) it is possible to allow several millimetres of cold (and therefore non-emitting) filament to protrude at each end. This has the advantage in manufacture of allowing plenty of room for spot-welding the filament to its supports. At the other end of the scale is the D.E.3 filament, which is hot practically throughout its length. In this case the whole filament is enclosed in the grid, and special arrangements have to be made for mounting it. One method is to form an incomplete loop of nickel with the filament mounted in the gap (J). The loop is mounted to its supports (K) and cut through at the points indicated by dotted lines in the figure, the loose pieces being then shaken clear.

Another essential is that the filament should be straight, *i.e.*, coaxial with the grid and anode; appreciable sagging tends to distort characteristics, and may even bring the filament on to the grid. Arrangements have therefore to be made, where necessary, for keeping the filament taut. This would appear to be rather simple, but actually is not. It is impossible, for example, to supply the right amount of tension to a straight filament running at a temperature much over 2,500° K., such as a bright-emitting filament of the "R" type. On heating up, the tungsten wire simply stretches and finally breaks, and one must rely upon the non-sagging effects of chemical additives to preserve a straight wire throughout life.

Microphonic Noise.

It is much easier to spring a dull-emitting filament, as its temperature remains well below the "softening" point of the wire, but here another and much more formidable difficulty arises; a sprung filament has a natural frequency of vibration, and if this frequency is within the audible range the valve is liable to cause what are known as microphonic noises. The modern tendency in design is always towards lower filament currents, and, unfortunately, the lower the current the greater is the tendency towards microphonic noise so long as the filament is sprung. One solution to this lies in a filament which operates at such a low temperature that its filament does not expand or sag and therefore does not require any tension. It will be noticed that the newest types of low-consumption receiving valve embody this improvement (L). When a spring is used with a straight filament it usually consists of a strip of nickel steel (M), but in the case of the vertical "V" filament a shaped hook of molybdenum is usually sufficient (N).

The three electrodes are assembled on to the "foot" by means of jigs. The precision of these jigs is of a high order, as exact location is most important, and each seal is carefully inspected before passing on to the next operation. With few exceptions every joint is spot-welded by means of a momentary current of 200 to 500 amperes at very low voltages. During assembly a small quantity of magnesium wire or strip is lightly welded to the anode for a purpose which will be described later.

Exhausting.

One matter of the utmost importance in the preparation of all electrodes, whether for receiving or transmitting valves, is the "gas-freeing" of all metal parts, which is carried out by cooking both the raw material and the finished articles, in a vacuum furnace at about 1,000° C. The raw metal contains various gases, such as water vapour and the oxides of carbon, not only on its surface, but internally, and it is essential that these gases be removed before the valve is exhausted, otherwise the process of exhaustion would be unduly prolonged and the probability of a permanent vacuum very much reduced. Once the "volume gas" has been removed by cooking, it is found that exposure to the atmosphere does not cause appreciable reabsorption, even over several days, while any fresh "surface gas" can be quickly got rid of by the pumping process.

Once the electrodes are assembled, the "foot" is sealed into the bulb (P), the neck of which is melted by

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gas flames around the flange and the excess of glass blown clear (Q); the valve is now ready for exhausting.

The machine usually employed for this purpose consists of a circular manifold carrying up to twenty-four rubber connections into which are placed the stems of the valves to be exhausted. The rubbers are connected to a system of pumps in such a way that as the manifold moves round, each valve is subjected to a more and more intense process of exhaustion. At the same time, the valve passes through a gas oven maintained at a temperature of 400° C. to 450° C., which has the effect of expelling from the glass parts any gases contained by them, in particular water-vapour, which has disastrous effects on the emission of most dull emitters. By the time the valve has reached the end of the circuit the gas pressure inside is of the order of 0.01 mm. of mercury; there is even at this pressure far too much gas in the valve to permit the formation of a coating of such a substance as thorium, for example, while the gas itself would, in the event of any emission being produced, become ionised and set up grid currents which would reduce the working efficiency of the valve. In order to clear up this remaining gas the magnesium previously attached to the anode now comes into operation. In probably the best method an oscillatory circuit is arranged so that a coil, carrying a heavy high-frequency current, can be lowered over the valve in one of the final positions of the pump. This sets up eddy currents in the metal parts of the valve, sufficient to raise the anode to a red heat, and so volatilise the magnesium, which leaves the anode in the form of vapour and condenses on the coldest surface in its immediate neighbourhood, usually the wall of the bulb. In doing so it "cleans up" the residual gas, together with the gas given off by the anode in heating up, leaving a gas pressure of the order of 0.0001 mm., which constitutes a sufficiently "hard" vacuum for our purpose.

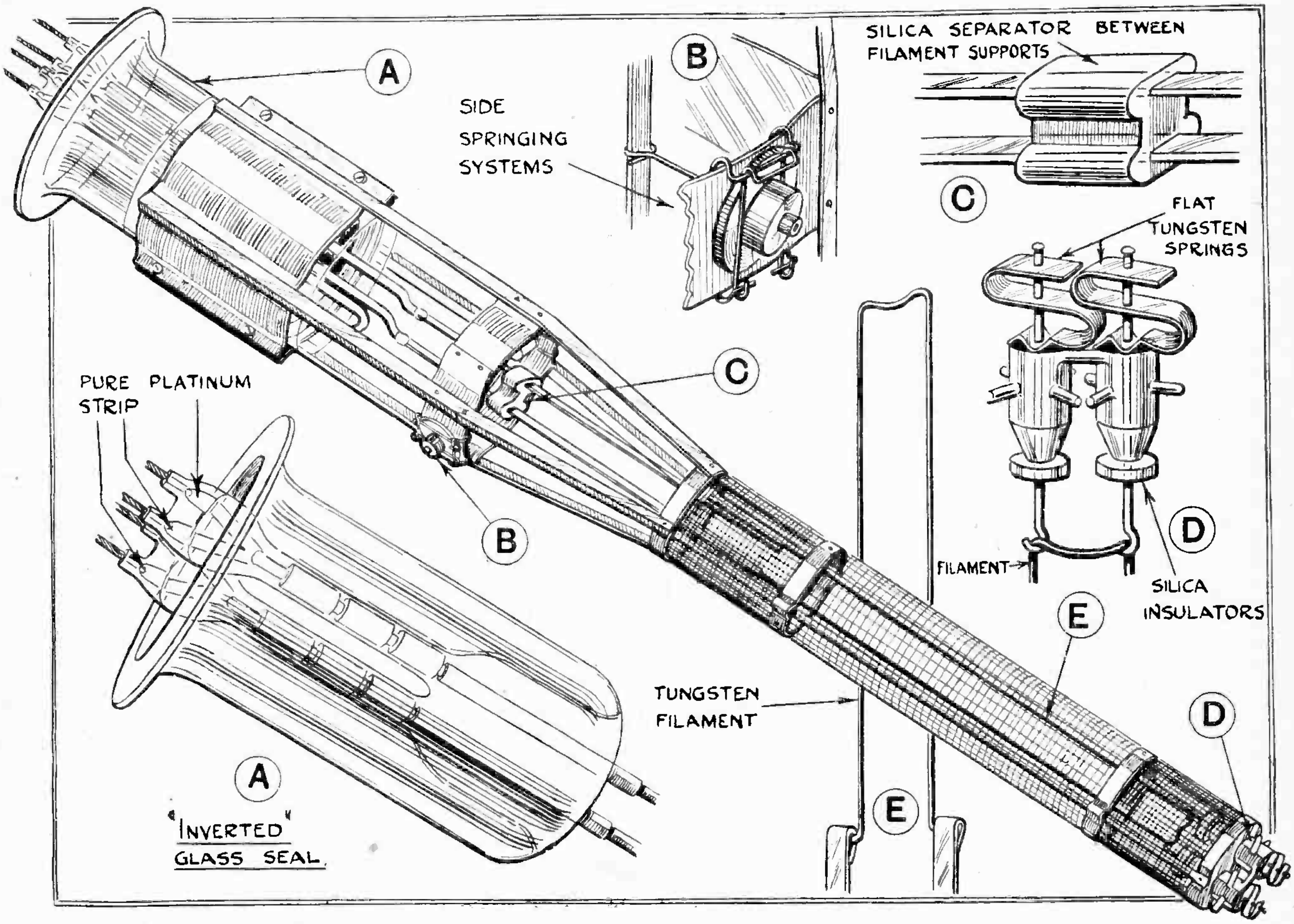

Fig. 2.—Constructional details of the electrodes of a 4 kW. "air-cooled" transmitting valve. (A) glass seal for filament leads; (B) side supports for filament leads; (C) silica separator for filament leads; (D) springs and insulators for end filament supports; (E) filament assembly.

The valve is then sealed off below the flange (Q), and the four-pin base is fitted by the application of cement, baked in a small electric oven, fitted over the base (S).

The subsequent processes depend upon the nature of the valve. A bright emitter needs only to be run for a short time at slightly more than normal voltages, whereas a dull emitter requires a certain amount of electrical treatment to produce the required standard of emission. Thoriated valves, for example, require the thoria in the filament to be reduced and diffused to the surface of the

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filament to form a molecular coating of thorium, the tungsten acting then partly as a heater and partly as a reservoir of more thorium. Again, some coated filament valves are lit up during the pumping operation to gas-free the coated substance and leave a pure uncontaminated salt of barium or strontium, or whatever the emissive substance may be.

It only remains to test the valve for emission, vacuum, filament volts and current, and characteristic slope. The vacuum is taken as roughly proportional to the amount of negative grid current due to ionisation of the gas particles, and is measured by applying a fairly high positive voltage to the plate and varying negative voltages to the grid, with a sensitive galvanometer in the grid-filament circuit; a soft valve gives a current of the order of microamperes, but a hard one gives practically no "backlash" at all.

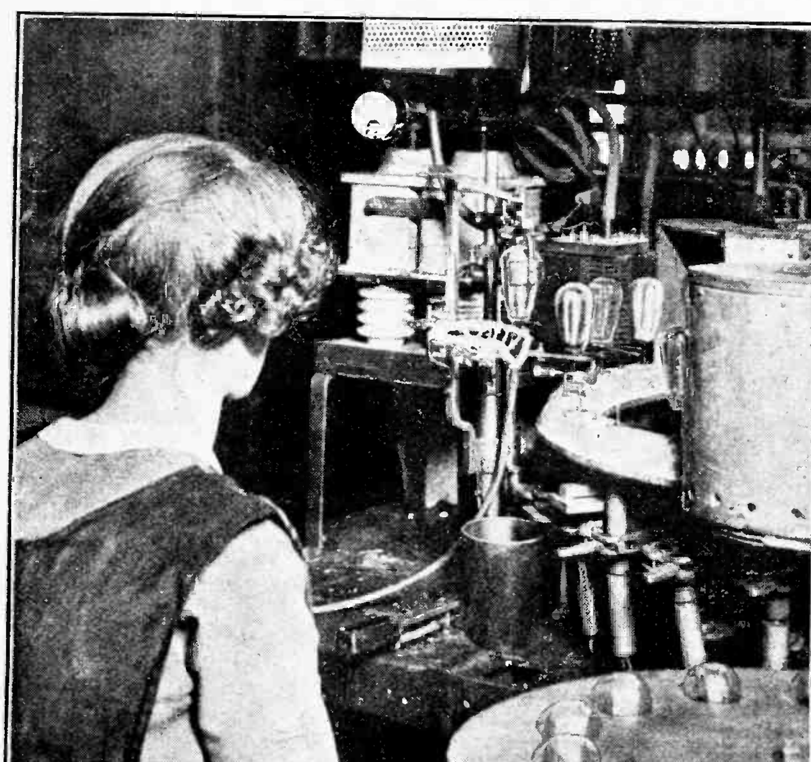
Transmitting Valves.

Both in construction and manufacturing processes, transmitting valves are a different proposition, the reason being, of course, that whereas in the receiving valve the object is to ensure the best possible reproduction of signals consistent with the minimum expenditure of power, the transmitting valve has to deal primarily with power output. The power used in a receiving valve is nowadays of the order of half a watt in the filament and anode circuits; in a transmitter the filament wattage alone is anything up to a kilowatt, and the valve may be called upon to handle as much as 15 or 20 kW., of which 10 may be dissipated at the anode in the form of heat. The anode voltage is often of the order of 10,000, but this is by no means the limit, one type of rectifying valve being capable of standing up to as much as 150,000 volts.

Clearly, then, the running conditions of transmitting valves are considerably more severe and must be taken into consideration during manufacture, with the result that a number of changes in method and design at once appear.

The amount of heat dissipated internally imposes additional restrictions; the glass bulb in turn has to pass on this energy in the form of thermal radiation, and in the high-power valves we soon reach the limit both in size of bulb (for practical purposes) and composition of glass. Beyond 4 kW. or so it is necessary to use some substance such as silica, or, better still, to dispense with the glass envelope altogether and make the anode the outside of the valve, cooled externally by circulating water or oil. The last type is generally known as a "water-cooled," or, more accurately, "cooled-anode," valve, and is the type now used in practically all long-range high-power transmitting stations, such as Daventry, Rugby, and the new beam stations.

In a valve dissipating up to ½ kW. it is permissible to use nickel anodes, but above this both anodes and grids must be of a less volatile metal, such as molybdenum, while tungsten is preferable for support wires in certain cases. The anode of the "water-cooled" valve does not reach a high temperature and can therefore be made of copper or iron.



General view of machine pump for exhausting receiving valves. In the foreground are valves waiting their turn for pumping and on the right a valve is about to enter the oven. At the other end of the oven the high-frequency coil has descended over a pumped valve to liberate the magnesium, and in the last position a valve has been sealed off and is being automatically removed from the machine.

It is impossible to use the ordinary flat glass "seal" common to all receiving valves, because the heavy currents involved, and the high anode voltages used, usually round about 10,000, necessitate a double-ended valve, while the grid lead, for considerations of both insulation and capacity, is usually taken out through the side of the bulb. The size of the anode and grid leads, hitherto unimportant, now demand consideration, especially on the lower wavelengths, where the grid current is of the order of amperes.

The grids of transmitting valves are quite complicated structures. Those of modulators have generally the usual spiral formation, but the grid of an oscillator is, as a rule, of molybdenum mesh, the spacing being closer at the ends than in the middle. In both cases the grid is carried by a rigid framework of molybdenum channel or solid rod, designed to withstand the effects of high temperature.

The filament is usually in the form of "V" or "W"; the tops of the loops may be kept in position by springs in buttons of insulating

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It will readily be appreciated that, in view of all these restrictions, the manufacture of transmitting valves does not at present lend itself to standardisation; moreover, methods of production vary considerably with the different types of valve.

We can perhaps take as typical the manufacture of a glass transmitting valve of the 4 kW. input class, and, later on, a cooled anode valve.

The filament seal and supports having been prepared, the filament, which has been previously bent to the correct shape, is mounted on the molybdenum strip supports (E).

The grid frame consists of uprights of channel molybdenum, carrying bands of molybdenum strip along its upper half, with lower down a wider spacing ring of the same material, and at the base a wide band of iron, which is eventually fitted over the outer tube of the filament seal and tightened up by means of small bolts and nuts. The filament seal thus acts as a support for the grid, although the grid lead is taken out elsewhere. The grid itself consists of molybdenum mesh and is first cut to shape and then literally sewn by hand on to the frame-

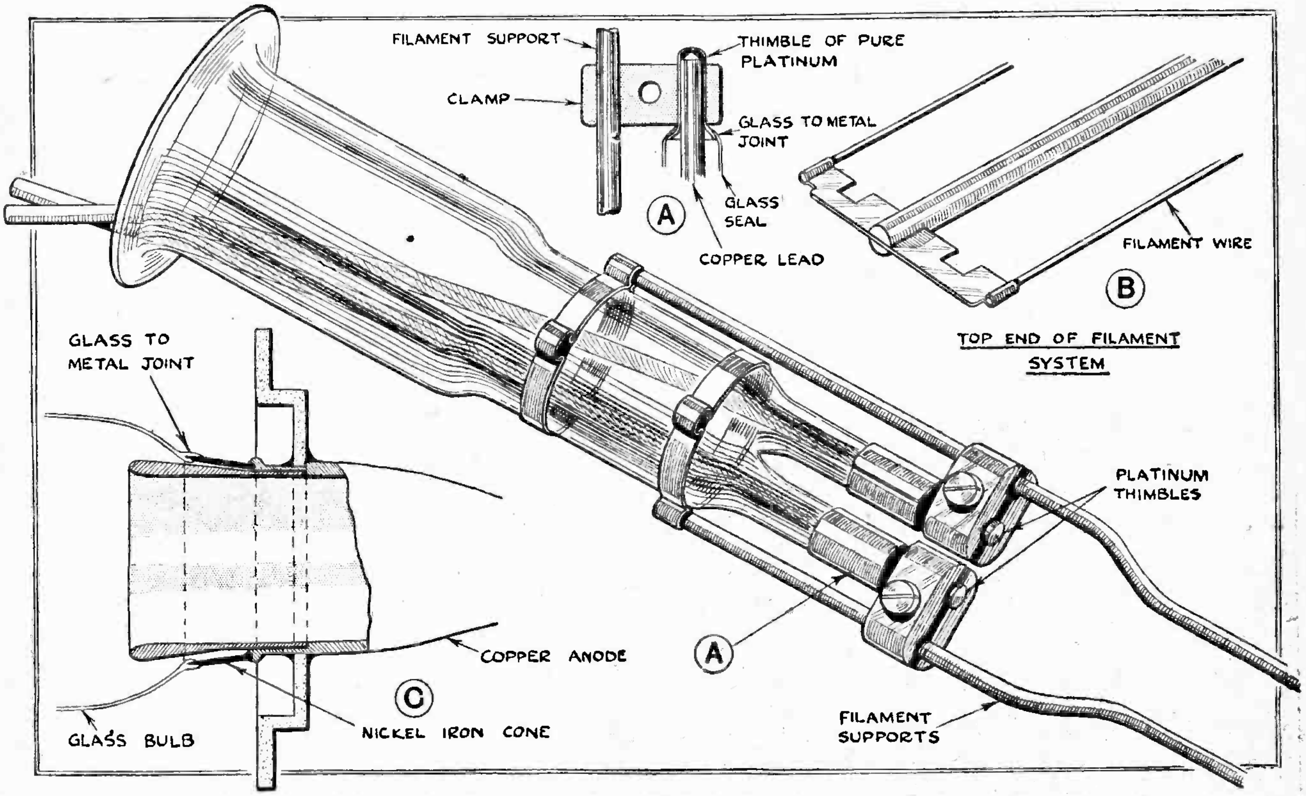

Fig. 3.—Cooled anode valve. (A) filament seal; (B) top filament support; (C) anode seal.

In the glass valve there are four "seals" to be made, two for the filament leads at one end of the valve, one for the anode lead at the other end, and the grid seal at the side of the bulb. All these seals are of the "inverted" type, *i.e.*, the flat "pinch" is outside the valve and supported by a double glass tube, Fig. 2 (A). Pure platinum is used in the form of strip in order to pass the heavy current (25 amperes in the filament circuit) without undue heating. The external leads are of stranded copper and inside nickel rod or strip connects with the electrode system. Fig. 2 shows the electrode system and its supports in detail and is self-explanatory. It will be noted that quite a lot of "extras," such as silica separators (C) and beads (B) are used to secure adequate insulation and precise spacing, and that great trouble is taken to keep the more susceptible glass parts, such as the seal, out of the heat zone.

work with threads of tungsten. Once the grid is mounted, the filament springs (D) are put in position and the filament correctly adjusted for position and tension, and this part of the valve is now ready for sealing-in.

The anode is made from molybdenum sheet and is of the usual cylindrical form. Among the mechanical disadvantages of molybdenum is its reluctance to be spot-welded to itself, and so rivets are used throughout. The anode is mounted on a framework of molybdenum uprights and clamped by an iron band to its own glass seal, which is then sealed into one end of the bulb, which differs from the ordinary valve or lamp bulb in having a neck at both ends. The grid-filament system is then sealed in at the other end, great care being exercised to get the two systems truly coaxial; finally, the grid lead is extracted through a hole in the side of the bulb and joined to the grid seal, which is then attached to the bulb

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from outside. It will be seen that the manufacture of such a valve as this involves a high degree of skill in glass-blowing, mechanical fitting, and even needlework!

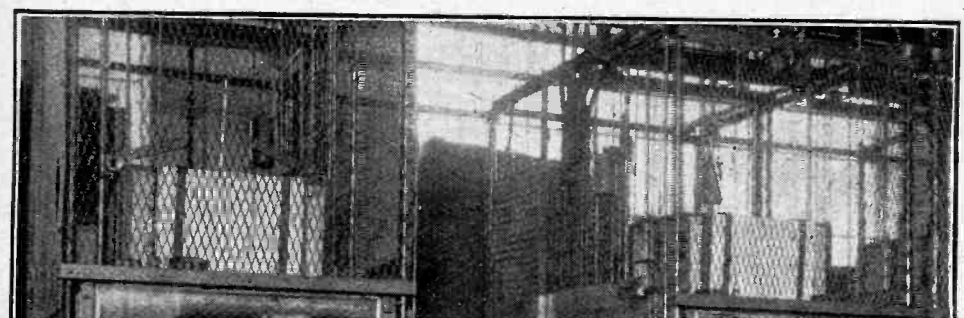
The exhaust of a valve of this sort is a long job, requiring several hours' constant attention by skilled observers. In this case, of course, automatic pumps are ruled right out, and each valve has its own pump system, which consists of a high-quality mercury vapour diffusion pump backed by a rotary oil pump. The valve is sealed on to a glass manifold connecting with the pumping system, and by means of a change-over tap and a McLeod gauge readings can be taken of the approximate pressure in the valve at any time. A gas oven is lowered over the valve, which is "baked" at 400° C. for half an hour to liberate the "glass" gases. The diffusion pump is then operated until a good vacuum is obtained.

During this time the electrodes have, of course, been cold, but now first the filament is lit up, and then volts are applied to the anode and grid, and in consequence large quantities of gas are given off as the electrodes heat up. The whole of the remaining time is applied to the removal of this gas as fast as it is evolved, and the severity of this "bombardment" of the electrodes may be estimated by the fact that at different periods the anode has to dissipate from two or three times its normal loss, running at a white heat for many minutes at a stretch. The valve is then sealed off and is ready for use after the usual beads and sleeving have been attached.

Cooled Anode Valves.

Technique of a different character has been developed in the construction of the cooled anode valve. Compared with any type of receiving valve, this might reasonably be described as a heavy engineering job. The "business" end of the valve consists entirely of metal, and the work is done by specially trained mechanics. The filament, grid, and anode systems are built up separately, then assembled, sealed in, and exhausted, but the methods employed are different from anything so far described.

The anode, as has been said, is the outside of the valve itself, and must therefore be absolutely non-porous and free from cracks, even at fairly high temperatures. In the case of single-ended valves it is pressed out from copper sheet into a closed cylinder 9in. or 12in. long and $\frac{1}{8}$in. thick, with a flange at the open end; into this end are fitted first a cone of nickel-iron tapering outwards to a very thin edge, which will ultimately receive the glass bulb direct, and next a copper cone, which is virtually an internal extension of the anode and acts as an electrostatic shield to the glass-to-metal joint.



Apparatus for pumping medium-power transmitting valves. Note the mercury vapour condensation pump and liquid air trap below table and gas oven lifted clear of the valves during bombardment.

In addition there is an external copper flange which acts as a support for the water-jacket when the valve is in use. The anode is usually cylindrical, but in the case of a rectifier is sometimes binocular, to reduce the filament-anode path and also to relieve electrostatic stresses between the filament limbs. The nickel-iron cone is copper-plated and treated with borax at the edge, after which one end of the glass tube which will ultimately contain the seals and electrode supports is held round it and melted on by carefully controlled gas-flames. The joint thus formed is not only absolutely gas-tight, but mechanically very strong and free from strain.

The grid of a "cooled anode" valve is similar to that of a large transmitting valve in general design, but more robust in construction and mounted on bands and seals in much the same way.

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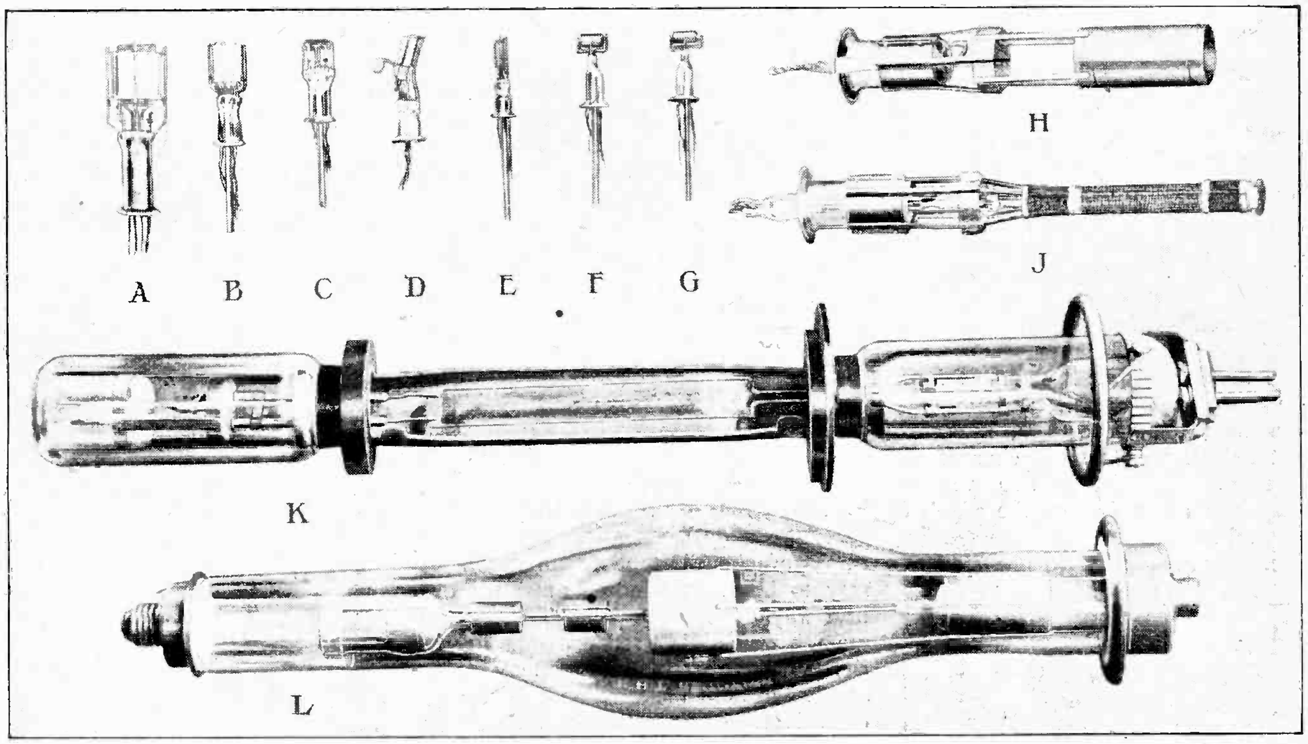
The filament current is usually 50 or 75 amperes, and ordinary platinum seals in glass pinches are no longer adequate. The method employed is shown in Fig. 3, in which it will be seen that a platinum "thimble" is joined direct to the glass tubing. The external copper lead is pushed up inside the thimble, and a clamp is tightened up on to the thimble, gripping the copper lead securely and at the same time passing the current to the filament by the usual "backlash" method, owing to the high voltage and currents involved, so a receiving valve of the L.S.5 type is attached beforehand to the valve by glass tubing, and suitable voltages are applied to its plate and grid, and the reverse grid current is measured, exactly as in testing for "backlash" in a finished receiving valve. We thus estimate the vacuum in the small valve, which can be taken as approximately equal to the vacuum in the larger one.



Representative types of receiving valves (A to G) compared with some high-power transmitting valves and their components. The anode and grid of a 4 kW. transmitting valve are shown at H and J. K is a sectional view of a double-ended cooled-anode rectifier, and L is a rectifier specially designed for an anode potential of 150,000 volts.

support. The filament itself is, of course, of generous proportions and so are its springs, which are made of stout tungsten wire.

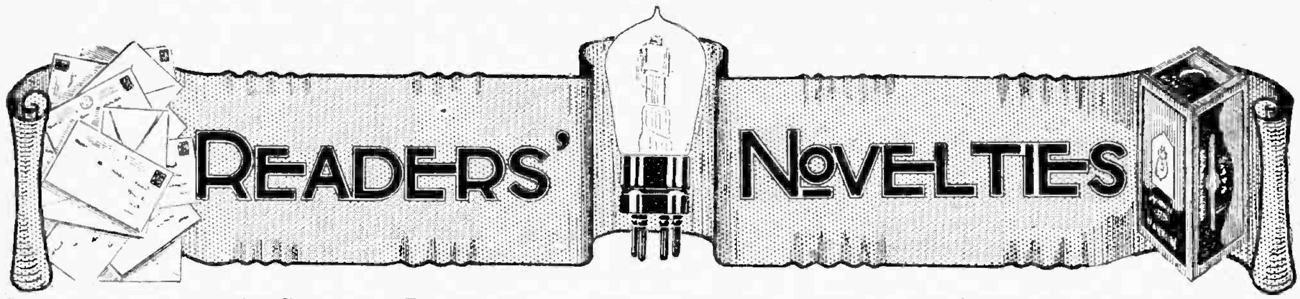
The sealing-in of such a valve is made difficult by the fact that the anode is opaque, and it is impossible to see by eye whether the grid and filament are co-axial with the anode or not. High-precision mechanical devices are therefore used for this operation, no subsequent inspection of the electrodes being possible, and up to the present the result has been quite satisfactory. In passing, it may be said that it is actually possible to inspect the electrodes by taking X-ray photographs of them, and this process is regularly used in "inquests" on valves at the end of their useful life, but obviously does not lend itself readily to factory usage.

The exhaust and bombardment of cooled anode valves lasts for twelve hours or more and is carried out on much the same lines as for glass valves, except that much more power is used and additional technical problems are introduced, some of a very interesting nature. In the finished valve it is not convenient to measure the vacuum

After exhaustion, a cooled anode valve is fitted with specially designed caps for the filament and grid leads, the anode connection being made direct to the anode itself.

Conclusion.

In conclusion it may be said that, owing to the enormous rush of new development work, the technique of valve manufacture is actually further from standardisation to-day than ever before. The constant cry for lower filament current *plus* better characteristics *plus* lower prices, in receiving valves, together with the necessity for increased power in single-valve transmitting units *plus* ability to handle short wavelengths, have combined to make the manufacturer's life "not a happy one." Presumably the thermionic valve, like its more brilliant but less ambitious brother, the electric lamp, will ultimately arrive at something like finality, when the number of types will be reduced to reasonable proportions and manufacturer and purchaser alike will have time to take a "breather."

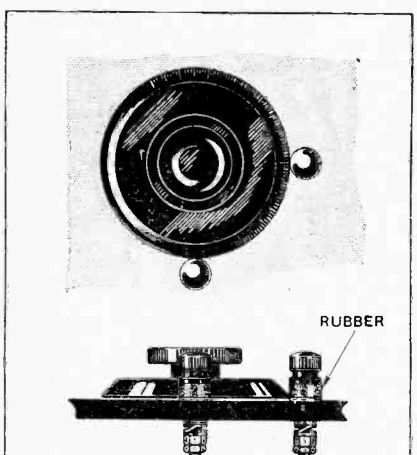


A Section Devoted to New Ideas and Practical Devices.

SIDE-PLAY IN CONDENSER SPINDLES.

The system of vernier control, consisting of a small friction wheel at the edge of a condenser dial, has been described in wireless periodicals since the earliest times, but the particular arrangement shown in the diagram serves another purpose.

Side-play, if not already present in the top bearing of a cheap condenser, soon develops where the diameter of the spindle is small, resulting in scratching noises due to the intermittent contact and to small changes of capacity. By fitting *two* vernier attachments at points on the edge of the dial separated by 90° the spindle is continually forced to one side of the bearing and no further trouble will be experienced. H. D. H.



Two vernier control knobs fitted to take up side-play in the condenser spindle.

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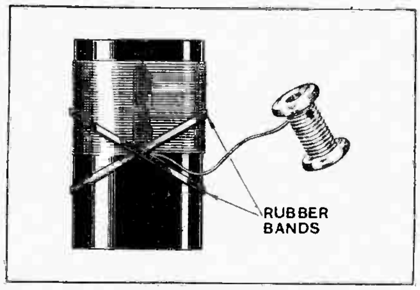
COIL WINDING.

The art of winding single-layer coils has fallen into abeyance during the vogue for plug-in coils, but is now being revived for the construction of H.F. transformers for short wavelengths.

The use of ordinary wire paper clips to hold the ends of the winding before fixing to soldering tags is well known, but this method cannot be employed should it be found necessary to interrupt winding operations half way through the coil. The diagram, which is self-explanatory, shows how two rubber bands may be applied to hold the wire under these conditions. W. B.



Holding wire in position when winding is interrupted half-way through coil.

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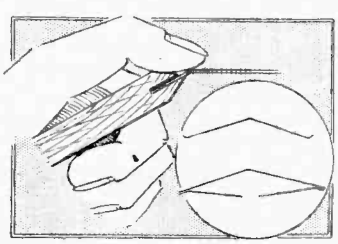
CONE DIAPHRAGM CONSTRUCTION.

The formation of a stiffening rim at the edge of a cone loud-speaker diaphragm is greatly facilitated by the use of a small forming tool. This consists of a piece of wood of round section $\frac{3}{8}$in. to $\frac{1}{2}$in. in diameter and 4in. to 6in. in length. The end is sharpened to a chisel edge and then saw-cut with a fine back-saw to a depth equal to the width of rim required. The saw-cut should be made slightly to one side of the chisel edge which should, in turn, be rounded at the edges to prevent damaging the paper.



Forming a rim on the edge of cone loud-speaker diaphragms.

The tool is worked round the edge of the paper with suitable pressure from the thumb in the position shown. No attempt should be made to finish the rim "once round" as the paper will be sure to crumple; three or four circuits should be sufficient.

The formation of a rim in this way is useful when constructing double-cone diaphragms, as indicated in section in the diagram, as a much firmer joint between the cones is thus obtained. V. W. E.

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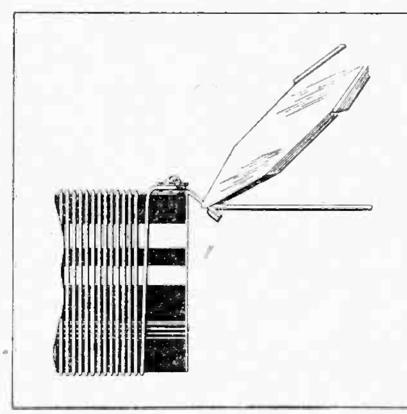
SOLDERING HINTS.

Faulty connections at soldering tags can often be traced to the presence of a non-conducting film of resin between the tag and holding-down screw due to flux gravitating on to the screw and the end of the winding.



Before soldering connection to tag, bend downwards to prevent flow of flux on to winding.

To avoid this trouble, all that is necessary is to bend the tag down before soldering, as shown in the diagram. This also directs the flow of solder to the desired point. V. W. E.

HINTS and TIPS for NEW READERS

A Section Devoted to the Practical Assistance of the Beginner.

PROTECTING VALVES AND BATTERIES.

Few of us are entirely guiltless in the matter of burning out valve filaments and short-circuiting expensive H.T. batteries. Good resolutions as to the observance of such obvious precautions as disconnecting the necessary leads are often neglected when making hasty adjustments or experimental alterations, and in the long run the slight expense and trouble involved in fitting some form of safety device which compensates for the fallibility of the human element will be amply repaid.

One of the most certain methods of reducing risk of damage is to insert

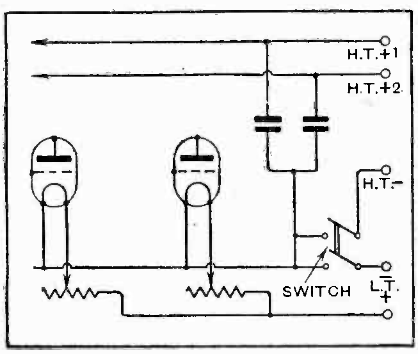


Fig. 1.—Connections of a D.P.S.T. switch arranged to break both L.T. and H.T. circuits. It may be connected up externally.

a fuse in the junction between H.T. and L.T. batteries, though unfortunately the number of fuses which are really satisfactory is at present strictly limited. It is still better to fit separate fuses in each positive high-tension lead.

A good alternative method is to fit a switch in such a way that the negative H.T. lead is broken as well as the L.T. supply to the filaments. The blades of the switch should be arranged to "make" the high-tension circuit before the filaments are lighted, and—more important—to break the L.T. before the H.T. is disconnected. By observing this precaution, risk of damage to such iron-cored inductive windings as those of transformers, loud-speakers, etc., is avoided. The connections of the switch are shown in Fig. 1.

The simpler device suggested in Fig. 2 is not altogether satisfactory. At first sight it may seem that the H.T. circuit is broken as well as that of the L.T. battery; a moment's consideration, however, will show that this is not the case, as the negative end of the battery is still connected to the filaments through the L.T. and rheostats. The arrangement is, however, of some utility, if it is always remembered that the rheostats should be turned to the "off" position when making adjustments.

oooo

VALVE CLASSIFICATION.

The amateur would probably do well to relinquish the idea of mentally classifying valves under the arbitrary headings of "H.F.," "L.F.," "power," etc. The present-day practice in this respect is liable to be confusing, and is in any case hardly helpful as an aid to the choice of a valve for a specific purpose.

It would appear to be a better practice to cultivate the idea of always thinking in terms of anode impedance (or A.C. resistance). Thus, for the majority of modern transformer-coupled H.F. amplifiers, a "20,000 ohm" valve, with a filament rating suitable for the L.T. battery in use, would be chosen. It should be realised that while the highest possible amplification factor for a given impedance is always desirable, designers are limited by various inherent difficulties, and in any case the figures applying to any of the more efficient makes are more or less the same. Taking the particular class of valve at present under consideration as an example, we find that an average amplification factor of about 20 is obtainable, although this is generally reduced slightly in the case of those with 2- and 4-volt filaments, which are inherently somewhat less efficient, all other things being equal.

The modern "20,000 ohm" valve is one of the most generally useful, and its usual title of "H.F. ampli-

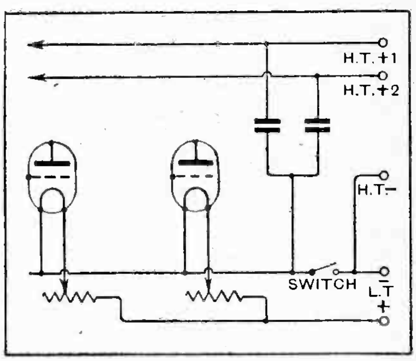


Fig. 2.—Another method of fitting an "on–off" switch. Note that the filament rheostats must be in the "off" position to disconnect the H.T. battery.

fier" is apt to be misleading; indeed, it has usurped the majority of the functions of the original "general purpose" type, as it operates satisfactorily as a detector or first stage L.F. amplifier in the majority of circuits.

Reference should also be made to the class including the so-called "power" valves, of from 5,000-10,000 ohms impedance, generally used in the last stage of loud-speaker sets from which no great volume is expected, and where cost, both initial and maintenance, is a consideration. It must be noted that, if the figures above are taken as truly representative under working conditions, the valve with the lower rating will as a rule be able to deliver louder undistorted signals, but will consume more high-tension current. The dividing line between these valves and the "super power" class of some 2,500-3,500 ohms tends nowadays to become less distinct.

It must not be thought that there will be a vast difference in performance between valves having impedances differing only by some 10 or 15 per cent., providing the relationship between the amplification factors remains sensibly constant; thus, it would be a difficult matter to detect any audible difference in signal strength were a 20,000 ohm valve to be substituted by one of 18,000 ohms and equal efficiency.

The high-amplification, high-impedance valves of from 50,000-100,000 ohms are being produced in increasing numbers, and have several distinct fields of usefulness, notably as tuned-anode H.F. amplifiers, and as anode rectifiers or L.F. amplifiers with resistance coupling. They must, however, be used with care and only under expert advice.

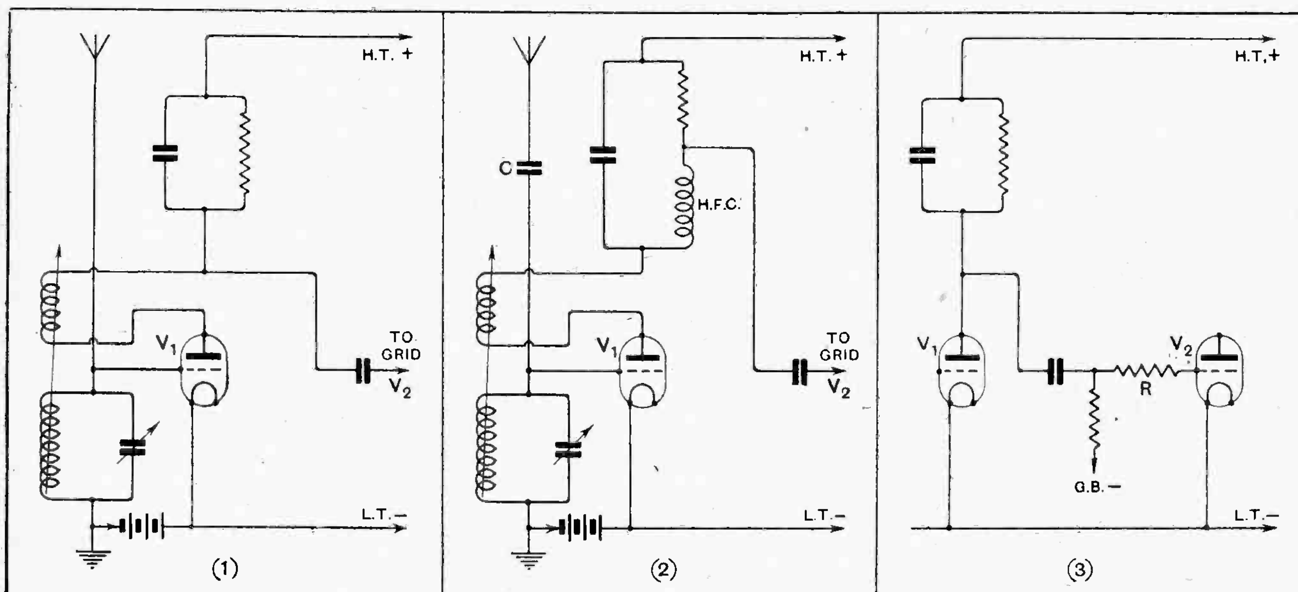
DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 66.—Anode Detector with Two Resistance-coupled L.F. Amplifiers.

(Continued from last week's issue.)

The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless receivers, and at the same time to assist readers in mastering the art of circuit diagrams. In the skeleton diagrams below are shown some modifications of the receiver discussed in last week's issue. Non-essentials are omitted.



Reaction is added by inserting the necessary coil (variably coupled to the aerial inductance) in series with the anode of the detector valve.

By connecting an H.F. choke and the usual by-pass condenser in the manner shown, the H.F. and L.F. currents are more or less separated.

Another method of preventing possible ill effects due to the passing-on of H.F. impulses into the L.F. amplifier. A resistance R is inserted.

ALTHOUGH reaction control at its best is not obtainable when using a "bottom bend" detector, the arrangement shown at (1) will result in a very considerable increase of range. A No. 30 or 40 reaction coil will generally be sufficiently large for use on the broadcast waveband, while a No. 100 should be suitable for Daventry. This coil, and the aerial inductance, may both be mounted in a "two-way" holder.

Selectivity may be improved by inserting a fixed condenser of 0.0001 to 0.0003 mfd. in series with the aerial, as indicated at C in (2). In this diagram is shown one of the many possible methods of separating H.F. and L.F. currents, and of preventing (or, rather, reducing) the application of H.F. impulses to the grid of the L.F. amplifier. The arrangement shown in (3) serves a similar purpose and is simpler; the resistance R, connected to the grid of V_2, may be of from 0.1 to 0.5 megohm. This device may be combined with (1), giving the arrangement of the B.B.C. demonstration receiver "B" (see *Wireless World*, March 16th, 1927).

CHOOSING THE RIGHT VALVE

Characteristics Required for the Various Stages in a Multi-valve Receiver.

By P. K. TURNER.

CHOOSING the right valve is an easy task if you are not afraid of arithmetic, but a puzzling one for the hazy-minded. Of course, there are two parts to the problem—first, to work out just what characteristics the valve should have; second, to find which of the valves on the British market have these characteristics.

There are eight distinct functions which the valve may be called upon to perform, and they fall into the following classes:—

(1) "Power," *i.e.*, the last valve in a domestic loud-speaker set.

(2) "Transformer amplifier," *i.e.*, any valve to be followed by a transformer, the ratio of which can be chosen at will.

(3) "Voltage amplifier," to be followed by some form of coupling such as resistance, choke, or tuned anode.

(4) "Grid detector."

(5) "Anode detector."

(6) "Super power," *i.e.*, for use in the last stage of a high-power amplifier.

(7) Power rectifier for H.T. supply from mains.

(8) Valves for A.C. filament feed.

I can see no better way of tackling the problem than to take each position in a multi-valve set in turn, and see what is required.

The Power Valve.

Here the first essential, of course, is the ability to put out enough power. It may be as well to begin, with the consideration of this valve, a campaign for the use of a type of valve curve different from the usual. This latter, as is well known (see Fig. 1), shows the anode current for any grid voltage, each curve being for a fixed anode voltage. It may be said at once that curves of this type are practically useless for purposes of design.

But if we take the four points A, B, C, D, for zero grid volts and various anode voltages, and plot them as one curve, as in Fig. 2, we have a curve of much greater utility. For the moment, however, I will base my discussion on the type of curve shown in Fig. 1, assuming that the reader also has information as to the μ ("voltage amplification factor") and R_a ("A.C. anode resistance" or "slope resistance") of available valves.

Now, in the case of the power valve, the requirement already mentioned—sufficient power—means that there must be enough "straight" in the characteristic curve. To get reasonable volume from a loud-speaker, there must be generated in the anode circuit of the last valve a voltage swing of about 120 for a "2,000-ohm" loud-speaker, or about 80 for a "750-ohm." Now, suppose that Fig. 1 is the curve of a power valve with an amplification

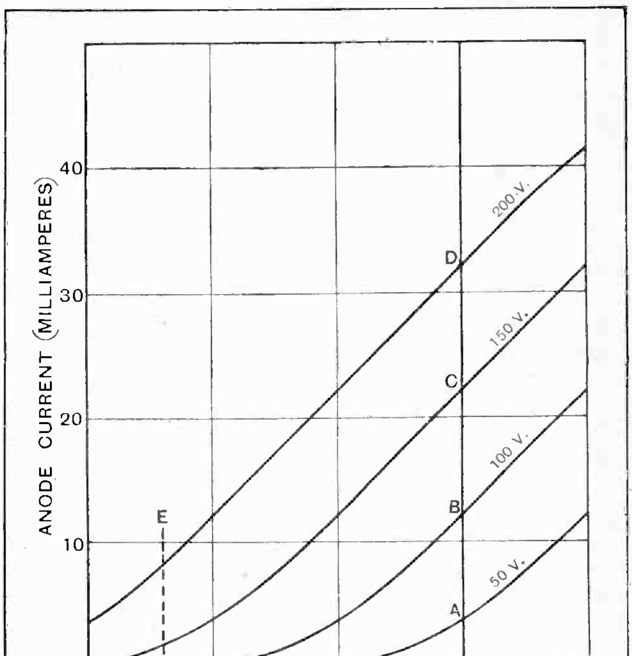


Fig. 1.—Usual form of characteristic curves of a typical power valve.

Choosing the Right Valve.—
factor of 5. If we are to have 120 volts swing in the anode circuit there must be 24 volts grid swing. So we must have a "curve" which is straight (or nearly so) between D and E. That is the first requirement, the actual grid voltage of E (24 volts in this case) being worked out as shown below.

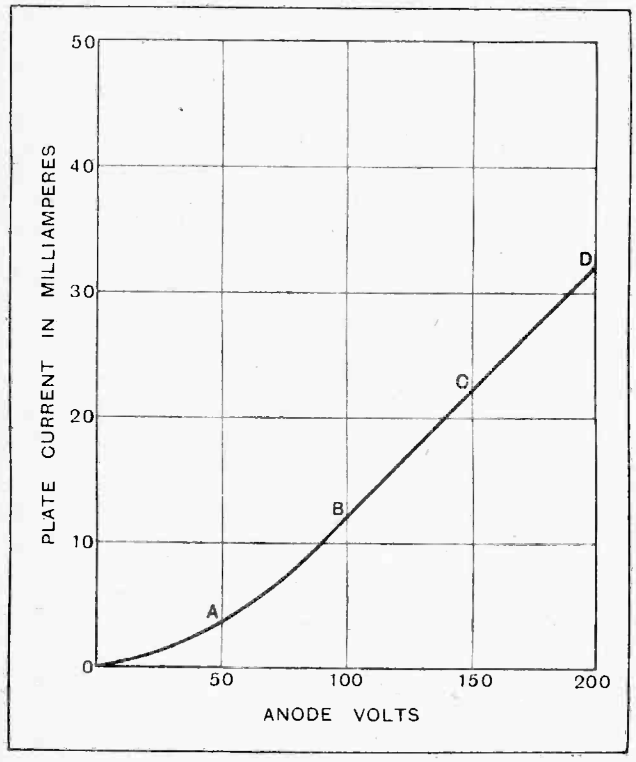


Fig. 2.—Anode characteristic curve (for zero grid volts) of the same valve as Fig. 1.

The second requirement is a slope resistance which is not too large for the loud-speaker. The bass notes will suffer if this slope resistance is much above 3,000 ohms for a 750-ohm speaker, or 7,000 for a 2,000-ohm speaker. This, of course, excludes the case where an output transformer is used; but it still applies for the modern fashion of choke output to keep the D.C. out of the speaker.

The Mutual Conductivity.

Now the μ of any valve is limited if we put a limit on the R_a. In fact, the ratio μ/R_a is the very important thing called the "mutual conductivity," and is usually written G_m (except by valve makers, who for some unknown reason often call it K_1). G_m is usually given as the above ratio multiplied by a million: in other words, multiply μ by 1,000 and divide by R_a expressed in *thousands of ohms*. Thus a power valve with R_a of 3,000, μ of 3.3, has a G_m of

$$\frac{3.3 \times 1{,}000}{3} = \frac{3{,}300}{3} = 1{,}100 \text{ "microamps per volt."}$$

Every valve maker tries to get as high a G_m as possible Plenty of filament power helps: a 625 valve (*i.e.*, with a filament current of 0.25 amps. at 6 volts) can always be made with two or three times the G_m of a 306. Again, an extremely high μ valve cannot be made with so high a G_m as one with a lower μ; and, lastly, there is in some sense a compromise between long life and high G_m.

Getting down to brass tacks, a valve with a 525 or 625 filament and R_a of about 3,000 will probably have a μ of something between 3 and 5, and will have a long enough curve to give the 20-volt grid swing required to get enough output for a 750-ohm speaker. There are several such valves listed. As between the various ones, see which has the *shortest bottom bend*: this will need the smallest H.T. supply both for voltage and current. With this valve in the last holder you can just fill a room with a D.C. supply of 10 mA at 120 volts, and do it properly with 20 mA at 200 volts.

With a 2,000-ohm speaker you can go up to, say, 7,000 ohms R_a, and get a μ of about 8; but you will be wiser to go for 5,000 ohms and a μ of 6 or thereabouts. Even with these lower values you will need at least 150 volts and 200 or more if you want full volume.

Please do not laugh at this—I know that hundreds of people are connecting loud-speakers to last valves fed with 90 volts, with about $4\frac{1}{2}$ volts bias, and producing very loud noise. But I am talking now about pure reproduction. Under-power is one of the three great curses of out-of-date wireless.

The Transformer Amplifier.

Let us first consider L.F. transformer coupling. As we all know, a transformer will not transform direct currents. Further, an intervalve transformer does not transform the lowest frequencies very well; but the point where it begins to go on strike is within the user's control. A good, big, expensive transformer will deal with much lower frequencies than a skinny one. You pay the extra money partly as a reward to the maker for knowing how, but largely because to get the lower frequencies you need more wire and more Stalloy, and both cost money. But also—and it is a big but—*any* transformer will get lower and lower frequencies as you use before it a valve of lower and lower R_a; and, considering various ratios of transformer by the same maker, the lower the ratio the better the low frequencies.

So, if you are using a first-class transformer of low ratio, you can use a valve of fairly high R_a, and thus make up for the low transformer ratio by high μ in the valve. But if you want to get fair results from a not-too-good transformer, keep R_a down. You will note that R_a is the limiting factor, and that good magnification for the whole stage depends on getting a fairly high μ for a given R_a. In fact, a high G_m is *the* quality wanted for a transformer amplifier.

Getting to figures: as an example of what *can* be done with a transformer, take a Marconi Ideal 2.7 : 1 after a 3,000-ohm valve. The falling-off will be only 10 per cent. at 32 cycles—which is for practical purposes all that we need—and the stage magnification about 8. The same transformer, or a Ferranti AF3, with a 20,000 ohm valve, will give fine results. With a 40,000 ohm valve it will give excellent results *if you are clever*. Roughly speaking, I feel that the following table indicates the

Choosing the Right Valve.—

highest R_a safe to use before a transformer for the ratio named:—

Ratio:	2 : 1	3 : 1	4 : 1	6 : 1
Max. R_a:	40,000	20,000	10,000	5,000.

Even so, this only applies if the transformer is *first class*. If it is good second class, cut R_a to half or two-thirds the above values. If the transformer is not up to this quality burn it.

Having decided the R_a, simply get the valve with the highest μ, provided that R_a is not above the settled value. But remember that valves of very high μ for their R_a—*i.e.*, very high G_m—have a slight tendency towards (*a*) short life, and (*b*) irregularity as between different samples. One has to pay for everything.

If you are free to choose both transformer and valve, remember that high μ and low transformer ratio will usually give the highest overall amplification.

With 512 or similar valves, one should get $G_m = 1{,}000$ for low μ, falling to $G_m = 500$ at a μ of 20; with 2-volt or 3-volt valves, half these values.

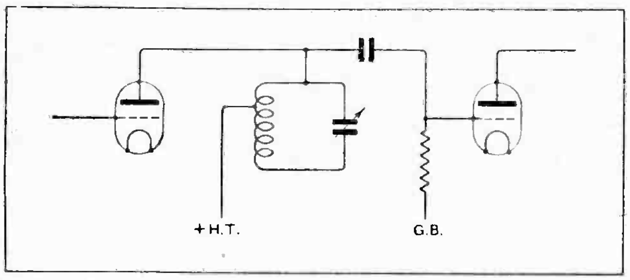


Fig. 3.—When the +H.T. lead is connected to a tapping on the tuned anode coil the valves are virtually transformer coupled. The system is often referred to as auto-transformer coupling.

H.F. transformer coupling includes such a circuit as Fig. 3, where the tapped "tuned anode" coil is really an auto-transformer. Here the matter of even amplification is not important. The first essential is maximum stage amplification for tuned signals. In the case of telephony there is also a rather complicated matter—that of getting high amplification before the selectivity is so great as to cut the side-bands. With transformer step-ups of the order of 2 : 1 for broadcast waves, or up to 4 : 1 for longer waves, it will be found that valves with R_a of 10,000 to 20,000 are usually most suitable, and the more μ the merrier.

Voltage Amplifiers.

In stages where one endeavours, as in Fig. 4, to insert in the anode circuit such an impedance that the passage of the varying anode current in it sets up a voltage across it which is passed on direct to the next valve, the amplification of the stage can never be quite as much as that of the valve itself. Hence there is a natural inclination to make μ as high as possible. The value of G_m falls off for valves of very high μ, but this does not have such an important effect with this type of coupling, though it must not by any means be neglected.

These couplings fall into two sub-classes: resistance couplings, where the anode impedance absorbs the D.C. supply to the valve as well as the A.C. output from it; and other types such as choke and tuned anode, where the D.C. supply is practically unaffected. Each has its own difficulties.

In the case of resistance couplings, there is the perennial difficulty that if the resistance is low compared with R_a the amplification is low (Fig. 5 shows how the stage amplification compares with μ for various ratios of the resistance to R_a), while if the reverse is the case very little of the H.T. voltage gets to the valve, and there is every prospect that the latter will be worked on the bottom bend of its curve.

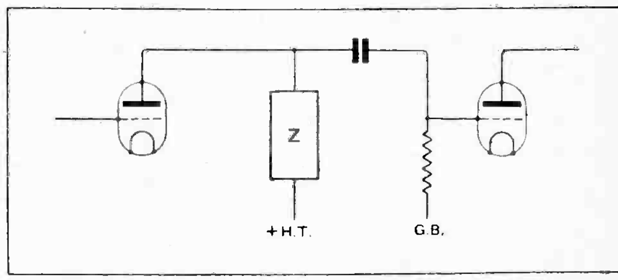


Fig. 4.—Schematic connections of impedance coupling between valves.

As practical advice, I suggest that you adopt one of the two extremes: either arrange, by fairly high H.T. and lowish coupling resistance, that the valve is working on its "straight," or on the other hand use a very high coupling resistance, when it will be found that (although the valve is working on a curved part of its characteristic) the resulting distortion is negligible.

If you decide on the first alternative, use a valve of R_a 20,000 to 40,000 and μ about 20, make the coupling resistance between 1 and 2 times the R_a, and use at least 120 volts, preferably 150-200. In the second case use a valve of R_a 50,000 to 100,000 and μ 30-50, with coupling resistance 0.5 to 1 megohm. In the first case, use a *wire-wound* resistance. In the second this is probably

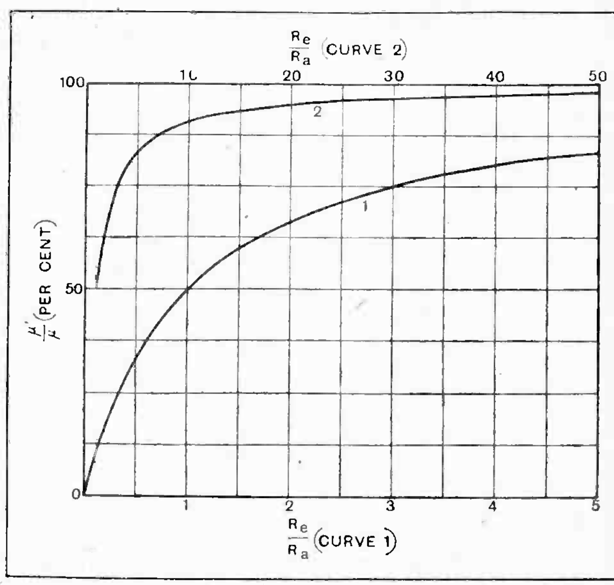


Fig. 5.—Curves showing the relation between the amplification per stage in a resistance-coupled amplifier and the ratio between the external anode resistance and the A.C. resistance of the valve. R_e = external anode resistance; R_a = A.C. resistance of valve; μ' = amplification per stage; μ = valve amplification factor.

Choosing the Right Valve.—
impracticable, so do not use a valve having a lower R_a than that suggested, because anode resistances which are not wire-wound will stand only very low currents.

Do not forget that with the low resistances you should use, say, 0.1 or 0.25 mfd. coupling condenser and 0.25 or 0.1 megohm leak; while with the high resistance you should use 0.01 or 0.005 condenser and a 3 to 5 megohm leak. The low resistance will give the purer tone; the high, of course, more amplification.

With L.F. choke coupling the difficulty is that as far as its coupling properties are concerned, the choke behaves like a resistance which varies with frequency. At the higher audio frequencies it will give a stage amplification of practically the μ of the valve, so that for good results it must be made big enough to give this amplification at the lowest frequency the loud-speaker can deal with.

Working it out numerically I find that if one allows a drop of 50 per cent., 30 per cent., or 10 per cent. in the amplification of the lowest frequency that is to be dealt with, one has the following figures, depending on the type of loud-speaker :—

	50%	30%	10%
Rice-Kellog	300	200	100
Kone ...	500	300	150
Horn ...	2,500	1,600	800

These figures are the ratio R_a/L: *i.e.*, slope resistance of valve over inductance of choke; and they are based on the assumptions that the amplifier must go down to 32 cycles for the Rice-Kellog, 50 cycles for the Kone, or 250 cycles for an ordinary horn speaker.

The figures are for *one stage*. If you want to use more stages, remember that you will get these losses in each stage.

Just as an example: if one wants to work a Kone from two choke-coupled stages, with 30 per cent. drop overall, and the chokes have been bought as 80 henries each, one must work for about 15 per cent. drop per stage, or, say, $R_a/L=220$, or $R_a=220\times 80=17,600$. This is the *highest* safe value of R_a: a lower one will give a better performance.

It is obvious that for first-class results very large chokes are necessary. Remember to get them guaranteed to have their rated inductance *with the steady anode current*. In a badly designed choke this may cut the inductance to only a tenth of its rated value.

Selectivity is the chief aim as a rule when designing tuned anode couplings; *i.e.*, one does not want uniform amplification, as in L.F. work. You will already have gathered that for even amplification valves of low R_a are always easier to find couplings for. By the same token, valves of high R_a always give increased selectivity for H.F.

Hence, for single H.F. stages use valves of high R_a (and high μ). The limit will be found in stability. It is only a well-arranged non-neutralised stage that will stand valves above 20 in μ.

For neutralised amplifiers one may go up to 30, but beware of getting too selective and cutting the side-bands. There is especial liability to this on longer waves and in supersonics, and in the latter case a μ of 15 is about the limit as a rule.

Remember that both dimming the filament and decreasing H.T. (or increasing the bias) tend to increase R_a. This may be useful.

Grid Detector.

The trouble here is that the essential factor of quality is one that is hard to measure and is never given by makers. However, if they give curves of grid current against grid volts one can make a guess: efficient grid rectification depends on having a sharp bend to the grid current curve. Efficient *use* of the rectified current is a matter of the μ of the rectifier; but this is governed by the coupling which follows it, as already explained.

Generally speaking, valves suitable for resistance coupling make the best grid detectors.

Anode Detector.

Here what one wants is a sharp bend at the bottom of the ordinary valve curve, but unfortunately this is usually got with valves of low μ, and thus large values of grid bias are called for, or else a specially low tap on the anode battery.

In any case, the R_a of the valve *under working conditions* will be high, even if the same valve used as amplifier has a low R_a. Hence this valve, like the grid detector, should be followed by resistance coupling, even if transformers are used for later stages.

In choosing the right valve it is a matter of looking at valve curves and picking out one with a sharp bottom bend. Generally speaking, the 2-volt class is the best hunting ground for valves of this type.

Super Power.

When it is desired to fill a ballroom with dance music or to give a demonstration in a room big enough to hold fifty people or more, one immediately requires a power which it is impossible to derive without distortion from the ordinary set. One needs a last stage with, say, 20 watts H.T. input.

If one has A.C. available, it is simplest to get the H.T. by rectifying. In this case one uses, say, 500 volts and puts in 40 mA. If there is only D.C., the labour of getting the necessary batteries makes it easier to use, say, 300 volts, 70 mA.

In each case the valve requirements are rather different from those of ordinary receiving valves. The essentials are: (*a*) safety under high voltage—this means, as a rule, a "bombarded" valve; (*b*) reasonable life—this means special filaments; (*c*) copious emission—this means fairly large filament power; and (*d*) ability to dissipate the H.T. watts without getting too hot.

Hitherto the L.S.5 and L.S.5A have been the British valves *par excellence* for this work. But I believe there are some other valves of this type coming along. The L.S.5 and L.S.5A will safely dissipate 10 watts, so are usually used two or three in parallel.

Power Rectifiers.

For H.T. from mains. Here high power is the main thing. If one is going to the trouble of using the mains the thing should be done properly. No "B" eliminator can be considered really good unless it can deliver at least 25 mA to the set, apart from any current used in an output potentiometer. The rectifier should be able

Choosing the Right Valve.—

to put out at least 45 mA. Here the helium gas tube, with no filament, has some obvious advantages, for a rectifier of the above output will probably take at least 1 amp. at 6 volts for the filament.

Valves for A.C. Filament Feed.

Just one point for those of you who are trying this: the hum comes in two ways. First, there is the fact that each end of the filament is sometimes positive and sometimes negative. Get over this by bringing all grid and anode leads back to a potentiometer. Second, the varying filament current causes varying emission. This can only be decreased by having a thick filament to hold its heat. Hence, apart from the choice of R_a and μ to suit coupling conditions, choose valves whose filaments are low-volt, high-current—such as the Weco (type 125), and similar valves.

Of course, the most obvious development is the use of an indirectly heated cathode. There are now separate cathode valves such as the K.L.1, specially designed for A.C. feed.

Conclusion.

I am afraid that this sketch has been devoted to couplings as much as to valves *per se*; but I hope I have shown that the two subjects are so closely interwoven that one cannot be considered without the other.

TRANSMITTERS' NOTES AND QUERIES.

R.C.A. Wavelengths.

We give below the wavelengths of a few of the experimental stations of the Radio Corporation of America, which will probably be of service to readers wishing to calibrate short-wave receivers :—

2XBC	Rocky Point, N.Y.,	14.1 metres
2XS	,, ,, ,,	14.93 ,,
2XT	,, ,, ,,	16.0 ,,
WLL	,, ,, ,,	16.6 ,,
WIK	New Brunswick, N.J.,	21.5 ,,
WIZ	,, ,, ,,	43.5 ,,

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Belgian Amateurs.

In view of the recent issue of Transmitting Licences to Belgian amateurs, it will probably interest our readers to know the names of the executive officers of the Réseau Belge—the Belgian section of the I.A.R.U.—whose headquarters are at Rue du Congrès 11, Brussels.

President, M. Paul le Neck, EB 4UU (ex U3).

Secretary-Treasurer, M. Marcel Ocreman, EB 4FU (ex Z8).

Traffic Manager, M. Georges Nulemans, EB 4FT (ex O8).

Technical Manager, M. Joseph Mussche, EB 4BT (ex C2).

Members of the Council, M. Robert Deloor, EB 4SA (ex P2), M. Léon Hunnincks (ex U2).

QSL Section, M. A. John, 88, Bd. Lambermont, Brussels.

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The "Club des 4" is conducting a regular series of tests to investigate the problem of "fading," and ask for the collaboration of all licensed transmitters, especially those working on low power.

The particular points to be noted are the period of recurrence and the influence of atmospheric conditions. M. G. Van den Eynde (EB 4GO), 22, Rue du Remorqueur, Brussels, is the Hon. Secretary in charge of these tests and will furnish full particulars to those wishing to participate.

Amateur listeners who are interested in the various short-wave tests conducted by the club should communicate with M. P. E. Leveque, 52, Avenue de Brouchère, Anderghem.

A series of calibrated waves will be transmitted during March and April from EB 4AI and EB 4AR at the following times :—Saturday, from 1530 to 1542 G.M.T. on 145 metres, from 1555 to 1607 on 135 metres, from 1620 to 1632 on 105 metres, and from 1645 to 1657 on 95 metres; Sunday, from 1005 to 1017 on 47 metres, and from 1030 to 1042 on 43 metres; Wednesday, from 2245 to 2257 on 20 metres. The signals will consist of an ordinary test for eight minutes, followed by a series of five-second dashes for three minutes, then a one-minute test and a notification of the wavelength—*e.g.*, "Ici 145 metres" for three minutes. These transmissions will be directed by Lieut. Vanhay, Rue Braent 122, Brussels.

The "Club des 4" will welcome any contributions in the form of books of reference for their library, which may be forwarded to M. R. Destrée, 38, rue de Suède, St. Gilles, Brussels.

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I.F.S. Transmitters.

We are asked to state that QSL cards for transmitters in the Irish Free State should be addressed to the Irish Radio Transmitters' Society, Solent Villa, Kimmage Road, Trenure, Co. Dublin. A mutual arrangement has been made (as stated in our issue of March 16th) between the I.R.F.S. and the Radio Transmitters' Union of Northern Ireland, whereby QSL cards sent either to Dublin or Belfast will be forwarded to amateurs in Northern Ireland and the Irish Free State, as required.

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Norwegian Whalers Returning.

A considerable number of our readers have heard signals from AQE, and it may be of interest to note that the Norwegian whalers, *Sir James Clark Ross* (AQE) and *Nielsen Alonso* (ARCX), are now on their way from the Antarctic, bound for Europe.

Mr. J. Diesen (LA 1A), Moen i Maalselv, Tromsö, to whom we are indebted for this information, tells us that on March 5th he was in two-way communication, at 8.45 G.M.T., on a wavelength of 32 metres, with the whaler *C. A. Larsen* (ARDI), in the Antarctic, using an input of about 5 watts. Signals from ARDI were about R6-7 on a two-valve receiver. The whaler at the time was about 70° 30′ S., 176° 10′ E., almost exactly antipodean to Mr. Diesen's station, which is situate about 69° 10′ N., 18° 30′ E. It is suggested that when the waves have passed the equatorial circle of the station the intensity of the signals increases, and reaches a maximum when the Antipodes is reached.

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Two-way Working with the Pacific Coast.

Mr. M. E. J. Samuel (G 5HS), 16, Blenheim Road, London, N.W.8, informs us that at 1915 G.M.T. on March 26th he succeeded in establishing two-way communication with U 7EK, of Everett, Washington, on a wavelength of 22.8 metres. The input was about 120 watts, and 7EK reported signal strength as R3, while his were received at R3-4. The Pacific Coast is always considered one of the most difficult places with which to establish communication with Great Britain.

G 5HS was also in touch with U 6ZAT, of Los Gatos, California, on December 12th, 1926, at 1805 G.M.T. This is believed to be the first case of European two-way working with that district on the 20 metre waveband. The transmission was also heard in Southern Rhodesia.

Mr. Samuels finds that, while it is exceedingly difficult to reach the Pacific Coast by the dark path on the 45 or 32 metre wavebands, it seems comparatively easy on about 20 metres via the daylight path. He attributes the difficulty of communicating with the Pacific Coast to the shielding effect of the great mountain ranges, and suggests that the 20 metre waves come down from the Heaviside layer at a steeper angle than those of greater length.

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New Call-signs Allotted and Stations Identified.

G 5CG and G 6PX D. Shannon, Gothic Cottage, Four Oaks Rd., Four Oaks, Birmingham. (Change of address.)

G 610 T. Woodhouse, 31, Tresco Rd., Peckham Rye, S.E.15.

2 APW A. D. Narraway, The School House, Dorrington, nr. Shrewsbury.

2 BLX J. W. Tyrrell, 14, Boundary Rd., Ramsgate.

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QRAs Wanted.

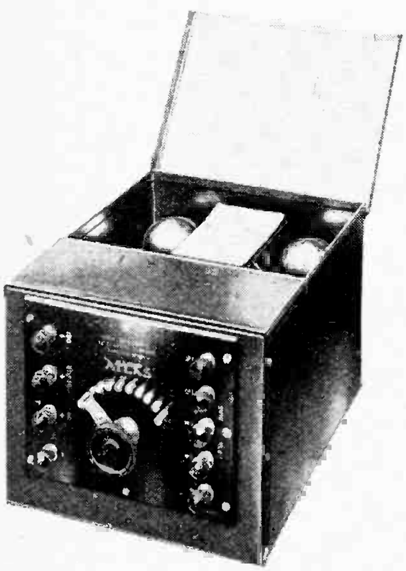
A 6WA, AR 8LHA, C 3AEL, C 3WAB, CS 2YD, EP 1AL, FQPM, NU 2BS, NU 7DBE, O 8RA, WAA, XO.

NEW APPARATUS

The Manufacturers' Latest Products.

ATLAS A.C. BATTERY ELIMINATOR.

There is considerable latitude with regard to the equipment which may be provided in a battery eliminator for obtaining ample output and liberal smoothing. The only form of battery eliminator which should be tolerated is one in which economy has not been the foremost consideration in the design. The dimensions of the transformer, as well as the capacity of the smoothing condensers and current-carrying capacity and inductance of the smoothing chokes should be liberal.



Atlas battery eliminator for use with A.C. supply. Full-wave rectification is provided, and grid biassing potentials are obtained as well as a high anode voltage suitable for operating a power amplifying stage.

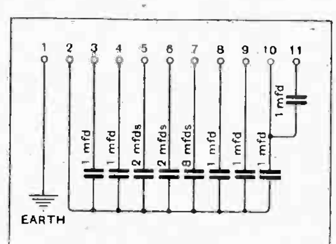
All these points have received careful attention in the A.C. eliminator of H. Clarke & Co. (Manchester), Ltd., Atlas Works, Old Trafford, Manchester, which is a full-wave rectifier in which provision has been made for using either two half-way rectifying valves to provide full-wave rectification, or a single full-wave rectifier may be inserted in one of the valve-holders.

The apparatus is housed in an iron case to which an ebonite panel is fitted carrying the potential controlling switch and the various output terminals. Three outputs for H.T. supply are provided, the approximate voltages developed being 60, 150, and a variable potential range between 20 and 150. A multi-contact switch arranged as a potential divider gives the adjustable voltage.

The eliminator (model A.C.2) is rated as being suitable for use on supply voltages between 200 and 250 at frequencies from 30 to 120. Connected to a 240, 50 cycle supply, the potential developed at the output terminals, which depends, of course, largely on the load, was found to be 250 when bridged with a shunt circuit passing 10 mA. The maximum voltage on a 25 mA. load was found to be 180 volts, while the stated voltage output of 150 was obtained when the total load was adjusted to 28mA. The variable voltage terminal is adjustable in stages of 20 volts when the current taken from the eliminator is 5 mA.

The inclusion of terminals for giving grid biassing potentials is a useful feature, particularly when power valves are used with the high anode potential which is obtainable. Terminals are fitted marked −4, −8, −12, and −16 volts. These potentials were found to be practically correct when the rectifier was on open circuit. With a 5mA. load, however, on the H.T. supply the biassing potential advanced in the case of the first 4-volt section to −5.2 volts, with proportional increases on the other tappings.

The eliminator is quite suitable for operating a multi-valve receiver, including both high and low frequency amplifying stages, and the high anode and biassing potentials which can be obtained render it suitable for use with a power amplifying stage where these potentials are essential in order to obtain good quality. The addition of the variable voltage control greatly adds to the usefulness of the eliminator, though the adjustment moves in rather large steps.



Internal connections of the Hydra bank of condensers.

Biassing potentials for H.F. or anode bend detecting valves should be obtained from separate cells.

Tested on the full load of 28 mA., and operating a four-valve set comprising two L.F. stages, there was an entire absence of hum when using two Mullard DU5 valves as rectifiers.

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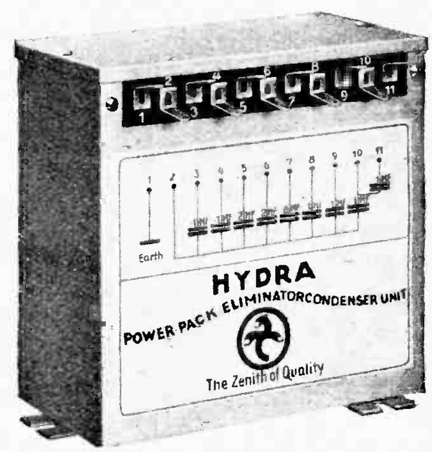
BATTERY ELIMINATOR CONDENSER.

To combine in one unit all of the condensers required in a battery eliminator is a good feature, for apart from the convenience of wiring, much less space is occupied.



Sectional condenser unit for use in the construction of an A.C. battery eliminator.

A bank of Hydra condensers (Louis Holzman, 109, Kingsway, London, W.C.2) is now supplied in a convenient form incorporating nine separate capacities graduated in value and breakdown voltage according to the position they would occupy in the circuit of an eliminator.

The diagram shows the connections of the section within a unit which should prove useful for the construction of almost any form of battery eliminator. Two sections of 0.1 mfd. are rated to withstand 1,500 volts. Two sections of 2 mfds. together with an 8 mfds. section are rated at 500 volts, the test potentials presenting the peak voltage on A.C. supply. The four remaining sections are rated as suitable for use at a D.C. potential of 500 volts.

Tests were applied to the section at 50 per cent. over the rated voltages without breakdown. Wiring would be simplified were the connecting tags near the base of the unit instead of at the top.

CURRENT TOPICS

News of the Week in Brief Review

WORLD RADIO CONFERENCE.

Germany is to be represented at the international radio conference to be held at Washington in the early autumn.

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THE TREACHEROUS SCILLIES.

Work is nearing completion in the erection of a wireless beacon on Round Island, one of the Isles of Scilly. When in operation the beacon will send out continuous signals capable of being picked up at a range of 500 miles.

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AN IMAGINATIVE CONTEMPORARY.

Under the title "New Terror to Travel," a contemporary describes the use of a portable wireless set on a train journey from Paddington to Gloucester. Considering that the set operated headphones only and could be switched on or off at will, we fail to see where the "terror" comes in.

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***LEVIATHAN'S* ATLANTIC 'PHONE CALL.**

The Atlantic wireless telephone service was employed for the first time on board ship last week, when Mr. Joseph E. Sheedy, European director of the Merchant Fleet Corporation, at a luncheon aboard the *Leviathan* at Southampton, exchanged greetings with the manager of the company in New York. The luncheon, attended by a large gathering, was in honour of the liner's fifty-first crossing of the Atlantic since being acquired by the American merchant marine.

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PORTABLE SETS IN AUSTRIA.

Readers whose travels take them to Austria this year will be interested to learn that foreign visitors taking wireless receiving sets into the country are not required to pay the usual licence fee of 2s. per month, but a special fee of 1s. per month, provided their stay does not exceed three months. An application form can be secured at any post office, and on entry into the country foreigners must deposit a given sum for Customs purposes to cover the set, which is reimbursed on leaving the country.

The saving of 1s. a month may not be of vital importance to people who can afford the fare to Austria, but the concession will be recognised as a friendly one.

MANY HAPPY RETURNS.

Senatore Marconi has just celebrated his fifty-third birthday.

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A WELSH DELINQUENT.

A Government official at Llanelly has been fined £2 for using a wireless receiver without a licence. This is believed to be the first wireless "piracy" prosecution in Wales.

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THE WIRELESS PIANO.

A private company has been formed, known as Wireless Piano Players, Ltd., for the purpose of acquiring and exploiting an invention for the electro-magnetic reproduction of wireless reception by pianos and similar instruments.

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HEEDED WARNINGS.

The chairman of the Bromley (Kent) magistrates states that the warnings issued from the bench in regard to the illicit use of wireless receiving apparatus have had a good effect. No increase in the usual fine of 10s. seems necessary.

DR. J. A. FLEMING.

Dr. J. A. Fleming, the famous wireless engineer, has been appointed president of the Victoria Institute or Philosophical Society of Great Britain.

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GERMANS TO BUILD SIAMESE STATION.

The German Telefunken Company has secured the contract for the erection of a new wireless station at Bangkok, Siam. English and French companies put forward quotations, but the German firm's quotation of an inclusive charge of £25,000 was considerably lower than that of the nearest competitor.

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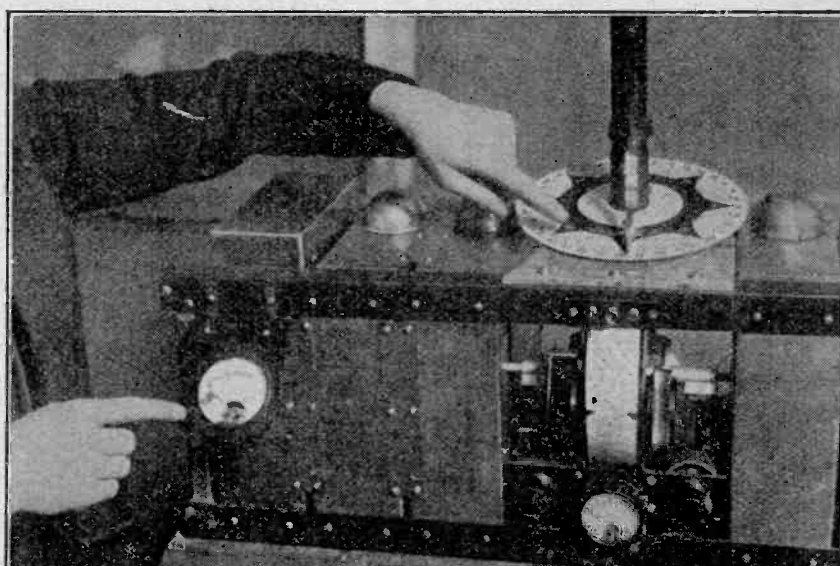
MUSIC ON A ZEPPELIN.

In the new Zeppelin airship now under construction at Friedrichschafen, says a Zurich correspondent, broadcast receivers will be installed so that passengers can listen to European and American programmes. The airship is intended for journeys between Spain and the Argentine.



SIMPLIFIED DIRECTION FINDING. A close-up view of a D.F. installation which is being installed on forty-four steamers patrolling the Great Lakes in America. The dial shown at the base of the frame aerial, indicates the direction of a transmitter, while the milliammeter gives a clue to its distance. The apparatus will be invaluable for locating vessels in fog.

WHEN LONDON SCHOOLS MAY LISTEN.

Wireless receiving apparatus has been installed in 100 London schools, says a report issued by the Elementary Education Sub-Committee of the London County Council. It has been decided to permit schools to listen on Friday afternoons from 3 o'clock onwards, subject to certain conditions. These conditions include approval of the programme and the correlation of the wireless lessons with the rest of the school work.

As the Sub-Committee consider that good reception is of paramount importance, arrangements have been made for the testing of the sets by B.B.C. engineers.

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IS YOUR MEDAL WAITING?

The Air Ministry announces that the British War and Victory Medals of a large number of ex-officers and ex-airmen of the Royal Air Force still remain to be issued, despite the efforts made to distribute them by sending communications to the latest known addresses of all those concerned.

Applications from ex-Service *personnel* entitled to medals should be addressed by ex-officers to the Secretary, Air Ministry, Adastral House, Kingsway, W.C.2, and by ex-airmen to the Officer-in-Charge, R.A.F. Record Office, Ruislip, Uxbridge, Middlesex.

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CANADA AND THE U.S. RADIO COMMISSION.

A knotty problem is facing the United States Federal Radio Commission with regard to the wavelengths employed by Canadian broadcasting stations. The Commission has work enough ahead in satisfying the claims of the hundreds of American stations which would each like an exclusive wavelength, but it is now realised that Canada, as sovereign in her own field, can employ wavelengths which may bring confusion to the most carefully laid plans.

The desire of the Canadian Government is for a treaty guaranteeing the undisturbed use of certain wavelengths, but no settlement can be reached until the reassembly of Congress. Meanwhile a working arrangement must be discovered.

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ADDRESSES, PLEASE!

In connection with their announcements in our advertisement columns,

EASTER HOLIDAYS AND SMALL ADVERTISEMENTS.

On account of the Easter Holidays the Small Advertisement Section in the issue of April 20th will close earlier than usual. Copy should reach the Advertisement Manager not later than April 12th.

Messrs. J. H. Corbett, of 1, Railway Approach, Lewisham, S.E., state that in several cases replies have been received from persons who have omitted to give their address. They would be glad if correspondents who have not received acknowledgments would write again.

WIRELESS AT WESTMINSTER.

BY OUR PARLIAMENTARY CORRESPONDENT.

B.B.C. Income.

In the House of Commons last week Lieut.-Commander Kenworthy asked the Postmaster-General why the British Broadcasting Corporation was to receive £50,000 in revenue less this year than last year; and how many wireless-listening licences were in force this year as compared with last.

Sir William Mitchell-Thomson said that the amount paid to the British Broadcasting Company last year covered not only the revenue for the service but also the sum required for the repayment of the company's share capital and the expense of winding up the company. The revenue of the British Broadcasting Corporation during the financial year 1927-28 would be substantially greater than the revenue of the company for the conduct of the service during the year 1926.

The number of licences in force on February 28th, 1926, was about 1,906,000, and the number in force on February 28th, 1927, was about 2,235,000, in addition to about 4,400 free licences for blind persons.

Regional Station Experiments.

Sir W. Mitchell-Thomson informed Mr. Day that the British Broadcasting Corporation had stated that they proposed to carry out experiments at Daventry at an early date, and when those had been completed they might be in a position to submit proposals for the establishment of regional high-power stations.

Post Office Wireless Cars.

Viscount Wolmer informed Sir H. Brittain that the use of motor cars for the detection of oscillation was at present in the experimental stage. The question of increasing their number would be considered if experience showed that the results were likely to justify the expense involved.

THE BRITISH WIRELESS DINNER CLUB. Air-Commodore L. F. Blandy presided at the dinner of the British Wireless Dinner Club, held at the Trocadero Restaurant on Saturday, March 26th, the principal guests being Sir Ernest Rutherford and Sir Evelyn Murray, Secretary to the General Post Office. A number of well-known personalities in wireless circles will be recognised in the photograph.

HOW TO TEST YOUR VALVES.

Design and Construction of a Simple Test Board.

By W. JAMES.

A VALVE testing board is one of the most useful pieces of apparatus that anyone taking a serious interest in the subject of valves and receiving circuits can possess. Valves vary enormously in characteristics; even individual valves of the same series differ among themselves to an extent sufficient to produce noticeable effects in reception. Normally the makers, or their publicity departments, supply characteristic curves and data relating to their valves, but it has to be remembered that this information applies to an average valve of each type and may be a very different thing from the specimen secured by a user. Further, the information does not always relate to the valves as used under normal conditions; anode A.C. resistance, in particular, varies considerably with the effective voltage acting to produce anode current. Consequently a comparison of the maker's figures will not, of necessity, serve to indicate the relative merits of the various valves; in fact, comparisons of makers' figures are not satisfactory unless complete data are available. That this is true is generally admitted by those competent to form an opinion; hence it is of primary importance for those interested in the design of receivers very carefully to attend to this question of a valve's characteristics under working conditions.

Taking Characteristics.

Static characteristic curves, fortunately, can easily be obtained. The illustrations here show a simple testing board which has been used by the writer for a considerable time. A feature which may appeal to the reader is that the four meters shown on the board can be removed by undoing the connections and sliding the instrument forward. The connecting wires are of stranded conductor provided with large connecting tags, and the wires are passed through holes in the board, so that even when the wires are removed from the instrument terminals they remain in position ready to be reconnected again. Instruments of the Weston Electrical Co. are used, and have the following ranges :—

Grid Voltmeter.—0 – 2.5 – 10 – 25 volts.

Anode Voltmeter.—0 – 75 – 300 volts.

Filament Voltmeter.—0 – 7.5 volts.

Filament Ammeter.—0 – 0.1 – 1 – 10 amperes.

For the grid circuit a microammeter having a full scale reading of 50 microamperes is used, while anode current is read on a Weston Sub-Standard Ammeter, 0 – 5 – 50 milliamperes.

The latter instruments are so often used for other work that they are not fixed in any way to the board.

The average amateur will probably not require the two filament meters, since the maker's filament ratings are usually reliable, and filament voltage can be read on the meter normally used in the

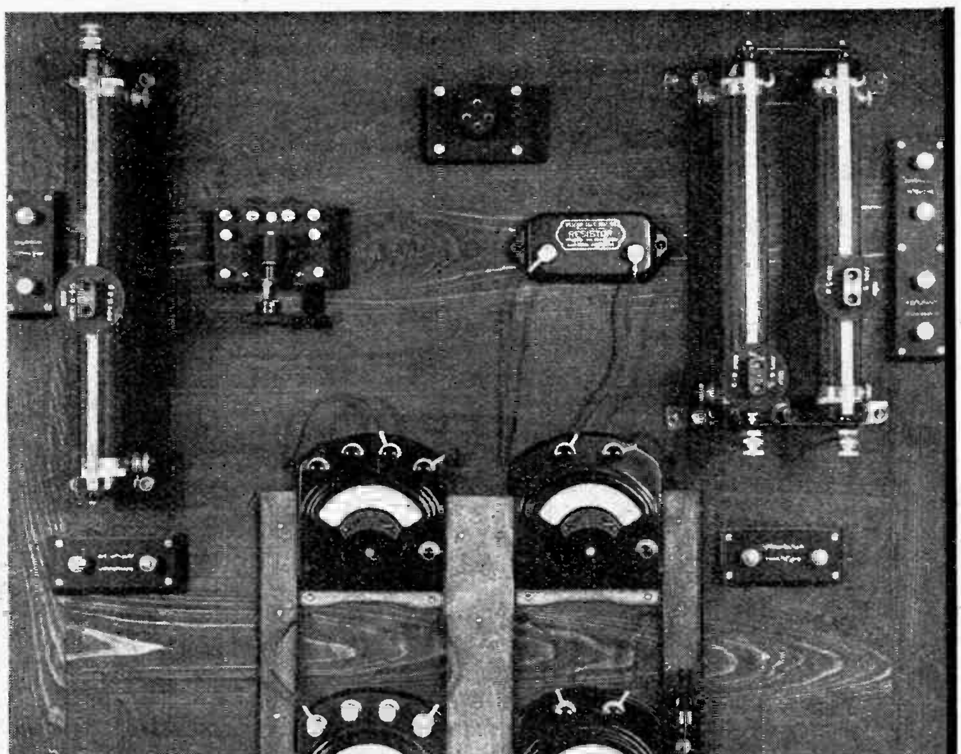

Fig. 1.—The complete valve testing board. All batteries are connected to terminals, as are the grid and anode ammeters.

How to Test Your Valves.—grid circuit. A further item included on the board is a 2-pole change-over switch; this merely transfers the polarity of the grid bias. With the switch in one position a negative voltage is applied to the grid, while a positive bias is given by throwing over the switch. The magnitude of the voltage applied depends on the battery connected to the grid bias terminals and to the setting of the potentiometer. A potentiometer having a resistance of about 1,000 ohms is suitable.

On the right-hand side of the board are two resistances; one has a fairly high value of resistance and the other a low resistance, the combination being such that the filament voltage can be carefully set at a given figure.

Another item of interest is the single-pole change-over switch mounted on the strip of wood by the side of the

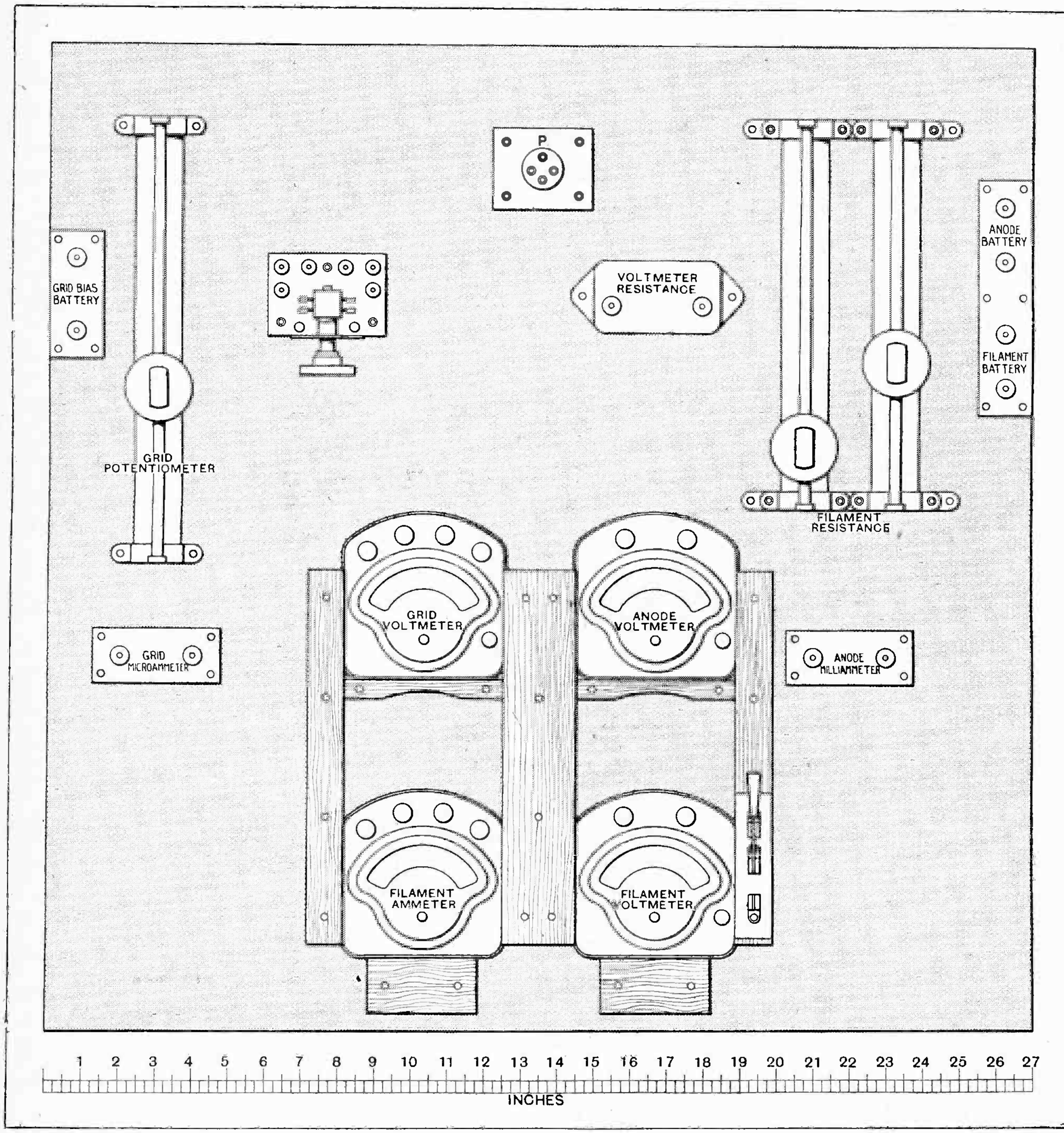

Fig. 2.—Scale drawing of the test board. Battens are fitted to raise the under surface an inch or so above the table, and all terminals are mounted on ebonite raised above the board by spacers.

How to Test Your Valves.—

filament voltmeter. This merely serves to connect the voltmeter across the filament of the valve or across the valve and filament ammeter in series.

The usual static characteristic curves are easily obtained in the following manner. A valve is put in the socket, its filament voltage being adjusted to the working value. A given anode voltage is applied and readings of anode current for various grid voltages taken. This is repeated for a number of anode voltages, and the results are plotted to give curves after the style of those given in Figs. 5 and 6. Two valves were chosen and tested for the purpose of illustration, one being of the type having a moderate amplification factor and A.C. resistance, while the other has a much lower amplification factor and A.C. resistance. Naturally the valve with the lowest A.C. resistance has the greater anode current for given grid and anode voltages.

To find the approximate amplification factor we have to set the anode voltage at a given value, say 120, and the grid bias to a value such as might be used under working conditions. The anode current should be noted. Now the anode voltage is reduced by, say, 10 volts, and the anode current is again noted. Next the grid bias is changed to restore the anode current to its former value.

From the figures obtained the approximate amplification factor can easily be found, as it is given by the change in anode voltage divided by the change in grid bias. For the anode A.C. resistance we divide the change in anode voltage by the change of anode current.

Details of the characteristics of the two valves tested by way of example are given below the figures. Anode A.C. resistance, and to a certain extent the amplification factor, is found to vary with the anode voltage, grid bias, and filament voltage. To reduce the anode A.C. resistance it is necessary only to raise the anode voltage,

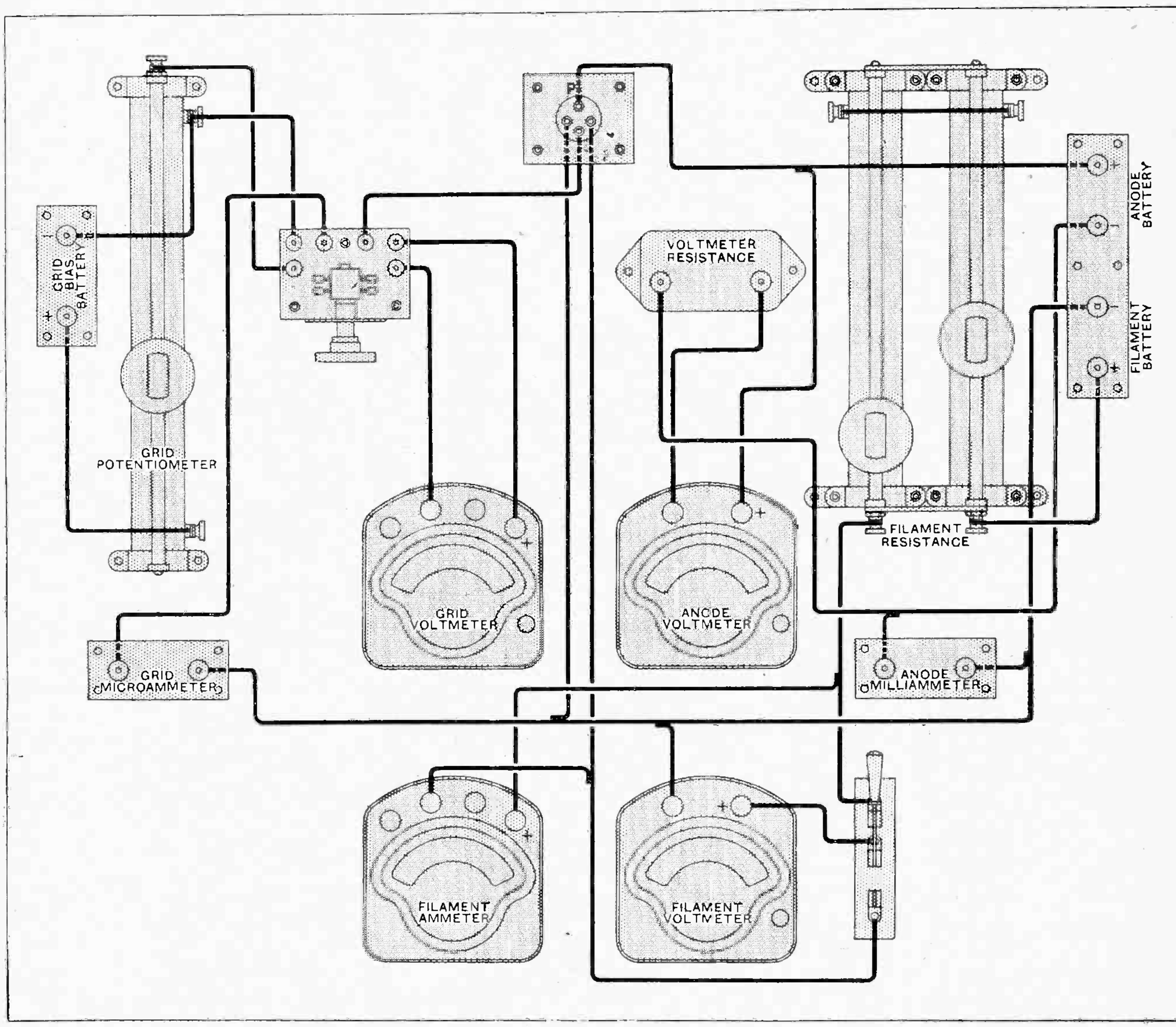

Fig. 3.—Wiring diagram. Most of the wires are run below the board and are brought through holes at the instrument terminals.

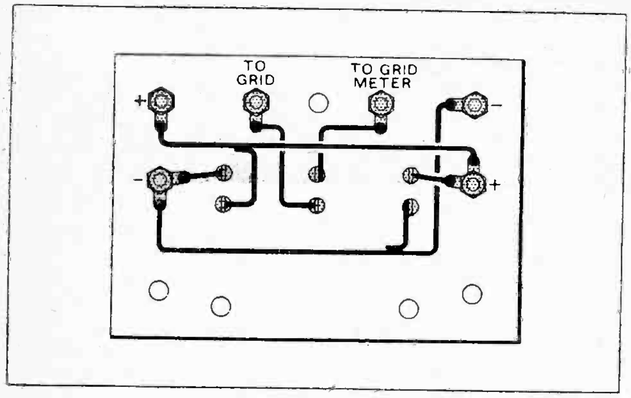

Fig. 4.—Wiring of the under side of the two-pole change-over switch.

reduce the negative grid bias, or to increase the filament current (if this is below normal). It follows therefore that the anode A.C. resistance can be increased by reducing the anode voltage or the filament current, or by increasing the negative grid bias. These statements can easily be verified by anyone having a valve testing board, and a realisation of them will enable the best results to

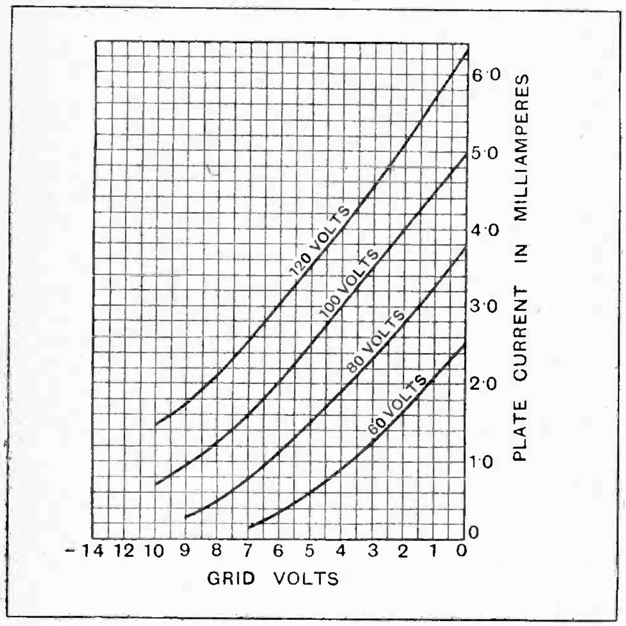

Fig. 5.—Curves of a typical 2-volt valve; the amplification factor and anode A.C. resistance are 9.1 and 17,000 ohms respectively for an anode voltage of around 120 and a grid bias of negative 4.5.

be obtained from a receiver the characteristics of which are known.

It will have been noticed that the amplification factor and anode A.C. resistance found by the above method is not, strictly speaking, for the anode voltage of 120, since the anode voltage was reduced to 110 volts as part of the test, but the results are sufficiently accurate for most purposes. This can be tested by finding the value when the anode voltage is raised from 120 to 130 volts.

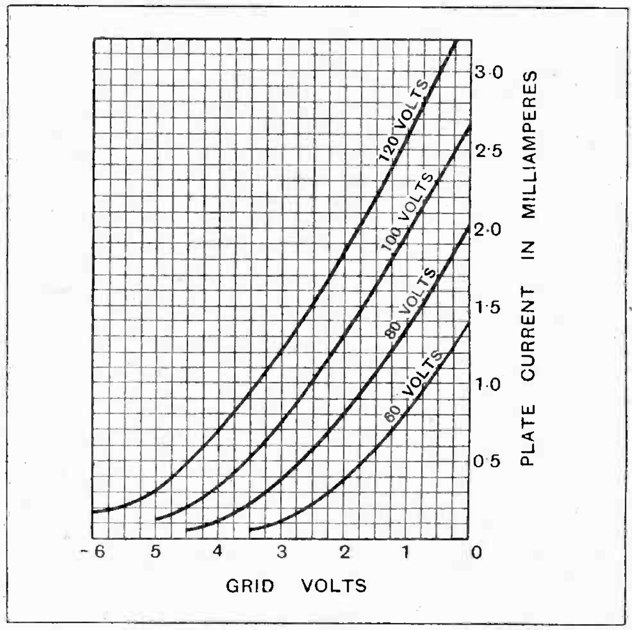

Fig. 6.—Curves of a 2-volt valve having a fairly high anode A.C. resistance. The actual amplification factor and anode A.C. resistance were found to be 25 and 37,000 ohms respectively for an anode voltage of around 120 and a grid bias of negative 1.5.

The characteristic curves shown in Figs. 5 and 6 are applicable under the conditions of the test only, that is, with no load in the anode or grid circuits. When a load such as a resistance is connected in the anode circuit the anode voltage, as distinct from the voltage of the anode battery, will vary with the voltage applied to the grid in such a way that a curve drawn to show the relation between battery volts and anode current will extend more to the left of the zero grid voltage line than an ordinary characteristic curve taken with no load in the anode circuit. Such a curve will be straight over a greater part of its length than the static curve, and its length will depend on the value of the anode resistance as well as the battery voltage.

Catalogues Received.

A. F. Bulgin and Co. (9, 10 and 11, Cursitor Street, Chancery Lane, E.C.4). Lists Nos. 110, 111 and 112, dealing with *Deckorem* and *Competa* Radio Products and *Competa* Measuring Instruments.

Chloride Electrical Storage Co., Ltd., Clifton Junction, near Manchester. Folder No. 5008, dealing with *Exide* "Mass" Type batteries for long, slow discharges. Folder No. 5009, relating to *Exide* WH and WJ special "Mass" type batteries.

J. R. Morris, Imperial House, 15-19, Kingsway, London, W.C.2. Folder dealing with *Columbia* dry batteries for wireless use, including the *Layerbilt* No. 4486 for heavy duty with neutrodyne and multi-valve sets.

London Electrical Co., 1, Sherborne Lane, King William Street, London, E.C.4. Eighty-page catalogue of high-class proprietary radio components. Leaflet describing the "Lecodyne" Receivers.

R.I. Instruments, Ltd., 12, Hyde Street, New Oxford Street, London, W.C.1. Leaflet dealing with the R.I. Power Transformer designed for operating K.L.1 Type valves from A.C. Mains.

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.

A Society in Lancaster.

The radio club in connection with the Storey Institute, Lancaster, has entered into a new era of activity, and its meetings now include debates, lectures, demonstrations and morse instruction. The subject of an interesting debate on Saturday, March 12th, was "Wireless *v.* Gramophone." All wireless enthusiasts in the district are cordially invited to communicate with the hon. secretary, Mr. W. Salt, 5, Coverdale Road, Lancaster. Experts and beginners are equally welcome.

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New Society in Huddersfield.

The first general meeting of the Huddersfield New Radio Society was held on March 21st at the Central Lads' Club, Ramsden Street, Huddersfield. Applications for membership are welcomed and should be forwarded to the hon. secretary, Mr. Frank Simpson, 39, Victory Avenue, Paddock, Huddersfield. The entrance fee is 1s. and the annual subscription 2s. 6d.

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A Survey of Science.

The Golders Green and Hendon Radio Society departed from the usual channels of discussion when on a recent evening they welcomed as lecturer Mr. G. G. Blake, M.I.E.E., who took his audience on an imaginary "Journey into the World of Science." Mr. Blake dealt with a wide range of subjects, touching upon the Einstein Theory and the construction of the atom, ether waves, radiant heat, and lines of force. He concluded with a short history of Clark Maxwell's theory of light. Of special interest was an analogy of a wireless circuit where the batteries were replaced by pumps and the wires by water pipes; the flow of energy was clearly demonstrated.

The Society will hold the third dance of the season in the club ballroom on April 27th at 8 p.m. Dance tickets, price 3s., together with full particulars of future field days, etc., can be obtained from the hon. secretary: Lt.-Col. H. A. Scarlett, D.S.O., 357a, Finchley Road, N.W.3.

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A Year's Work.

Twenty-nine meetings, including two field days and a celebration dinner, was the record of the North Middlesex Wireless Club for 1926, as revealed in the secretary's report at the annual general meeting held on March 16th. The hon. treasurer, Mr. H. A. Crowch, presented a very creditable balance-sheet showing a slight increase over the balance of last year. Mr. Gartland gave an explanation of the Club's Instrument Loaning Scheme, while a short account of the work of the Club Library was given by Mr. F. C. March.

As a result of elections which took place towards the conclusion of the meeting all the officers were re-elected for another year.

Hon. secretary: Mr. H. A. Green, 100, Pellatt Grove, Wood Green, N.22.

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Irish Transmitters.

The Irish Radio Transmitters' Society held a business meeting on March 15th, when Col. M. J. C. Dennis, C.B. (GW-11B) was elected president, while Messrs. J. J. Dowling and Eric Megaw were elected vice-presidents, and numerous other officers were appointed. The committee is now arranging lectures, demonstrations and morse classes.

Hon. secretary: Mr. Cyril Fagan, 2, Upper Leeson Street, Dublin.

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A New Hornless Loud-speaker.

Mr. Maurice Child demonstrated a new moving coil loud-speaker, constructed by himself, at the March meeting of the Kensington Radio Society. Instead of a horn Mr. Child used a baffle board of three-ply wood, and on testing it showed no special resonance peaks, as did two loud-speakers of the horn type which were put to the same test.

The occasion was very unfavourable, the evening being devoted to a simultaneous land-line broadcast, but members heard enough to convince them that, especially on the lower notes, Mr. Child had succeeded in making considerable improvements on the average commercial type of loud-speaker.

Hon. secretary: Mr. G. T. Hoyes, 29, Upper Phillimore Place, W.8.

oooo

A Long-wave Receiver.

Of particular interest to long-distance enthusiasts was the lecture given at the Tottenham Wireless Society's last meeting by Mr. F. E. R. Neale. The lecturer demonstrated a long-distance receiver, specially constructed by him for use on wavelengths over 900 metres. Up to five valves were used, and the lecturer showed that with this equipment he had all the long-wave continental stations at his command. With the aid of two tone controls Mr. Neale showed how comfortable loud-speaker strength could be obtained from most stations. Owing to the fact that none of the three H.F. tuned circuits was highly selective, tuning in was simple, and yet the all-round selectivity was sufficient for general purposes. In the course of the lecture, mention was made of the system of neutrodyning employed by Mr. W. James in his well-known receivers, and it was shown that stability was maintained over the entire tuning range.

Hon. secretary: Mr. A. G. Tucker, 42, Drayton Road, Tottenham, N.17.

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Wireless Films Displayed.

Films of interest to all wireless enthusiasts were displayed at the Central Hall, Bristol, under the auspices of the Bristol and District Radio Society, on Wednesday, March 16th.

Thanks to the generosity of Messrs. The General Electric Co., Ltd., and Standard Telephones and Cables, a programme was provided which lasted two and a half hours. In the interval the Rt. Hon. the Lord Mayor of Bristol, Mr. E. R. Appleton (director of the Cardiff B.B.C. Station), and the chairman of the society each addressed the meeting, explaining the charitable objects to which the proceeds of the occasion were to be devoted. These were the Lord Mayor's "Wireless for Hospitals" Fund, and the 5WA "Sets for the Sick" Fund.

Hon. secretary: Mr. S. J. Hurley, 46, Cotswold Road, Bedminster, Bristol.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 6th.

Institution of Electrical Engineers, Wireless Section.—At 6 p.m. (Light Refreshments at 5.30). At the Institution, Savoy Place, W.C.2. Lecture: "Battery Eliminators or Appliances for the Operation of Radio Receiving Apparatus by Energy Derived from Electric Supply Mains," by Messrs. P. R. Coursey, B.Sc., and H. Andrewes, B.Sc.

Tottenham Wireless Society.—At 8 p.m. At the Institute, 10, Bruce Grove. Business meeting. Subject: "Summer Programme."

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Lecture: "The Water Analogy," by Mr. J. S. Gillott.

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

THURSDAY, APRIL 7th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way, N.W.11. Auction of Surplus Apparatus. Chairman, Mr. A. J. Bremner, B.Sc.

FRIDAY, APRIL 8th.

Sheffield and District Wireless Society.—At the Dept. of Applied Science, St. George's Square. Lecture by Mr. R. E. Rayner.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Annual general meeting.

MONDAY, APRIL 11th.

Northampton and District Amateur Radio Society.—At 8 p.m. At Cosmo Café, The Drapery. Lecture by Messrs. Shaw and Trusler.

Croydon Wireless and Physical Society.—At 8 p.m. At 128A, George Street. Lecture: "Quartz." by Mr. A. Hinderlich.

Savoy Hill Topicalities: By Our Special Correspondent.

Lord Clarendon on Tour.—"Daventry Junior" and Essential Services.—A Plea from Shetland.—If Summer Comes.—Signals During the Eclipse.—A Soviet Programme.

Histrionics at the Microphone.

Berlin is copying London by opening a school of broadcast dramatic art.

oooo

Lord Clarendon on Tour.

Lord Clarendon, the new chairman of the British Broadcasting Corporation, has paid his first visits to the Cardiff and Manchester stations respectively. He is no stranger at Savoy Hill, where the members of the board meet regularly every fortnight to discuss policy. That his lordship will visit each station in turn, including the relays, is extremely doubtful, nor does the necessity for such a course appear to be very urgent.

oooo

By the Way.

If I am not mistaken, Lord Clarendon is one of the few celebrities associated with broadcasting who have never themselves used the microphone.

oooo

"Only too Happy."

The Soviet Government has issued instructions to "actors, singers *and* musicians" not to accept any supplementary fee for having their performances broadcast.

"Artists, as well as authors," runs the regulation, "should be only too happy to perform the rôle of public educator which the science of wireless telephony allows them to assume."

Now, if the B.B.C. approached the music-hall interests in this tactful fashion . . . !

oooo

Daventry and the Post Office.

Apropos the test transmissions which are shortly to be made from "Daventry Junior," the powers that be are very explicit on the point that these will be of an experimental nature only. While there can be little doubt that the new station will eventually form the first link in the regional chain, the Post Office, it must be remembered, have a veto in the matter.

5XX, with its power of 25 kilowatts, has been tolerated by the authorities simply because, being on a wavelength of 1,600 metres, it has not interfered with essential services. But "Daventry Junior" and the other stations comprising the regional group will work on the ordinary broadcast band. On the assumption (by no means preposterous) that the other regional stations will be situated near London, Cardiff, Manchester and Glasgow, the possibility of interference with ship signals is not unlikely.

Before licensing a regional station the Post Office will assure itself that essential services are not encroached upon.

THAT SPRING FEELING. Broadcast reception on the river has a fascination of its own. The fact is evidently realised by the fair occupant of this up-Thames houseboat.

Wanted—100 per cent. Service.

Heaven forbid a battle royal between the Post Office and the B.B.C. anent the plans which have been so conscientiously developed at Savoy Hill during the past few months. With tact and diplomacy on both sides trouble may be averted, and the B.B.C. may achieve its laudable object of providing a 100 per cent. service throughout the country.

According to estimates at Savoy Hill the present service covers 80 or 85 per cent. of the population.

oooo

A Tragic Petition.

Certain districts are badly served at present, as is shown by the complaints received from time to time at headquarters. Among the benighted areas are the dales of Cumberland, County Donegal, the north of Scotland, and Orkney and Shetland.

Not long ago a tragic petition against ship interference, with forty signatures, was received from Shetland.

oooo

No Complaints.

One of the few spots from which no complaints have been received is Lundy Isle, in the Bristol Channel, but I hear that this apparent contentment is due to the fact that the erstwhile sole inhabitant of that island is either dead or has gone away.

oooo

Return of Rev. H. R. L. Sheppard.

The address during the service which is to be relayed from St. Martin-in-the-Fields on Good Friday evening will be given by the former vicar, Rev. H. R. L. Sheppard. "Dick" Sheppard, listeners will be glad to know, is now much improved in health.

oooo

If Summer Comes.

No doubt the brains of Savoy Hill are already engaged in framing a summer policy. If they are not . . . well, the sooner they are the better.

The type of programme which seems graceful and pleasing in winter can on a day in summer be as flaccid as a pancake. As a suitable summer item a friend suggests that the B.B.C. should take the wireless perambulator round the Tower of London and similar places of interest in company with lecture parties of American tourists.

oooo

Atmosphere.

In "tours" of this description the guide could supply talk and atmosphere, while the Americans could also supply a little of both in the form of a "running commentary."

Thus :—

Guide : This is the Monument, commemorating the Great Fire of London, 1666.

Tourist : Gee, but Ah guess, bo, that fire wouldn't have come off in our li'l old town. We got a Niagara. . . .

oooo

A Peculiar Piano.

A piano built specially for broadcasting purposes has been installed in the studio of the WEBM station, Chicago. The lower tones are specially strengthened, while the middle tones are subdued. The top notes are endowed with additional ring.

oooo

A Fresh Start in Jo'burg.

On April 3rd the Johannesburg broadcasting station, which closed down in ignominous circumstances recently through lack of funds, was taken over by the new African Broadcasting Company, Ltd. This company, which seems to be built on a surer foundation than the previous broadcasting enterprise, is to erect a high power station at Killarney, near Johannesburg, to supersede the present "J.B."

A relay station will then operate at Bloemfontein.

oooo

Signals during Solar Eclipse.

Probably because it will occur at such an abominably unreasonable hour, the eclipse of the sun on June 29th is not likely to form the subject of a running commentary by the B.B.C. The period of totality occurs about 5.25 a.m., and at that time there is a probability that broadcasting stations within and near the shadow, such as Liverpool and Manchester, will transmit a tuning note for the benefit of listeners who are carrying out experiments on the effect of the eclipse on signal strength.

oooo

Without Foundation.

There is no truth in the rumour that, if weather conditions are unpropitious, the B.B.C. programme department will postpone the event. "In this particular case," a B.B.C. official is said to have remarked, "we shall offer no objections to the natural course of events."

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Soviet Programmes.

Typical programmes of the Moscow stations have been sent me by correspondent, and they serve to show that Russian listeners will stomach even more talk than the Germans. The educational element seems to predominate, and who shall say that it is superfluous?

Here is the "Komintern" programme for a recent Saturday :—

4.00-4.30.—Children's programme.

5.20-5.45.—Statement by the Central Committee for Workers' Education.

5.50-6.15.—Lecture on the Resources of the Soviet Union. "Iron." Professor Federovsky.

6.15-7.05.—Workers' Wireless Newspaper.

8.00-8.30.—Statement by the Central Committee of the Young Communist League.

8.30-11.00.—Dance Music.

And so to bedski.

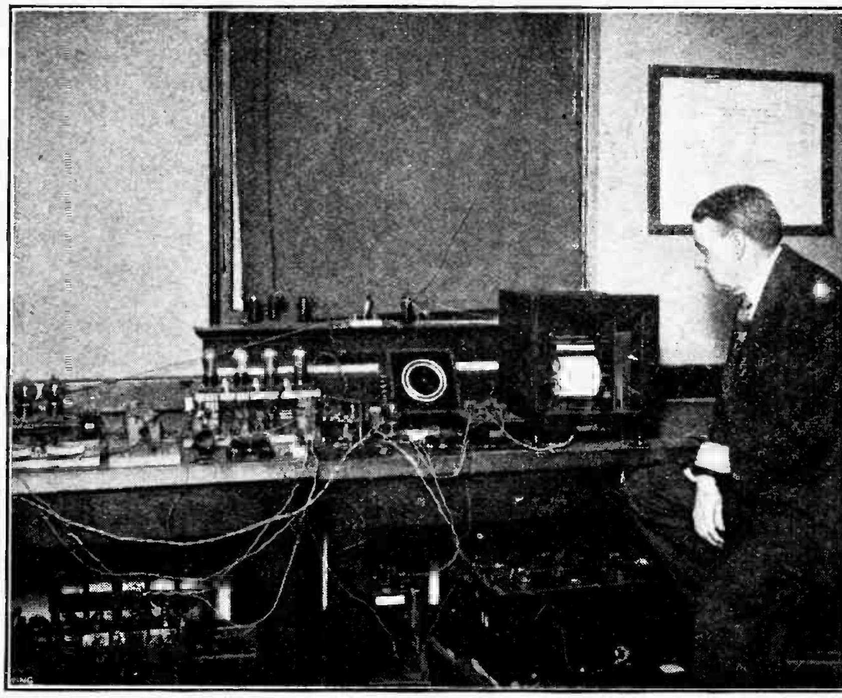
oooo

An Æsthetic Anæsthetic.

The following story, emanating from New Jersey, commands respect if only on account of its extreme tallness.

It appears that a dear old gentleman who had passed his threescore years and ten was required to undergo a serious operation. It was feared, however, that an anæsthetic of the ordinary kind might have fatal results, so the surgeons cast about for some other means of saving their patient unnecessary pain. They had almost given up the problem in despair when the patient himself came forward with a constructive proposal which was put into effect. While the operation lasted the old gentleman wore headphones and listened to broadcast music which took his thoughts off the pain.

Considering the sort of music we sometimes have to listen to, I begin to believe that the story might be true.



AN AUTOMATIC RECEIVER. This rather cumbrous piece of apparatus is claimed to be the first broadcast receiver fitted with automatic tuning. When the mechanism has been set it will tune in a dozen different broadcasting stations at predetermined times during the day. The instrument has been designed by the United States Bureau of Standards in Washington. Dr. L. W. Austin, head of the Radio Transmission Research Laboratory, is seen in the photograph.

FUTURE FEATURES.

Sunday, April 10th.

LONDON.—Matthew Passion, relayed from York Minster.

BELFAST.—Special Palm Sunday Service relayed from St. Anne's Cathedral.

Monday, April 11th.

LONDON. — Concert by prize winners of London Musical Competitions.

ABERDEEN.—Scottish Programme.

Tuesday, April 12th.

LONDON.—"Polly," an Opera by Mr. Gay.

GLASGOW.—A Railwayman's Night.

Wednesday, April 13th.

CARDIFF.—Concert by "Women of Wales."

MANCHESTER.—The Roosters Concert Party.

Thursday, April 14th.

LONDON.—Spanish Programme.

GLASGOW.—Scenes from "King John": "The School for Scandal."

Friday, April 15th.

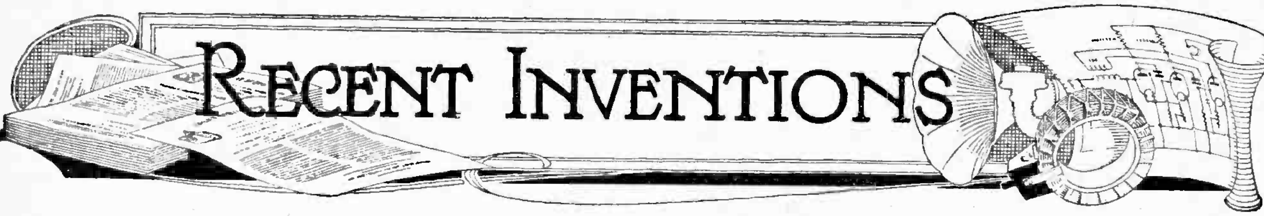
LONDON. — "The Dream of Gerontius" relayed from Bishopsgate Institute.

BIRMINGHAM.—Good Friday programme of Passion Music.

Saturday, April 16th.

GLASGOW.—Neapolitan Programme.

BELFAST.—Idylls of the Hebrides.



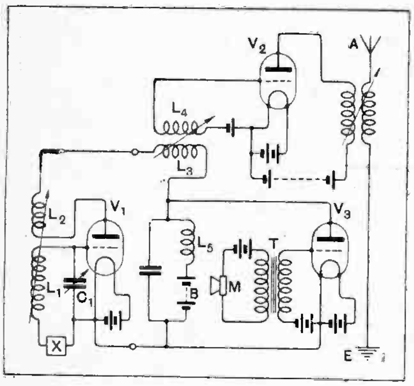
RECENT INVENTIONS

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.

Short-wave Transmission.
(No. 242,653.)

Convention date (U.S.A.): Nov. 6th, 1924.

One of the disadvantages of short-wave transmission lies in the periodic fading to which the higher frequencies are particularly susceptible. Briefly, this may be assumed to be due to there being two waves, one a ground wave and the other a wave reflected from the Heaviside layer. Owing to variation in the Heaviside layer the voltages at the receiving station, which are a combination of those obtained from both waves, are constantly changing in magnitude and phase. According to the present invention, which is due to A. N Goldsmith and Marconi's Wireless Telegraph Co., Ltd., the difficulty is overcome by continuously varying the wavelength of the transmitting station, so that over a given short interval appreciable signal voltages will be obtained at any given instant from one or other of the frequencies of transmission. The accompanying diagram shows a form of transmitter utilising this principle. The valve V_1 is provided with a grid inductance L_1, a condenser C_1, and an anode inductance L_2, the two being coupled so as to produce continuous oscillations of a very high frequency. The anode circuit contains another inductance L_3, which is coupled to another inductance L_4 in the grid circuit of an amplifying valve V_2 coupled through the usual coils to the aerial system. A speech modulation valve V_3 is connected in the usual manner with the microphone M and transformer T. The anode supply for the valve V_1 and V_3 shown at B is connected through a choke L_5 so that the arrangement of the two valves comprises an ordinary choke-control modulation system. Connected in the grid circuit of the master oscillator valve V_1 is an arrangement shown at X, which is used continuously to vary the frequency of the oscillations. This may consist of a rotating condenser plate or some means for altering the value of the inductance in the grid circuit of this valve. The specification indicates how this can be done by the use of two valves oscillating at another frequency.



Variable wavelength transmitter for short-wave communication. (No. 242,653.)

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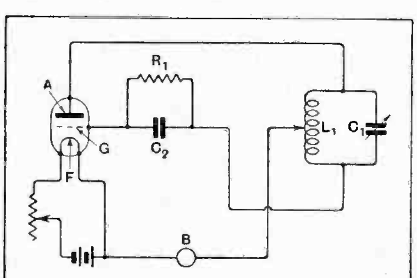
Valve Oscillator.
(No. 258,257.)

Convention date (Germany): Sept. 11*th*, 1925.

A valve oscillator is described in the above British patent by Telefunken Gesellschaft für Drahtlose Telegraphie. The particular novel feature of the invention lies in the use of a positive potential on the grid with respect to the filament. The manner in which the circuit is arranged is shown in the diagram. The oscillatory circuit consists of an inductance L_1 tuned by a condenser C_1. One end of the oscillatory circuit is connected to the anode A, while the other side is connected through a condenser C_2, shunted by a resistance R_1, to the grid G. A tapping on the inductance L_1 is connected to a source of positive potential B, the negative end of which, of course, is connected to the filament F of the valve. Here, then, both the anode and grid are given a positive potential with respect to the filament. Since the grid is positive, current will flow in the grid circuit, and will occasion a fall of potential along the resistance R_1, thereby maintaining the grid at a lower positive potential than the anode. It is stated that this particular circuit is conducive to the production of gentle oscillations and also does not give rise to the generation of spurious oscillations. The circuit is claimed to be particularly efficient when the anode potential is supplied from a source of alternating current.



Oscillatory valve circuit. (No. 258,257.)

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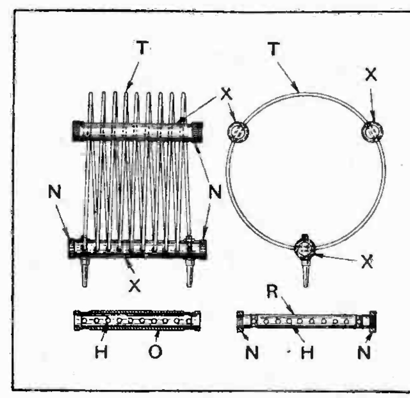
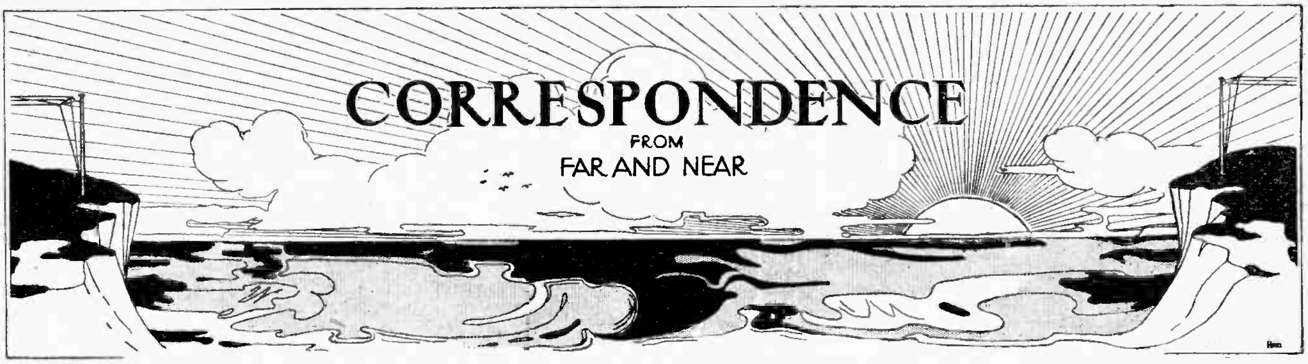
Short-wave Coil Construction.
(No. 263,259.)

Application date: October 21st, 1925.

E. L. Wildy and the London Electric Wire Co. and Smiths, Ltd., give details in the above British patent of a system of short-wave coil construction which is illustrated by the accompanying diagram. The coil is of the type comprising a number of spaced turns of thick wire which are separated by insulating supports provided with transverse holes for retaining the wire. The novelty of the invention lies in the construction of the insulating supports. In the accompanying diagram the turns of the coil are shown at T, and are spaced by means of ebonite or other insulating spacers X. The construction of the spacers is shown in the lower half of the illustration, and will be seen to comprise an outer tubular member O and an inner member R. Both the members O and R are provided with little holes H, and the member R is slipped into the tubular member O so that the two sets of holes register. The ends of the inner portion R are threaded and provided with nuts N. Thus it will be seen that on tightening the one or other of the nuts against the ends of the outer member O it will cause the inner member to be displaced slightly, thereby bringing about a locking action on the turns of the wire, thus maintaining a rigid construction.



Insulating supports for short-wave coils. (No. 263,259.)



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.

DIRECTORY OF SOURCES OF SPECIAL INFORMATION.

Sir,—Just as the practical utility of a book is impaired by the want of an index, so the vast aggregation of knowledge that has been built up and is in many cases being added to day by day is largely lost to mankind owing to the lack of a master-key to its whereabouts. Throughout this country there are numerous centres of specialised knowledge and experience of the most varied description, the existence of which has only to be known for them to prove of great service to the world.

It is with the object of bringing these to light and recording their salient features in concise form that the Association of Special Libraries and Information Bureaux, in collaboration with the Carnegie United Kingdom Trust, has asked me to compile a directory.

It has been decided to go forward with the printing of a first edition of this directory at midsummer, but much still remains to be done. It is recognised that completion in any one subject is well-nigh impossible in so short a time. It would, however, greatly further this end if libraries, organisations, firms and individuals possessing special information on any subject and willing to answer inquiries thereon, which have not yet been in touch with us, would communicate with me at 38, Bloomsbury Square, W.C.1.

G. F. BARWICK,
General Editor.

London, W.C.1.
March 18th, 1927.

RANGE OF ATMOSPHERICS.

Sir,—I was interested in your article in the March 16th issue in reference to a test from Rocky Point on the range of atmospherics.

You may be interested to hear that years ago, while working long-range wireless, it was a general practice, during bad atmospherics, to repeat any word, without request, whenever we had a bad "X" this end, as the same disturbance invariably was heard the other end, thereby mutilating the signal.

"1916."

London, S.E.20.
March 19th, 1927.

B.B.C. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—In my previous letter in connection with the B.B.C. transmission of pianoforte music I described in some detail the power stage of my receiving set, merely to show that the receiver should be capable of giving pure results with adequate volume. Mr. Richardson's receiver, from the description he gave of it in his second letter, should also give very fine results. The advice given by one of your correspondents that we should use suitable valves and grid bias was, no doubt, well meant, but was hardly necessary. While agreeing with Mr. A. L. Royer that it is possible to overload a super-power valve (or even two such valves in parallel—which I use), yet I can assure him that the distortion I complain of is not due to overloading of the valves, being evident on quite soft passages on the speaker and in the telephones on two valves. Naturally, too, I had made careful tests with a milliammeter in the plate circuits of the valves before I felt justified in complaining about the matter.

I would also like to emphasise the point that the distortion is by no means always present. There can be little doubt that the trouble is entirely acoustical, most of the studios at Savoy Hill being more or less unsuitable for bringing out the finer points of piano tone. In this connection I should like to mention that the most natural piano that I have ever heard broadcast has been from the Grotrian Hall.

The following passage, which has a distinct bearing on the subject in question, I quote with due acknowledgment from the Broadcasting Column of a recent issue of *The Observer*:

> "Some while ago I drew attention to the distinctly bad rendering of piano music that was sometimes obtained from the London station, and pointed out that a really bad rendering of a solo might be followed by a good transmission of a pianoforte accompaniment. I was given to understand that the fault existed in one particular studio, and that directly arrangements could be made it would not be used for this type of transmission. I am now sure that it is not one, but two or three of the studios which suffer from the complaint, whatever it is. Perhaps the use of suspended microphones, instead of the stand-supported "pick-up," will make a difference. It is certainly high time that something was done, since it is no doubt that the fault is in the transmission."

G. F. ROSSITER.

Teignmouth.
March 16th, 1927.

Sir,—With reference to the discussion which has arisen over the transmission of pianoforte music by the B.B.C., I entirely agree with Mr. Richardson when he states that it is bad.

Mr. R. N. Ballard airily dismisses him by advising him to look to his set or loud-speaker. Perhaps he would like to know the apparatus that I am using.

For London I use a D.E.5B as rectifier, using anode bend rectification. This is coupled through a resistance capacity coupling to a L.S.5, which in turn is coupled through a choke (150 henries) to three L.S.5A valves in parallel.

The loud-speaker is one I built on specifications of the model used by Dr. McLachlan in his lecture before the R.S.G.B. in January, 1926, namely, a free-edge coil drive.

The result on all music with the exception of the piano is perfect.

With the piano there is a blasting effect, although there is no actual overloading of the valves, as all the meters remain perfectly steady.

My theory (I am not an authority) is that the microphone actually picks up the mechanical blow of the hammers on the strings of the piano.

If one sits close enough to the piano the same effect is noticed.

I might add that I am using 400 volts H.T. obtained from Exide 5 amp.-hour accumulators, with 40 volts grid bias on the L.S.5 and 90 volts bias on the L.S.5As.

I am situated about four miles from 2LO.

A. S. BROWN.

London, S.E.16.
March 22nd, 1927

Sir,—As one of the great majority of your readers who are following with intense interest the progress of your campaign for good quality in broadcast reception I would like to mention one way in which the B.B.C. can give invaluable assistance towards the realisation of this ideal. I refer to a transmission of a series of equally modulated notes covering the whole musical scale, the frequency being indicated after each note.

A simple way to do this was shown in a recent R.S.G.B. talk, where a piano was used. Thousands of interested listeners must have missed this opportunity of testing their receivers, for the nature of the talk was not announced in *The Radio Times*, and 6 p.m. is an inconvenient time for many of us. I had the exquisite torture of hearing it in a local dealer's shop, for the result did not flatter his reproducer, and my set was five minutes' walk away, just out of reach.

No doubt financial considerations will preclude the use of more accurate methods, but a weekly piano transmission would be very useful. It would not be necessary to trespass on programme time, and "2LO stand-by transmitter testing" could be made to have a real meaning for the listener.

Teddington, S. J. WALLIS.
March 16th, 1927.

Sir,—With reference to the correspondence anent the B.B.C. piano transmission, might I put on record the following facts which I have not seen mentioned as yet:—

1. When 2LO is "distorting," the transmission from 6 BM or 5IT is perfect—naturally, when 2LO is S.B. to these stations.

2. When 2LO is bad, 5XX is perfect, on the same programme.

3. Up to the time a certain London store started extending their premises, and of necessity erecting large steel cranes and using many tons of steel girders and corrugated iron, this distortion was not noticeable in this district. This store is the "base" of the 2LO aerial.

For a considerable time I have, in a very humble way, experimented for perfect reception, and my instrument is a Marconi Straight 8, with a D.E.5A in the last L.F. stage, especially wired for large grid bias, working a Western Electric "Kone" loud-speaker.

I might mention that the facts I have referred to have been verified many times in this district.

That distortion *is* present at times the B.B.C. are the first to admit, but if every receiving station were to be only one-tenth as efficient as the B.B.C. transmission I doubt if there would be so much "grousing." I would like to have had some of the "grousers" with me in 1916 when using wireless telephony from the air! "LATE CHIEF INSTRUCTOR."

Farnham, March 21st, 1927.

MICROPHONIC NOISES.

Sir,—I have recently been subject to low-frequency howling, due to my using a high-impedance valve as detector with a plate potential of 90 volts, and leaky grid method of rectification.

After trying many ways of curing the trouble I tried those described by "Howler," and the one under the heading "Valve Vibration," in the March 16th issue, but none effected a cure.

After some further experiment I decided to bind the glass walls of the valve with Empire tape, and, giving four layers, leaving the top exposed, I fastened the tape with a rubber band. This completely cured the trouble. I may add I can now bring the loud-speaker within a few inches of the valve without any howl whatever. RICHARD C. LE MARE.

Stockport, March 19th, 1927.

Sir,—In connection with Mr. Tyer's article on "Microphonic Noises" in your March 9th issue, and the reply thereto in your issue of March 16th by "Howler," my own experience may be of interest.

It is often possible to raise the pitch of a microphonic noise due to an L.F. amplifying valve by lowering the filament temperature, and *vice versa*. The noise in this case is clearly due to a vibration of the filament with a frequency depending on its tension, and this may be controlled at will by varying the thermal expansion. In fact, in many cases a valve will stand sufficient L.T. voltage to run the filament quite slack, and all possibility of microphonic noise due to this cause can then be avoided.

That a microphonic noise of definite pitch can be caused by other means, however, is shown, I think, by a further phenomenon I have obtained. Using a valve whose bulb was wound tightly with shellacked string, which I have found effective in preventing vibration of the glass, and in a rigid holder, I obtained a microphonic noise of about 1,000 cycles which waxed and waned regularly. The waxing and waning occurred with a frequency of 2 to 6 times a second, and this frequency was controllable by the filament rheostat. I assume, therefore, that the filament vibration was beating with another vibration of nearly equal frequency, arising probably from the holder.

Birmingham, March 16th, 1927. G. H. S.

Sir,—Since, in criticising my article on "Microphonic Noises," your correspondent, "Howler," makes certain statements which, I venture to suggest, are not scientifically accurate, and may, therefore, lead some of your readers astray, I should welcome this opportunity of replying to his comments.

"Howler" suggests that the fault does not lie in the valve holder, and the resonance effect is due to the vibration of the electrodes. If "Howler" examines my article he will find that I state in the fourth paragraph that what he calls the resonance effect is due to the vibration of the electrodes. I cannot agree with "Howler" that the fault does not lie in the holder. Since the electrodes are mechanically connected with the holder, it follows that if the holder is capable of sustaining oscillations, then the electrodes will remain in a state of oscillation. If, however, the holder cannot sustain oscillations, then the electrodes will not remain in this condition. Frankly, I cannot see "Howler's" line of argument in suggesting that the holder is not responsible.

"Howler's" experiments of substituting spring holders of different natural periods and finding that the note in the telephones is not varied are quite inconclusive, and he deduces therefrom inaccurate conclusions. The natural period of all spring holders when loaded with the mass of the valve is such that it is capable of shock exciting the electrodes and enabling them to remain in a state of vibration. The note which is given is a function of the natural period of the electrode system.

"Howler" suggests that I have generalised from the result of one experiment. I do not think I am guilty of this. The experiment mentioned was merely given to illustrate my theoretical deductions, of which the major portion of my article consists. The cessation of howling due to the substitution of a rubber-mounted holder for a spring holder was not a coincidence as suggested, and it seems to me that my article clearly points out how and why this should have occurred.

"Howler" is quite wrong when he states that "acoustic energy is collected by the glass walls of the valve and transmitted to the electrodes. . . ." Sound energy by its very definition is kinetic. Energy which is collected must obviously be potential. Obviously, then, any energy which is collected is not in the form of sound. What actually happens is this: Of the sound impinging on the wall of the valve, a minute part is collected or absorbed and converted into heat. The majority of the sound energy, however, does work on the glass wall, causing it to turn about a fulcrum situated in the spring holder, this work overcoming the inertia of the valve and operating against the restoring force of the spring and the air resistance. A valve in a spring holder is not highly damped unless it is of considerable mass. This could only be obtained by using a very light spring, insufficient to support the valve, or, alternatively, loading the valve with a heavy mass. Since this is not the case the sound waves cause the valve in the holder to remain in a state of oscillation, because the damping is not sufficiently high, and accordingly the electrodes also remain in a state of oscillation. However, by mounting the valve on a block of sponge rubber, the mechanical damping is sufficiently high to prevent the valve as a whole from remaining in a state of oscillation. "Howler's" suggestion of using a lined wooden box over the valve would certainly tend to prevent a large proportion of the sound waves doing any work on the valve, but if this can be more easily accomplished simply by mounting the valve on a block of rubber I do not see that any advantage is gained. Moreover, the suggested method still does not protect the filament from any shock excitation which might be transmitted through the base of the valve and through a bench on which the set may be placed. "Howler" can easily prove my statements experimentally by arranging, perhaps, a four-valve amplifier in spring holders. If the first valve is given an impact, the amplifier (if it is amplifying properly) will give a tremendous noise in the telephones. If, now, he damps the vibrations of the first valve simply by holding the top in two fingers, or, alternatively, tying it against a small rigid support, with a small block of rubber, rag, or cotton-wool, and then if the valve is once more given an impact he will find that practically no noise will be heard at all. This experiment, of course, should be carried out in such a manner that the first valve and its associated equipment is mechanically isolated from the other valves in order that the other valves are not affected by the impact given to the first valve.

Watford. PAUL D. TYERS.
March 22nd, 1927.

GAS DISCHARGE RELAYS.

Sir,—On page 262 of your issue for March 2nd there appears a description of a three-electrode neon tube relay attributed to Messrs. Richter and Geffcken, of Leipzig. I have already constructed and experimented with this arrangement, which I patented in France on September 30th, 1926 (patent No. 225,835).

The substance of the claims of my patent are:—

(1) Valve having unilateral conductivity employing neon gas at low pressure, two or more cold electrodes being located in the valve between which an electrical discharge takes place, but having one or more electrode, the purpose of which is to control this discharge.

(2) In one method of constructing this valve the cold electrodes take the form of plates and points, or one electrode with multiple points erected towards the plates with one or more control electrode placed between the discharge electrodes in the form of a grid, spiral, perforated plate, etc.

One of these types, which was constructed for me by the L.S.I., functions with a 250 volts and a discharge current of 0.02 amperes, and with this low-frequency amplification has been obtained.

My work in this direction is not complete, and on this account I have not yet communicated the results obtained to any scientific society.

I should appreciate it if you would publish this information in order to draw attention to the probable priority of my work over that of Messrs. Richter and Geffcken.

Juvisy-s-Orge, France. M. JOSEPH ROUSSEL.
March 3rd, 1927.

THE SILENT PERIOD.

Sir,—I have read with interest your Editorial and the many letters from correspondents on the matter of a silent period which it is proposed to institute for the express purpose of allowing owners of valve sets to receive programmes from foreign countries. As an amateur who has been interested in long-distance reception for some years, I should like to give you my experience.

First and foremost we now have a silent period from about 5.45 p.m. to 8 p.m. every Sunday, and without fear of contradiction I say that during that period it is absolutely impossible to receive distant stations as the air is rent with every conceivable variety of "cat call" and "squeal" from listeners trying to receive distant stations; this state of affairs commences the moment London switches off and continues until it starts transmitting again. From this experience I am forced to the conclusion that the only use for a silent period would be—in fact, is—to demonstrate the amount of interference which can be caused by oscillating receivers.

Under present conditions it is only possible to receive distant stations when London is transmitting, and then programmes, preferably orchestral or military band, so that the "wipe out" is effectual, for the squealers will attempt their distant reception when speech is being transmitted—as then they can possibly hear a spot of music above the speech—and, further, there seems no point in a silent period, for, with a modern properly designed receiver employing four valves, it should be perfectly easy to separate such stations, to mention a few, as Stuttgart, Toulouse, Hamburg, Frankfurt, and Brussels. The trouble at present seems to be that the average receiver, at least in this neighbourhood, is quite incapable of receiving anything but the local station without oscillating, and should we have another advertised silent period it is perfectly certain from what happens every Sunday evening all sets really capable of receiving distant stations would be switched off, the owners knowing full well that the correct name for such a period would be "The Oscillator's Paradise."

South Croydon. GEORGE H. TOZER.
March 23rd, 1927.

Sir,—Having read the letter on the subject of the silent period by Mr. Caddick in your issue for March 23rd, I wish to express my views as a wireless fan who has spent considerable time and money on expensive sets.

May I say first that I certainly do not approve of a silent period until such time as one can be assured that the air is not rent with squeals and howls, as it is during the silent period on Sunday evenings. My experience is that distant stations are only worth listening to when the local is on the air. At such a time those people with out-of-date valve sets know perfectly well they cannot cut out the local, and therefore do not try. It is at this moment that the man with the deeper pocket, if he is up-to-date and has spent his money well, can cut out the local and get the distant stations with some degree of comfort.

For my own part (I am situated within about two miles of 2LO) I do all my long distance listening whilst the local is on, as I find it impossible to listen in during the silent period on Sunday evenings.

I can only suggest that Mr. Caddick should make his set more selective (not a difficult matter), or, if his set is fairly selective, to be content with a moderate number of foreigners instead of wanting *every* station in existence.

If we had a silent period I guess under present conditions it would be impossible to listen. B. GLADSTONE.

London, W.14,
March 23rd, 1927.

Sir,—I have read with considerable interest your Editorial concerning the above subject in the March 23rd issue of *The Wireless World*.

Your point was very plainly demonstrated in this district last Sunday evening. It so happened that the Cardiff station was broadcasting a religious service in Welsh at a time when other B.B.C. stations were silent. A few of us in Carnarvon in possession of selective multi-valve sets are able to receive the Cardiff broadcasts with comparative ease at almost any time. The majority, however, are only able to receive Cardiff under the most favourable conditions.

Last Sunday evening Cardiff came in at good strength, but owing to the ear-splitting howls caused by people who were obviously hearing nothing of the Cardiff transmission, I for one was obliged to switch off my receiver, as it was painful to listen to a score of sets in the neighbourhood oscillating furiously.

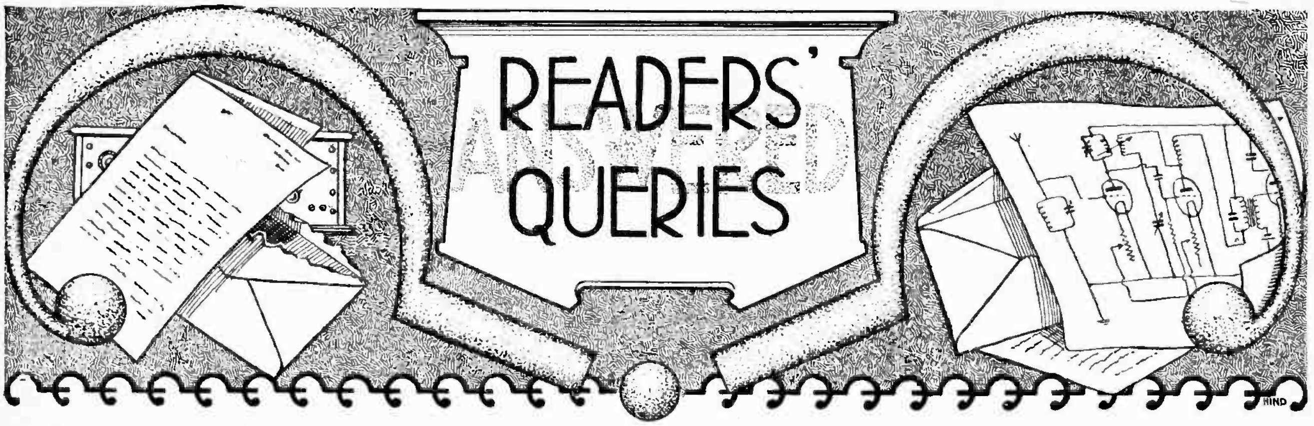
I have heard of others who experienced the same annoyance, and I think it is safe to say that the nett result was that no one in the town itself received the transmissions satisfactorily.

Carnarvon, E. LYON RICHARDS.
March 24th, 1927.

ALUMINIUM PANELS.

Sir,—We notice on page 331 of your journal of March 16th that hints are given by your correspondent, "C. H. R.," for frosting aluminium. Your readers may not be aware that frosting is a standard finish with which the metal is obtainable through the usual channels. H. COUSINS,

London, E.C.4, For the British Aluminium Co., Ltd.
March 23rd, 1927.



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

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

H.F. Transformers.

I am modifying the H.F. side of my receiver to correspond with that of the "Everyman Four" set, and find on winding the transformer to terminate the primary section at a convenient point it means that I must have either $14\frac{3}{4}$ or $15\frac{3}{4}$ turns. Will the fact that I cannot use the exact winding as specified adversely affect results? Furthermore, I find that it will be necessary to cross the primary and neutralising windings, unless I reduce the number of turns on the former. I should appreciate your comments on this.

T. C. B.

Although the designer's specification should be followed closely, the fact that you are using half a turn or so more or less will not affect results appreciably, and as long as the wires are air-spaced where they cross no ill effects will be produced. You are wise, however, to pay special attention to this point, as most cases of difficulty with these transformers have been traced to incorrect or partially short-circuited windings.

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Connecting an "Everyman Four" Coil.

The selectivity of my "Everyman Four" receiver is not quite so good as I have been led to expect, and the tuning range of the secondary circuit is very different from that of the aerial circuit. Would you suggest a likely trouble?

E. C. L.

Lack of selectivity and peculiar tuning is invariably due to the method of connecting the secondary of the high-frequency transformer. The end of the secondary winding of the high-frequency transformer over which is wound the primary and balancing windings should be connected to the filament side of the circuit, while the free end of the secondary—that is, the end farthest from that which carries the two primary windings—should be connected to the grid. This is the correct method of connecting practically any H.F. transformer; the primary windings should be wound over the end of the secondary connected to the filament. The object of this is to reduce the current which passes from the primary to the secondary through the capacity of the windings. As is well known by anyone who has tried the wrong method of connection, the effect is to weaken signals considerably and to broaden the tuning.

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H.T. from D.C. Mains.

I wish to construct an H.T. battery eliminator for use on my 240-volt D.C. mains, and believe that an instrument likely to be suitable for my purpose was described in February last year. Please inform me as to the exact date of the issue, and if it is still available from your publishing office.

A. C. S.

The eliminator to which you refer was described in our issue of February 24th, 1926, which is, however, now out of print. We reproduce herewith the circuit diagram of the arrangement in question,

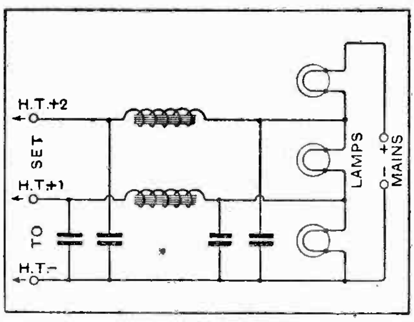

Fig. 1.—A straightforward eliminator for D.C. mains.

from which you will see that lamps are used as potential dividers. The chokes may have an inductance of from 30 to 50 henries each, while the condensers should have capacities of from 2 to 5 mfds. It may be added that another, and possibly in some cases a superior, arrangement was discussed in the "Hints and Tips" section of our issue for February 16th, 1927.

Constructing a Moving-coil Loud-speaker.

Can you tell me where I can obtain the iron stampings described in a recent article on moving-coil loud-speakers by G. W. Sutton?

A. S. A.

These stampings are, we believe, of a standard pattern, and obtainable from Messrs. Joseph Sankey & Sons, Ltd., 168, Regent Street, London, W.1.

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Low Loss or High Efficiency.

I am intending to build a short-wave receiver for reception of wavelengths round about 60 metres, but as I have by me a large number of components such as variable condensers of a very good type, I wish to know whether I can use these, or is it essential that I purchase low-loss components?

D. T. S.

As has been frequently pointed out in this journal, the term "low-loss" is only a synonym for "high-efficiency," and is not, as many people would suppose from a perusal of many catalogues, a synonym for skeleton inductances, condensers, etc. It is obvious that whether constructing a wireless receiver or indeed any other piece of apparatus, we shall get better results if we employ components of high efficiency than if we use components of low efficiency. Because your variable condensers are possibly of conventional appearance and are not of weird and wonderful design, it does not necessarily say that they are of low efficiency, and we think that in all probability you would obtain excellent results with them. In any case, why not put a short-wave receiver together roughly on a board with the components you have on hand, and you can soon see whether or no they are suitable. If you do not obtain great success on the first trial, do not, however, jump to the conclusion that your components are at fault, because the element of skill enters very largely into the successful operation of a wireless receiver, more especially on the short wavelengths.

The First Superheterodyne.

I understand that the first constructional article dealing with a superheterodyne receiver was published in this country by The Wireless World *some time in* 1925, *and I shall be glad if you can give me the date of the issue in which this article appeared.* P. H. G.

The first complete constructional article dealing with a superheterodyne receiver was published in *The Wireless World* not in 1925, as you suppose (although certainly a seven-valve superheterodyne was described in the issues of March 4th and 11th of that year), but in the issues of November 14th, 21st and 28th, 1923, although circuit diagrams of superheterodyne receivers had been published in this journal a good time previous to that date. The receiver was invented in 1917 and was in quite common use among amateurs in this country very early in the present decade, although it did not become really popular until the summer of 1925, partly owing to the lack of ready-made components on the market until that period, and to the absence of reliable constructional data and values suitable for British valves.

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Modernising a Receiver.

Could you tell me how best to bring up to date the receiver of which the circuit diagram is shown on the attached sheet? T. W. T.

As your circuit comprises the now obsolete arrangement of a direct-coupled aerial with tuned anode H.F. amplification, we are afraid it is a difficult matter to suggest how it may be remodelled without considerable alteration. In all probability the best method of effecting a real improvement is to rebuild the H.F. and detector circuit to approximate closely to the arrangement of the "Everyman Three" receiver described in our issue of November 3rd and 17th.

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An Unknown Locality.

I am building a six-valve wireless receiver, and wish to ask your advice concerning the question of erecting an aerial. I have ample space at my disposal, and find that I can erect an aerial of over 200*ft. in length. Should I obtain much greater efficiency than by the use of a standard* 100*ft. aerial? Not being on British territory I am not restricted to the standard length of aerial.* L. G. K.

You omit to state in your letter whether you expect to receive the stations of the British Broadcasting Corporation, long-wave telephony stations, or the very many long-wave C.W. morse stations which are in existence. Moreover, it is somewhat difficult for us to deduce this point definitely from your letter, since you omit to put your address, but judging from the postage stamp on your envelope we should say that you are too far away to successfully receive the ordinary broadcasting stations of either this country or the European continent. We do not mean that you could not receive these at any time, but on very few nights would reception likely to be free from interference due to atmospherics, mush, etc. We assume, therefore, that you are desiring to receive long-wave stations mainly, and in this case the long aerial which you propose to erect would be of advantage. Of course, on the shorter wavelengths it would be a great disadvantage from many points of view, as for one thing it would greatly mar selectivity.

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Reinartz Wronged.

I have noticed that there seem to be a large number of circuits bearing the name of "Reinartz" which differ very greatly from one another. Can you, therefore, give me the true Reinartz circuit. P. L. S.

It is quite true, as you say, that there are a large number of circuits which are wrongly given the name of Reinartz circuit, and it appears to have become an obsession with certain people to give this name to any circuit in which reaction is controlled by means of an ordinary variable condenser. We give in Fig. 2 a diagram of the original Reinartz circuit with the addition of an ordinary stage of L.F. amplification for the purpose of loud-speaker operation. It must be remembered, of course, that strictly speaking the Reinartz is a single-valve circuit, and it is not really correct to speak of a three-valve Reinartz circuit when we mean a Reinartz circuit followed by two stages of L.F. amplification, because, obviously, the L.F. amplifier is perfectly conventional.

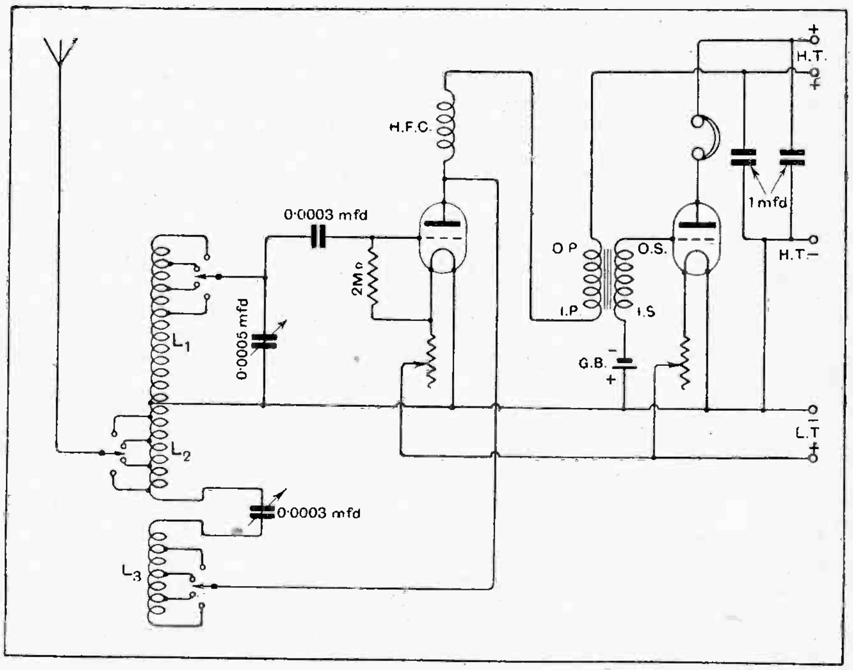

Fig. 2.—The original Reinartz circuit with one stage of L.F. amplification.

Referring to Fig. 2, the coils L_1 and L_2 really consist of one continuous winding of 75 turns of No. 22 D.C.C. or any other approximate gauge of wire wound on a cylindrical former 3in. in diameter. The earth connection is joined in at 60 turns from the grid end, whilst a few tappings are made at the grid end of the coil to give a coarse adjustment of the inductance of the grid circuit. The last fifteen turns of the combined coil, that is L_2, are similarly tapped in order to give a variation of aerial coupling. A space of about ¼in. is left on the former, and then the reaction winding is wound on in the same direction. This winding may, of course, be of much smaller gauge than the other windings if so desired. The actual number of turns, of course, cannot be stated precisely, as it depends on various factors, such as the damping present in the grid circuit, which may be small or otherwise according to whether we have used good components and whether or no there are leakages due to a valve holder, a former, or other component made of inferior material; usually 15 to 18 turns are ample. The H.F. choke may consist of any of the commercial chokes upon the market, or a simple home-made choke. The remainder of the circuit is perfectly conventional.

This original circuit is open to much criticism, such as, for instance, the losses introduced by the switching arrangement at the high potential end of the grid coil, and has been improved and modified from time to time by the original author, whilst at the same time other experimenters have made certain alterations and have even in many cases changed the name of the circuit.

An "Everyman" Alteration.

I am building an "Everyman Four" receiver, but wish to know if I can use two 0.0005 mfd. variable condensers which I have by me, in place of the 0.0003 mfd. specified. D. V. R.

The first effect of using .0005 mfd. variable condensers would be to raise both the maximum and the minimum of the tuning range of the receiver. Provided the condensers were of modern type, however, the minimum range would not be greatly increased, and you could still tune well down with the receiver. It might be thought that the increase in the maximum of the tuning range would be a great advantage, but it must be remembered that the receiver would be considerably less sensitive on the upper end of the scale. You could, however, use the condensers as 0.0003 mfd. instruments, by utilising only the lower half of the scale, but it would be obvious to you that you would have a more crowded condenser dial, since the same number of stations which would have to be spread over 180 degrees of scale in a 0.0003 mfd. condenser will be crowded in a less portion of scale. Provided, however, that you use good slow motion dials, this disadvantage will not be so great as it might at first seem.

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A Superfluous Condenser?

I am building an A.C. mains battery eliminator, and I should be glad if you would tell me whether it is necessary for me to use a fixed condenser in the earth lead of my receiver in order to avoid short-circuiting of mains, since, of course, the mains will be entirely isolated from the set by the transformer, as naturally the primary and secondary windings are not in electrical contact. A. C. B.

As a measure of safety we would advocate that a condenser be used in the earth lead even although the mains are isolated from your receiver as you state. There is always a possibility of a sudden breakdown of the insulation between the primary and secondary of the transformer with possible resultant disaster. Indeed, we would advocate that as a measure of safety a large-size fixed condenser be used in the earth lead of the set irrespective of whether the mains are A.C. or D.C. and irrespective of whether in the case of D.C. the positive or negative main is earthed. This condenser should be of as large a capacity as possible (preferably not less than 1 mfd.) in order not to upset the tuning. An important point is that the condenser dielectric should be one which is guaranteed to withstand a voltage greatly exceeding the mains voltage, since obviously it would be of little use employing a 1 or 2 mfd. condenser whose dielectric would break down immediately the mains voltage was thrown across it as a result of a breakdown of the insulation between the primary and secondary of your power transformer, as it would then be no safeguard at all.

A Tuning Problem.

I have a two-valve set consisting of a detector followed by a choke-coupled amplifier. I find that when connected up in the usual manner to a standard aerial and to a water pipe earth, signals are very faint in the loud-speaker, whilst if I connect the earth lead to the wiring of the electric bell system signals come in at great strength. I shall be glad if you can assist me in my trouble. H. M. V.

The trouble is probably due to the fact that your earthing system is of very high resistance. You do not say whether or no you make use of reaction, but we presume you do not, as we observe from your address that you are very close to 2LO. The use of the electric bell system as a rough counterpoise probably results in a great decrease in damping. Possibly, also, your aerial is of somewhat high resistance, and the set might work all right with your existing earth system if your aerial were of smaller size, as possibly the aerial is exerting a great damping effect. You could with advantage completely overhaul your aerial and earth system, shortening the aerial, making sure that all soldered joints are in order and that you are earthed on to the *main* water pipe. As a temporary measure, we would suggest that you reverted to your earth system and connected a small fixed condenser in series with the aerial lead-in, the capacity of which may be 0.0002 mfd. Another cause of the trouble might be that fundamental wavelength of the aerial and earth system may differ considerably when the bell system is used, compared with when the proper earth is used. Therefore the tuning range when the proper earth is used may be such that your local station does not lie within the tuning range of your coil and condenser, and you might therefore try the effect of merely changing the value of the aerial tuning coil.

A Schnell Snag.

I am constructing the Schnell circuit, which has been published from time to time in your journal, and wish to know if I may follow the detector valve with a stage of resistance-coupling, using an 80,000-ohm valve as detector, and a 1-megohm anode resistance. M. F. O.

It is not possible to follow the detector with this form of resistance-coupling, as you desire, owing to the fact that you desire reaction effects. Indeed, this is true with all regenerative detector receivers, namely, that if the ordinary smooth control of reaction is desired, then a stage of resistance coupling using a very high value of anode resistance, cannot be used. You must use either a transformer or a choke, or you may use a stage of resistance-coupling employing a 100,000 to 150,000-ohm anode resistance shunted by a 0.0001 mfd. fixed condenser, this being used in conjunction with a valve of about 30,000 ohms impedance, and, moreover, one having the highest possible amplification factor for this impedance, such as the D.E.5B or other similar valve.

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Three or Four?

I have only recently heard of your "Everyman Three" and "Everyman Four" valve receiver, and I shall be glad if you can tell me in which issues of The Wireless World *these were published, so that I may obtain same from you. Could you also indicate which receiver you consider to be the best for all-round work solely on the normal broadcasting wavelengths.* T. L. A.

The "Everyman Three" receiver was described with full constructional details in our issues of November 3rd and 17th, 1926, and these two back numbers may still be obtained from our publishers. The "Everyman Four" was described in our issues of July 28th, August 4th, September 8th and October 13th, 1926, but some of these are now out of print; however, we have published a book entitled the "Everyman Four," giving full constructional details both theoretical and practical wiring diagrams, and all other particulars, and this book may be obtained from our publishers at a cost of 1s. 2d., post free.

The "Everyman Three" and the "Everyman Four" both make use of one H.F. stage of a similar type. In the former case, however, a leaky grid rectifier was used, followed by a single stage of transformer-coupled L.F. amplification, whilst in the latter case an anode bend rectifier was used followed by a resistance-coupled stage and then a transformer stage of L.F. amplification. For general loud-speaker work probably the "Everyman Four" is the most suitable instrument, the other being more for the man who desires to search for very distant stations on the telephones, although, of course, it will operate a loud-speaker at great strength from a large number of the less distant stations.

The Wireless World
AND RADIO REVIEW
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Editor: HUGH S. POCOCK. Assistant Editor: F. H. HAYNES.

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ANOTHER CRITIC OF BROADCASTING.

THE latest addition to the ranks of the critics of broadcasting is Mr. H. G. Wells, who, in a recent edition of one of the Sunday papers, occupied the greater part of a page to tell us why broadcasting is a farce and why its decline and eventual fading out is inevitable. At the conclusion of the article the Editor promises that "another vigorous article by H. G. Wells will appear on Sunday week." When we had reached that editorial appendix after having laboriously read through Mr. Wells's entire article, we could not help wondering whether the Editor had not been a little careless in his choice of an adjective, for we cannot remember having read anything by Mr. Wells previously where the use of this adjective would not have been more appropriate than in describing his article on broadcasting. We had hoped when we came to read the article that at least we should have been given some strong points against broadcasting sufficient to provoke a desire on our part to argue, but perhaps the strongest case which Mr. Wells makes out is that music in the home can be obtained equally as well from a gramophone or pianola as from broadcasting, and that in the former case you can make your own selection of the music you wish to hear. In our opinion, it is so difficult to compare these two that the point is scarcely worth discussing, even if we omit the consideration of cost, which in the case of the pianola and gramophone, with the addition of records, places these instruments beyond the reach of a very large proportion of the population.

"But, sooner or later," says Mr. Wells, "boredom and disappointment with these poor torrents of insignificant sounds must ensue. Are there, indeed, any indefatigable listeners who have stuck to this amusement since the beginning? If so, I think they are probably very sedentary persons, living in badly lit houses or otherwise unable to read, who have never realised the possibilities of the gramophone and the pianola, and who have no capacity nor opportunity for thought or conversation."

A Phantom Army of Listeners.

Mr. Wells makes it quite clear that he himself has no use for present-day broadcasting, but it is surprising that he, whom we are accustomed to regard as having an extraordinarily complete knowledge of human nature, should now be "at a loss to imagine any sort of person becoming addicted to listening-in as a frequent entertainment," when, if Mr. Wells would go to the trouble of looking up the facts, he would find that the number of listeners is steadily increasing, and the copies of the wireless programmes sold weekly and the correspondence received at the B.B.C. headquarters are alone a guarantee that the future of broadcasting will not present the amusing picture which he draws of the service continuing to operate for the entertainment of a phantom army of listeners, "the last living listeners having dispersed and gone to other things."

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Coil-driven Diaphragm LOUD-SPEAKER DESIGN.

Constructional Details of Diaphragm, Moving Coil and Electro-magnet.

(Continued from page 377 of the issue of March 30th, 1927.)

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

WE have dealt, in the previous article, with the theoretical side of the subject in a somewhat extensive, though by no means exhaustive, manner, because it is imperative that the experimenter should know exactly the foundations upon which the design is evolved. When unexpected results are obtained he will have more chance of arriving at the reason, and greater possibility of rectifying defects.

The Electro-magnet.

So far as actual construction is concerned, it is proposed to describe a coil-driven loud-speaker in detail, but there are minor points of construction which can be left to the conception of the reader. Dealing with the electro-magnet, this is shown dimensionally in Fig. 10. The winding depends upon the voltage to be used, but is designed to dissipate about 25 watts. This gives a field strength in the air gap of about 8,000 to 9,000 lines per square centimetre. For working from a D.C. supply circuit the magnetising coil is wound in one section of 19,000 turns or in two sections, each of 9,500 turns of No. 34 D.S.C. The resistance of each section is just over 850 ohms. For a 100-volt supply the coils are connected in parallel[1], whereas for a 200-volt supply they are connected in series. The circuit diagram is shown in Fig. 11. Owing to the large inductance of the coil (bordering on 90 henries), it is *imperative* to connect a buffer resistance across it to prevent undue sparking at the switch and voltage rise on the winding when the current is switched off. The value of this resistance is 4,000 to 6,000 ohms, and it must be capable of withstanding the mains across it without undue heating. In addition there may be a series resistance for regulating the current in the winding of the electro-magnet. For continuous work some of this resistance may be required to reduce the heating of the pot, more particularly for a 240-volt supply, where the loss will exceed 25 watts. However, this is really a matter for experiment. It may be useful to paint the outside of the pot with a dull black paint, thereby giving a high coefficient of emissivity to promote cooling.

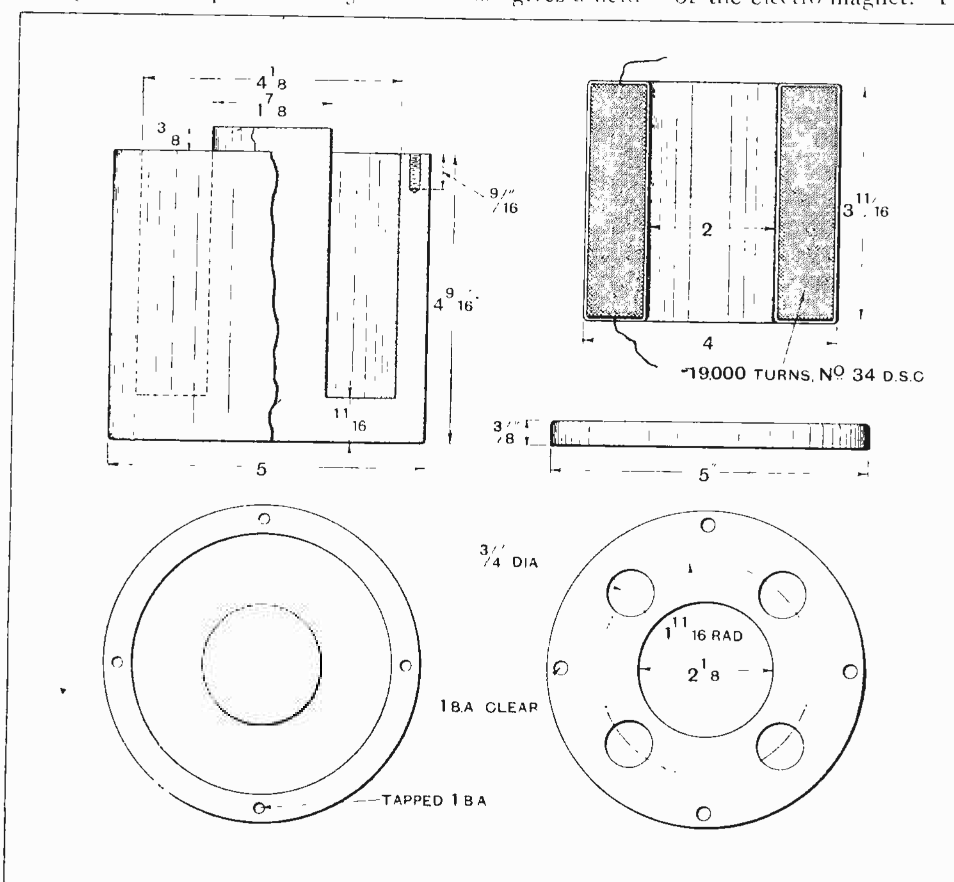

Fig 10.—Leading dimensions of electro-magnet. The winding for 200 to 240 volts may consist of one system as shown or two sections if desired, as indicated in the text. There should be a thin ring of insulating material at the bottom of the pot and the lower lead should be well insulated.

The coils should be carefully insulated. Impregnation and baking with suitable varnish, *e.g.*, bakelite, is recommended, the whole coil being well taped with silk. This is very important to avoid any chance of breakdown to the metal due to voltage rises. The ends of the winding must be brought out at the middle of the coil, and not at the inside or outside, so that there is no chance of the insulation being rubbed off when the coil is put in the pot. To get the coil comfortably into the pot, the latter should be rubbed carefully inside with

[1] A single coil of larger wire to dissipate 25 watts can be used for 100 volts.

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paraffin wax. Where the leads come up inside the coil near the central pole and at the bottom they should be well protected with cistoflex. A slight space should be left above the winding to allow the leads to be brought out readily.

Moving Coil.

So far as this item is concerned, the reader must determine for himself whether he uses a high- or a low-resistance unit. I should advise him to try both, making quite sure that the diaphragms for each coil are as alike as possible. A high-resistance coil 2in. in diameter can be wound with 800 to 1,200 turns of No. 46 enamelled wire. It must be varnished and baked to get good insulation between turns and to secure the necessary mechanical rigidity. A wire of smaller diameter will give a lighter coil, but is more difficult to wind and more liable to burn out. This, however, can be left to the reader's discretion. He ought to remember that more turns mean reduced upper and lower tones, but a greater output. The greater the diameter of the wire, the greater the mass, but the lower the resistance and the better the mechanical rigidity. With the above coil the internal A.C. resistance of the power valves can vary from 4,000 ohms to 1,000 ohms. The quality, of course, changes, but the alteration is not serious. The output increases as the valve resistance decreases, due to the augmented alternating current in the coil. For example, with a 1,000-turn coil the D.C. resistance is about 900 ohms, and with a valve having $\rho = 4,000$ ohms the output would be proportional to $\left(\frac{1}{4,900}\right)^2$. Putting another valve of the same class in parallel would make the output proportional to $\left(\frac{1}{2,900}\right)^2$. Thus the ratio of the outputs would be $\left(\frac{4,900}{2,900}\right)^2 = \frac{2.9}{1}$. This is readily detected by ear, especially when the intensity is appreciable. With this coil, a valve impedance of 1,300 ohms and a set operated from 200-volt mains, the low tones of the grand organ are sufficiently powerful to make objects in a room of average size vibrate appreciably, whilst an orchestra is more pleasant in the next room. In other words, the intensity is considerable, but where low tones abound, the shrillness of the upper register is counterbalanced.

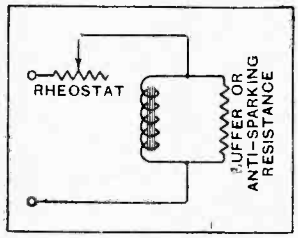

Fig. 11.—Connections of magnet winding showing buffer or quenching resistance to absorb back E.M.F. of magnet winding.

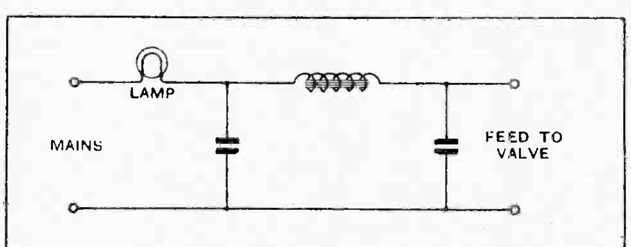

Fig. 12.—Safety lamp connected in H.T. feed to reduce damage through a short-circuit between moving coil and electro-magnet.

Attention should be paid to the insulation of the inner surface of the coil to avoid the wire touching the central pole and short-circuiting the mains as described previously. Various precautions can be taken. In Fig. 12, if a short-circuit occurs, the lamp lights, and this is possibly better than using a fuse. This point, however, can be settled by the constructor himself. A partial short-circuit occurred on my own set, due to the field winding earthing to the pot. When the coil touched the pot it made a valiant effort to drive the diaphragm across the room.

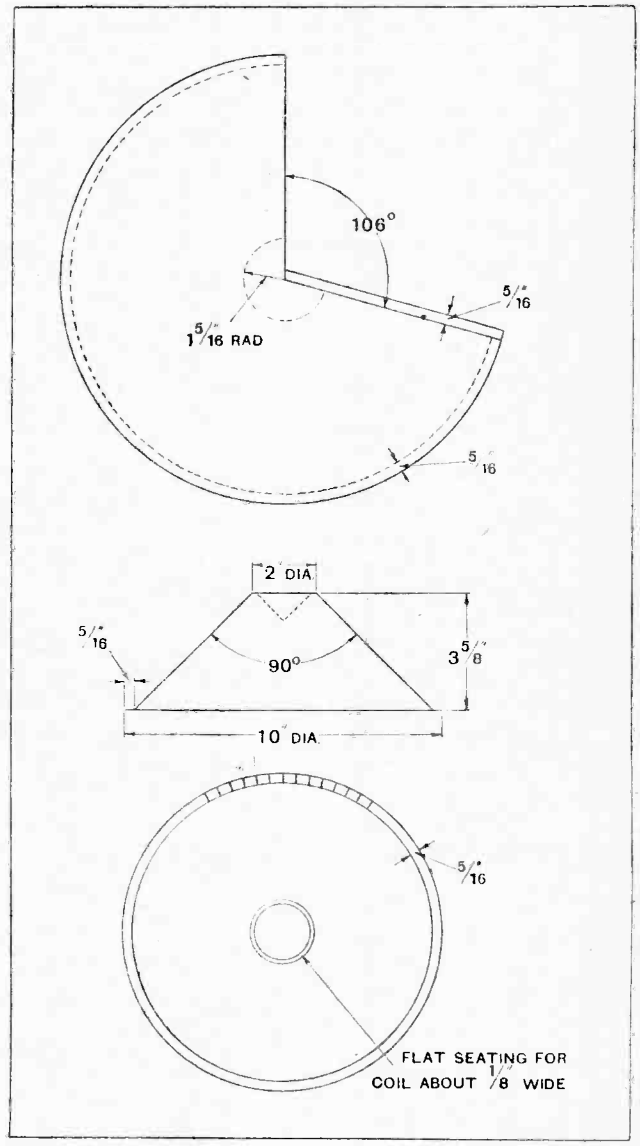

Fig. 13.—Dimensions and constructional details of diaphragm. The cuts in the rim are spaced ½ in apart.

A low-resistance coil can be wound with 40 to 50 turns of No. 32 or 34 D.S.C., the construction being identical with that of the high-resistance moving coil. The transformer can be a Marconiphone Ideal core with 3,600 turns on the primary and 360 turns on the secondary. The primary is wound in three sections, and the secondary in

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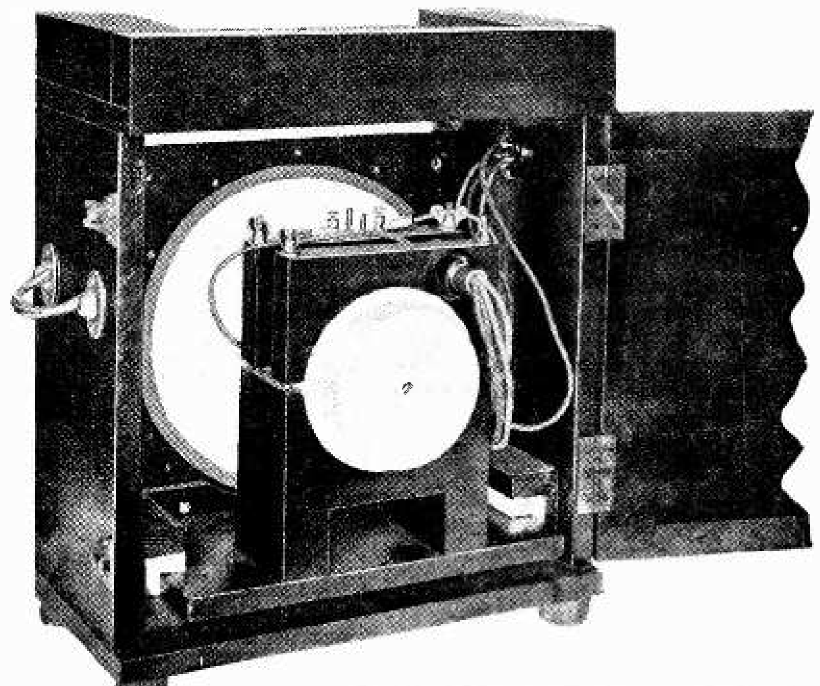
two or four. The latter is preferable to reduce leakage. The terminals should be such as to allow a ratio of $\frac{3,600}{360}$ or $\frac{3,600}{180}$, but the whole of the secondary should always be used, *i.e.*, for 180 turns the two halves are connected in parallel.[2] The windings should have the lowest possible resistance. No spacing pieces are needed to separate the coils. The wire for the primary is No. 38 enamelled or No. 40 D.S.C., the latter being preferable, unless the No. 38 is well varnished and baked. The coils should be wound closely, or they may not fit on the core. It is advisable to make a check calculation to make sure that, according to the winding method employed, the five or seven sections will fit on the core. As a first approximation the primary of an Ideal $\frac{6}{1}$ has about the correct number of turns, viz., $\frac{20,000}{6} \doteqdot 3,300$. This winding, with a secondary of 170 and 340 turns of No. 22 D.S.C., will make quite a good first attempt.

The inductances of the windings can be calculated approximately *for small alternating currents* as used with an A.C. bridge at 500 cycles, from the knowledge that 1,000 turns are equivalent to 1 henry. Thus 3,300 turns $\doteqdot$ 11 henries. The inductance depends, of course, on the value of the alternating current, and increases therewith up to a point.[3] At low frequencies, where the magnetising current of the transformer is greatest, the inductance will exceed 11 henries. The permeability of the iron for this value of inductance is 260. The permeability steadily increases with the magnetising current, and the latter will depend upon the frequency and the signal strength. Thus we have a further distortion from the transformer, which ought to have been cited previously. If we assume that the magnetising current of the transformer is 10 per cent. of the total current at 100 cycles when that total is 10 milliamperes, the R.M.S. magnetising force is approximately 0.23 C.G.S. unit. From curves for Stalloy we find that the permeability exceeds 1,000, so that the inductance will exceed 40 henries, which is quite a large value.

So long as the inductance with small currents is fairly large, the increase in inductance does not alter the quality to the extent indicated by this calculation. For the best results, the intensity should not be too weak, or the magnetising current will be an appreciable fraction of the whole In this way the coil would be robbed of current by the transformer, or, in other words, the value of L_1 in Fig. 8 (b)[4] would be small enough to by-pass coil current. Obviously this argument becomes more forceful at frequencies lower than 100. At 50 cycles the by-passing action of L_1 is roughly double that at 100 cycles.

The Diaphragm.

The shape chosen for the diaphragm is a right circular cone. Its central angle is probably more a matter of experiment than calculation. The projected diameter is a question depending upon the conditions of operation and the personal taste of the experimenter. From the flat disc theory we saw that the larger the disc the weaker the high tones, and after a certain point the low tones decreased, owing to the "accession to inertia effect." Then on top of all this we must consider the low-frequency motional and high-frequency inductive reactances of the coil. Also there are cone resonances, which may spoil all our schemes unless care is taken to reduce them to a minimum. Taking various factors into account and including balance of the musical scale, spatial distribution, and efficiency, I have found the diaphragm of Fig. 13 to give satisfactory results. But I think the experimenter should discover for himself the result of increasing or decreasing the diameter of the diaphragm. A 6in. diaphragm is somewhat lacking in bass, and usually makes the letter "s" whistle, but, apart from focussing, a 12in. diaphragm should give fair results, provided always that the real result is not masked by strong resonances. This diaphragm will have a noticeable focussing at high frequencies, but the low-frequency register should be good.



Rear view of loud-speaker movement, showing clamp for electro-magnet.

The paper portion is cut to the dimensions given in Fig. 13. No reinforcing cone is used at the apex, but a circle is drawn which has a projected diameter on the diaphragm equal to that of the coil. The apex is pushed inwards, starting at the point and gradually advancing

[2] A 3,600 : 240 (15 : 1) ratio can be used if desired.
[3] See "Intervalve Transformer Cores," *The Wireless World*, July 14th, 1926, p 45.
[4] *The Wireless World*, March 30th, 1927.

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with care until the diameter at the base is that of the coil, *i.e.*, to the circle line.

A piece of cardboard 14in. square is cut with a central hole about 11in. diameter and smeared with Seccotine. A piece of sheet rubber (5 to 8 mils. thick; a rubber apron will probably serve the purpose) is stretched —just taut—over the sheet and pasted down with a roller faced with rubber as for photographic work, or a rolling pin. This is allowed to dry. The serrated edge of the diaphragm is painted with seccotine, and the diaphragm then put centrally on the rubber. The various paper flaps round the edge are pressed down on to the rubber, and a light weight put on the top of the diaphragm until the adhesive is dry. A better but more tedious way is to apply a little french chalk to the rubber and place the diaphragm centrally on it before applying the adhesive. This, under the action of a pressure by hand on the vertex, allows the periphery of the diaphragm to slide over the rubber and take a more circular shape. Having got a good seating on the rubber, four flaps 90° apart are lifted and painted with Seccotine, using a small brush, each flap being pressed down. Meanwhile, pressure is maintained at the top of the diaphragm, and

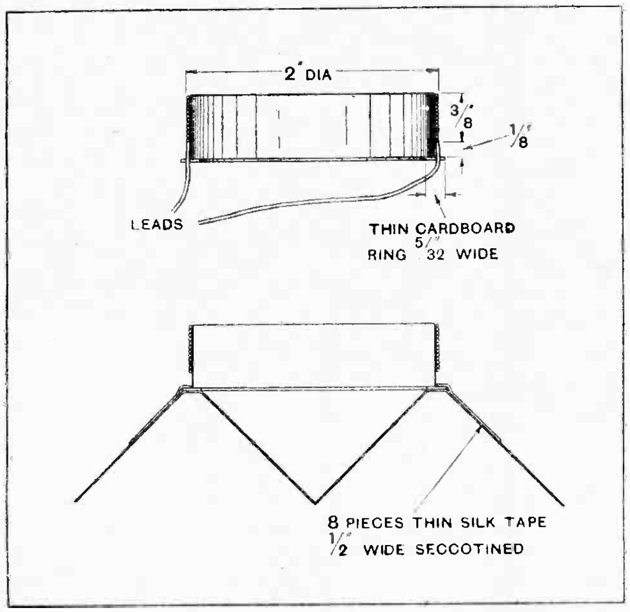

Fig. 14.—Method of mounting coil on diaphragm.

other flaps treated similarly. A light weight is left on the diaphragm whilst the adhesive dries.

The rubber at the front is now cut away with a sharp knife or scissors, which can be dipped in water to make cutting more facile. The cardboard is then mounted in a wooden frame—unless it is stiff enough to be self-supporting—or a piece of multi-ply wood was used in the first instance, as in Fig. 15. The frame is put on a horizontal table and the circle at the vertex adjusted until its plane is horizontal. This ensures that the axis of the coil will also be horizontal. Take now a piece of ebonite tube of external diameter equal to that of the coil and the wall thickness of which is 3-32in. Turn the diaphragm over and run round the inside with the tube to make a flat seating for the coil. Now invert it to check whether the flat seating lies in a horizontal plane. Place the paper flange of the coil on the seating and see that the axis of the coil is vertical and that it sits properly.

Before proceeding further a decision must be made regarding the leading-in wires to the coil. Various courses are open, but it is always essential to avoid resonance due to leading-in wires. The wires will vibrate audibly if care is not taken. One method is to stick them to the diaphragm and bring them to terminals on the wooden frame. Another is to take them part-way along the diaphragm and bring them up to terminals mounted on the cradle for the pot. In any case, the free portions should be flexible, short, and of greater diameter than the wire of the coil (see Fig. 16).

Having settled the mode of leading-in, the coil flange is smeared with seccotine and pressed on to the diaphragm seating. Then a number of strips of silk (say eight) are used for additional strength to connect the flange to the cone (see Fig. 14). This mode is, of course, not unique, and other methods will occur to the experimenter. The pip or re-entrant cone has not been decapitated to avoid circulation pressure. A centering device can be used, in which case the pip is removed. Care must be taken to avoid appreciable constraint due to this device, or the amplitude may be curbed at low frequencies. On the other hand, there is the possibility of introducing sufficient elasticity to cause resonance. With a wide air gap the centering device—for an experimental model—is unnecessary. Sometimes centering can be done with three threads at 120° on the flange of the coil, but care must be taken to avoid these resonating. Elastic might serve the purpose.

The mounting of the diaphragm and pot are shown clearly in one of the photographs. The back of the cone should be as free as possible of obstructions to allow the sound to be freely radiated.

Influence of Diaphragm Mass.

For efficient working it is necessary to reduce the mass of the diaphragm as much as possible. There is a limit to the reduction in mass beyond which the acoustic performance alters appreciably, but there is little fear of that being approached with present-day materials of construction, using a diaphragm 8in. to 10in. in diameter.

As against this we might enquire what happens when the mass of the diaphragm and coil are increased beyond the values given in Table I.[5] Suppose we double the mass of the disc. The total mass is now $20+5+3.5=28.5$ grams. The value of the motional capacity C_m is $\frac{m}{C^2}$. But C^2 is unaltered, as we have not changed the coil, whereas m is increased in the ratio $\frac{28.5}{18.5} \doteq 1.5$. This means a 50 per cent. increase in C_m. Thus the low-frequency motional reactance will decrease considerably, thereby giving a larger current. This increase, combined with the lesser relative importance of

[5] *The Wireless World*, March 30th, 1927.

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the air inertia at low frequencies—3.5 is a much smaller proportion of 28.5 than of 18.5—means augmented output at low frequencies. But—the inevitable price we pay—the radiation resistance at *all* frequencies is reduced in the ratio $\left(\frac{1}{1.5}\right)^2 = \frac{1}{2.25}$, *i.e.*, the output is halved, except at low frequencies, to get an improved bass register. In practice it is imperative to ensure that the conditions under which the above statements are formulated do not suffer violation due to pronounced diaphragm resonances.

The Baffle.

The function of this accessory is to reduce interference between the two sides of the diaphragm. To avoid interference absolutely, the two sides of the diaphragm should be completely isolated. A box construction does this, but generally introduces additional effects and should be avoided if possible. To prevent a loss in output, especially below the middle of the pianoforte, a baffle is necessary to reduce the solid angle into which the diaphragm discharges. It is an easy matter to try various shapes of baffle made out of cardboard. A size 4ft. to 6ft. square is suggested for experimental work. A wide, short, conical horn (say, 3ft. long), made out of cardboard, should be tried in addition to the flat board to investigate the problem. As a permanent fitting, a piece of multi-ply board 4ft. square and ⅜in. thick will be found satisfactory, although to get the very low tones of the organ properly it should be larger. Perhaps we should mention that there must be no air space through which pressure waves can leak in the vicinity of the diaphragm. The baffle should bed well on the diaphragm frame, and a thin piece of felt at the rear of the baffle would accomplish this comfortably.

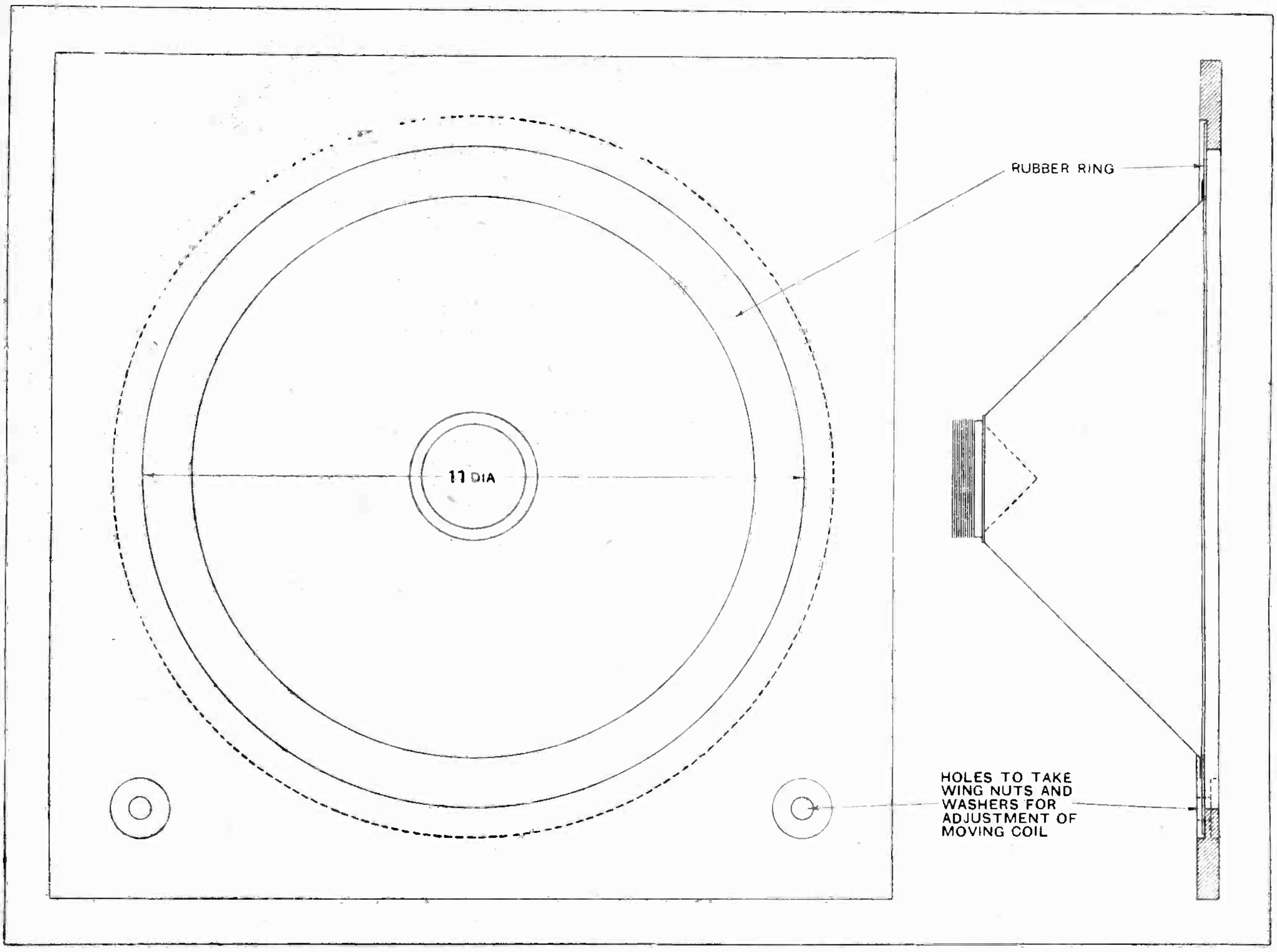

Fig. 15.—Adjustable frame for supporting edge of diaphragm

We have seen that the motional capacity and the accession to inertia are responsible for reduced low-tone output. Also we know that acoustic output can be enhanced by reducing the solid angle into which the diaphragm discharges. Thus we should expect a baffle shaped after the form of a short, wide, double hollow pyramid of square section would assist the lower frequencies. This is easily made for experimental purposes with cardboard. Comparative tests can be made with a flat baffle, but these tests should be conducted when there are low tones to

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reproduce, *e.g.*, full orchestra, grand organ, military band with bass drum.

Amplifiers.

It is not intended to discuss the question of amplifiers or amplifier design. Obviously the amplifier characteristic should be uniform from 50 to 7,000 cycles or more in order to do the loud-speaker justice.[6] The amplifier described by Mr. Haynes in *The Wireless World* for February 16th, 1927, suits the purpose quite well. Some experimenters may prefer to use resistance-capacity coupling for the last two valves. On this score I hold no hard-and-fast views. If a $\frac{2.7}{1}$ transformer is used, the H.T. voltage with a D.E.5, L.S.5, or similar valve should not exceed 150 volts, to avoid saturating the core and reducing the low-frequency inductance. In the majority of cases 120 volts will be ample. The ampere-turns per centimetre can be checked, knowing that the turns per centimetre are about 400. Thus with a feed current of 6 mA. the ampere-turns per centimetre are $6 \times 10^{-3} \times 400 = 2.4$. The variation in value of the differential permeability at 500 cycles is indicated by the curve of Fig. 3, "Intervalve Transformer Cores."[7] The inductance will be reduced in value, however, if the iron has previously been magnetically saturated by too large a feed current through the primary.

Summary.

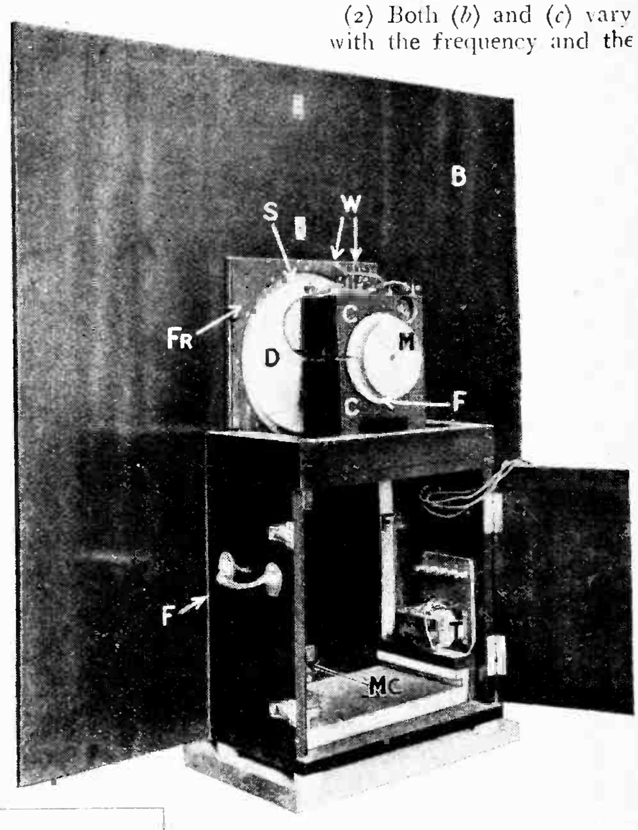
Owing to the extensive nature of the subject, it is well to epitomise the situation in general.

(1) The force required to make a diaphragm vibrate in air consists of three components, namely, (*a*) that required to overcome the mass inertia of the diaphragm, (*b*) that required to overcome the "accession to inertia" of the diaphragm in virtue of the air moved, (*c*) that required to overcome the pressure due to the generation of sound.

(2) Both (*b*) and (*c*) vary with the frequency and the size of the diaphragm. (*b*) is greatest at low frequencies, and increases with the size of the diaphragm. At low frequencies it is proportional to the cube of the diameter of the diaphragm. Since the mass of the diaphragm depends on the square of the diameter, the accession to inertia increases more rapidly than the mass of the diaphragm.

For diaphragms of average size the magnitude of (*c*) is almost negligible in comparison with (*a*) and (*b*).

(3) The distribution of acoustic radiation from a diaphragm depends upon its shape. With a flat disc (and a cone) there is a reduced output at high frequencies, owing to interference of the radiation from different parts of the diaphragm. With a cone the reduced solid angle at the concave side and the



The complete loud-speaker with 4 ft. baffle B of multi-ply wood. C, cradle for holding magnet; D, cone diaphragm; F, felt for damping; Fr, supporting frame for diaphragm; M, field magnet; MC, magnet control rheostat and multi-sparking resistance; S, diaphragm suspension; T, input transformer; W. leads from moving coil.

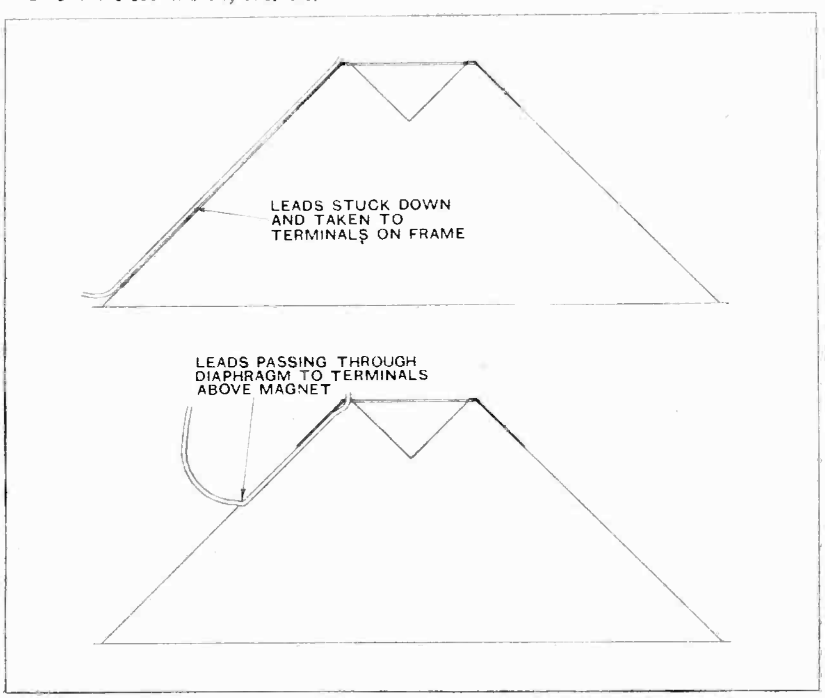


Fig. 16.—Alternative methods of fixing leads from moving coil.

[6] A rise in the lower register would be beneficial to counteract the effect of motional capacity.

[7] *The Wireless World, loc. cit.*

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increased angle at the convex side mean a greater and a lesser H.F. output respectively.

(4) Apart from resonance, the larger the diaphragm, the less the high-frequency radiation.

(5) When a diaphragm is driven by a moving coil the motion of the coil in the magnetic field induces a back E.M.F. which reduces the operating current. This means that the coil has a motional impedance. For simplicity this impedance can be regarded as a resistance, equal to the acoustic radiation resistance, in series with a condenser. The impedance (owing to the condenser) increases as the frequency decreases.

(6) The current is also reduced at high frequencies due to the coil inductance. At a certain frequency the inductance and motional capacity yield electromechanical resonance.

(7) To prevent the current being reduced appreciably at the upper and lower extremities of the acoustic register, the internal valve resistance *plus* that of the coil should be somewhat greater than the capacity reactance at low frequencies and the inductive reactance at high frequencies.

(8) The air pressure on the axis of a flat disc at points exceeding about eight diameters distant is directly proportional to the acceleration of the disc and inversely proportional to the distance from the disc.

(9) The acceleration of the disc depends upon the current in the coil and upon the total equivalent mass of the moving parts. The latter is greatest at low frequencies, whereas the current tends to fall away at both high and low frequencies. Thus the acceleration of the disc, and therefore the axial air pressure, falls off at both extremities of the acoustic register.

(10) The air pressure at a point distant from the disc whose radius vector (see Fig. 6, March 30th issue) makes an angle θ with the axis, is equal to that at a point on the axis, equi-distant from the disc, multiplied by a factor depending upon θ and the frequency. The factor *decreases* with increase in f and θ. At high frequencies there are values of θ where the air pressure is zero, and in general the radiation is confined to a beam whose angular width is $2\theta_1$ where θ_1 decreases as the frequency increases.

Book Review.

"History of Radiotelegraphy and Radiotelephony." By G. G. Blake, M.I.E.E., A.Inst.P. (*Radio Press, Ltd., London*, pp. xix—425. 1926. Price 25s.)

Although the science of radio communication in the sense that we know it to-day may be said to be only thirty years old, the first discoveries relating to this method of transmitting intelligence were made more than fifty years ago. Prior even to this date many suggestions and experiments had been made in connection with electrical communications both with and without connecting wires between the two stations, and descriptions of many of these early experiments and apparatus make curious reading in the light of modern knowledge.

The invention, and more particularly the practical development of the thermionic valve, has probably been responsible for a more intensive and revolutionary development of radio methods than has taken place at any other period of its history. As a result of the more powerful methods of research thus made available, the realisation or development of several of the earlier arrangements or methods becomes more practicable and may have valuable results. The possibility of such developments by the bringing to light again of almost forgotten schemes and inventions is one of the reasons which have led to the production of this history, in which accounts are given of the development of radio communication and of many of the devices and appliances associated with it. To assist the experimenter and research worker full references are included in the bibliography attached to the end of the volume so that fuller details of any apparatus mentioned can be found if desired.

The work is divided into sixteen chapters with four appendices, and is profusely illustrated throughout. A résumé is given of modern views of electrical action as an introduction to the history, and this is followed by a sketch of the development of electrical signalling systems and of the telephone, before electromagnetic waves and their production and detection are discussed. Subsequent chapters deal with various practical radio transmitting appliances in use to-day—Spark, Arc, Alternator, Valve, etc.—with details of their development from early ideas. The applications of radio to direction-finding, radio control, photographic transmission, television, broadcasting, short-wave and "beam" transmissions are dealt with in considerable detail, while in Chapter XV is a particularly full account of the many applications of the thermionic valve to the numerous receiving and amplifying circuits in use to-day.

An entire chapter is devoted to the development of the microphone as applied to radiotelephone transmission as distinct from ordinary telephony; while frequency raisers, radio "calling-up" devices and recording apparatus also find a place.

To produce a complete history of the growth and advance of radio appliances from their embryonic states is a task of encyclopædic magnitude, and the author of the work under review must have experienced considerable difficulty in arriving at a decision as to what to include and what to omit. The selection that has been made, however, provides a very interesting historical story, and one that will doubtless also be of considerable value to all workers in this field of investigation.

The book is well printed and produced, and the diagrams and illustrations are very clear. There is evidence also that extensive additions have been made throughout the text to keep it up to date during the publication period, and the inclusion, for example, of reference to the Transatlantic Telephone is evidence of the author's success in this direction. It may be added, also, that this history is a particularly welcome one in that it gives an account of radio development from the scientific aspect rather than from the necessarily biassed view-point of commercial application.

PHILIP R. COURSEY.

BOOKS AND CATALOGUES RECEIVED.

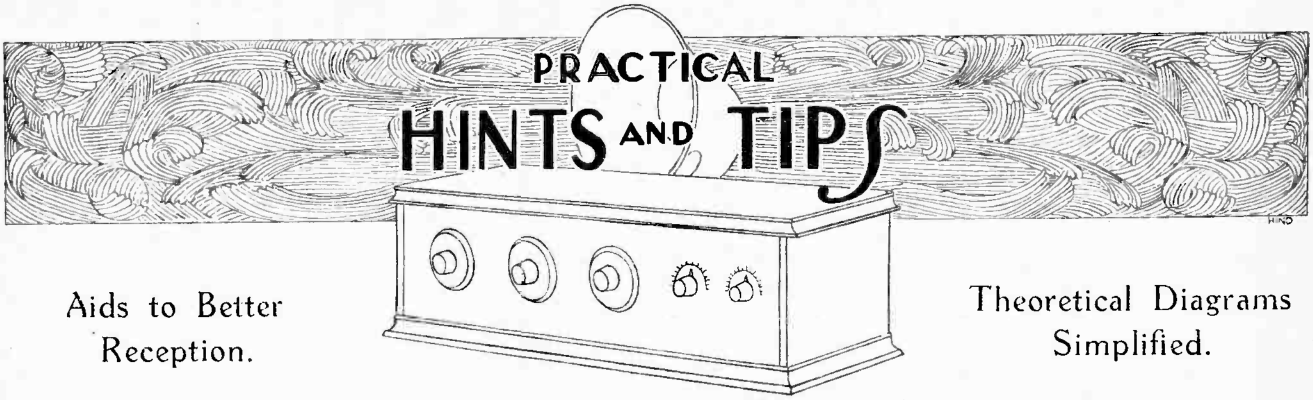
Ward and Goldstone, Ltd., Frederick Road, Manchester. List RW/51, relating to all types of wire for radio purposes.

D.P. Battery Co., Ltd., Bakewell, Derbyshire. Brochure dealing with D.P. Kathanode batteries for locomotives.

"The Inner Number," by F. Chenhalls Williams. A story based upon wireless and mental telepathy. Pp. 274. Published by Longmans, Green and Co., Ltd., London. Price 7s. 6d. net.

"Bildfunk." Anleitung zum Selbstbau eines Bildempfängen (Wireless Transmission of Pictures with Instruction for Constructing a Receiver). By R. Hell. Pp. 114, with 80 illustrations and diagrams. Published by R. C. Schmidt and Co., Berlin. Price Rm. 3.50.

"Rundfunktechnisches Handbuch," Part II., by Dr. Heinrich Wigge. Pp. 314, with 417 illustrations and diagrams. Published by M. Krayn, Berlin. Price mk. 12.



Aids to Better Reception.

Theoretical Diagrams Simplified.

PREPARING LITZ WIRE.

The high-frequency resistance of a coil wound with multi-stranded cable may be increased appreciably if even a single conductor is broken, so great care should be taken in baring the wire. It is recommended that, after unlaying the outer silk coverings, the ends should be laid on a piece of paper, when the individual wires may be lightly scraped with a knife—which should not be too sharp—or a piece of emery cloth. It will then be an easy matter to see if any of the strands are broken off.

It is hardly necessary to test each conductor, although it is not a very difficult matter to do so; one end should be bared and soldered, and then connected to a terminal of a testing circuit. The separate strands at the other end should be scraped and frayed out, when they may be counted and the continuity of each tested in turn.

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WIRING PROCEDURE.

When wiring up a receiver, it is as well to adopt a methodical and systematic plan. While no method can be said to be definitely right or wrong, it will be found convenient to start with the negative 'bus-bar (common to both L.T. and H.T.). Whatever kind of conductor is used for the main wiring, this lead should be of bare wire, as a considerable number of connections will eventually be made to it.

The filament circuits of all the valves should now be completed, after which the aerial-earth leads and connections of the grid circuit associated with the first valve should be wired. One should now proceed with the grid circuit of the succeeding valve, and so on to the output stage. By following this plan, the risk of omitting essential leads, or introducing errors, is reduced very considerably.

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MODIFYING THE "NUCLEUS" RECEIVER.

When an extra low-frequency amplifying stage is added to the "Nucleus" receiver (described in *The Wireless World* for December 1st, 1926), trouble may occasionally be caused by the action of H.F. currents in the L.F. circuits. This will probably manifest itself by the production of a "howl," which can generally be prevented by connecting a resistance of from a quarter to half a megohm in series with the grid of the first L.F. valve, as shown in Fig. 1. This arrangement, which has been included in several receivers described recently in this journal, is applicable to any circuit in which a stage of resistance coupling follows the detector valve. Room can almost invariably be found for the necessary resistor, and the plan is one which should always be tried when the reproduction seems to be lacking in quality, even if audible L.F. oscillation is not produced.

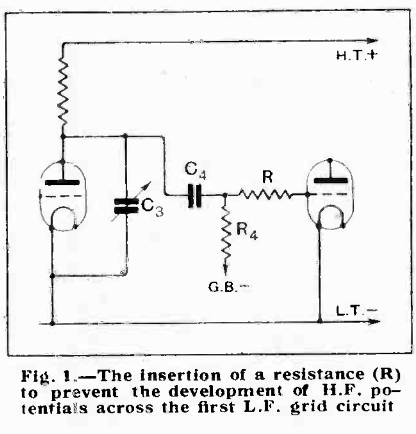

Fig. 1.—The insertion of a resistance (R) to prevent the development of H.F. potentials across the first L.F. grid circuit

The resistance will naturally be of the grid-leak type, and, if possible, various values should be tried experimentally. An H.F. choke of small physical dimensions and low self-capacity may be substituted for it; this is likely to be even more effective on the longer wavelengths, where the difficulties of separating the L.F. and H.F. components are more pronounced.

oooo

REACTION ADJUSTMENTS.

The best size of reaction coil in almost any receiver can be found only by the method of trial and error, as so much depends on the amount of damping present in the circuit, and on other factors which can hardly be allowed for by the designer. The constructor who is disappointed with the results obtained from his set should accordingly make experimental adjustments to the number of turns in this coil, always bearing in mind the fact that the smallest inductance which allows oscillation to be produced over the whole tuning range is likely to be the best.

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TESTING "EVERYMAN" COILS.

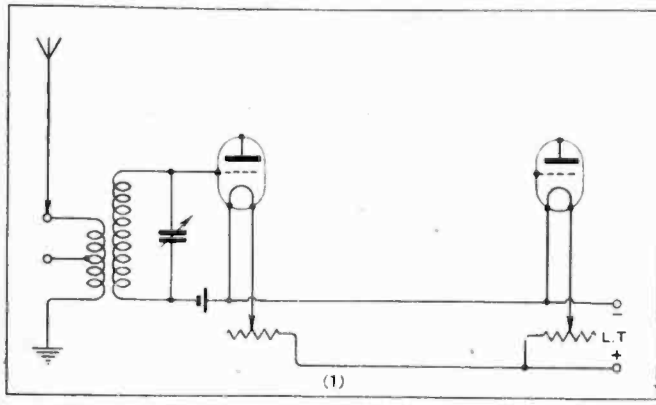
Before connecting up the H.F. transformers used in the "Everyman Four," the "Wireless World Five," and several other receivers recently described in this journal, the amateur is advised to assure himself that the fragile primary and neutralising windings are intact and not short-circuited. The connection between the two screws, which will ultimately be joined to H.T.+, should be removed temporarily, as by doing so it will be possible to make a more conclusive continuity and insulation test.

DISSECTED DIAGRAMS.

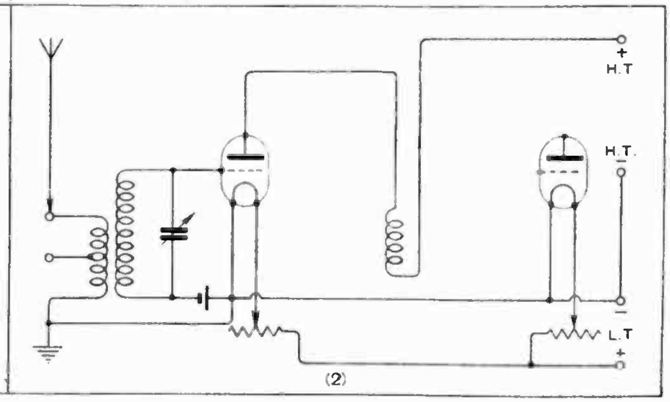
Practical Points in Design and Construction.

No. 67.—A Modern H.F. Amplifier with Anode Detector.

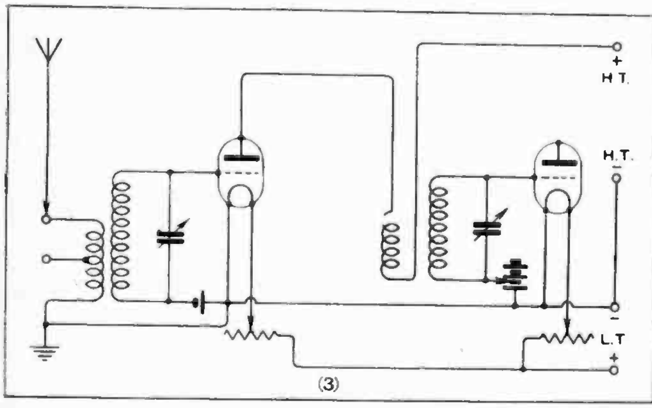
The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless receivers, and at the same time to assist readers in mastering the art of circuit diagrams. The arrangement shown below, with the addition of a suitable L.F. amplifier (to be shown in next week's issue), represents the best modern practice, and is, in essentials, that of the popular "Everyman Four" receiver.



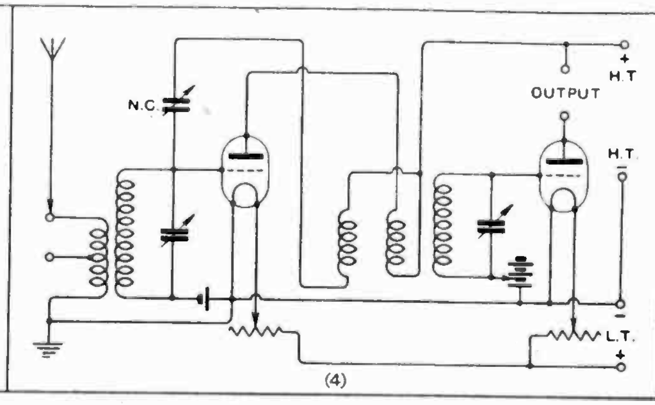
The filament circuits of the valves are completed in the usual manner. The tuned secondary of an "untuned aerial" transformer is connected between grid and filament of the H.F. valve, a negative bias battery being interposed.



The negative L.T. is generally connected to earth as shown, thus tying down all the batteries to earth potential. The anode circuit of the H.F. valve is completed through the transformer primary and H.T. battery.



The tuned secondary of the H.F. transformer, with condenser in parallel, is connected between grid and filament of the detector valve. An adjustable bias battery for rectification is inserted in the low potential end of the circuit.



A neutralising winding, coupled to the primary, is connected back to the H.F. grid through a balancing condenser. The anode circuit of the detector is completed through telephones or an L.F. coupling device.

THE majority of modern H.F. transformers are designed to work with a valve of, very roughly, 20,000 ohms impedance, so one of this pattern will be chosen as an H.F. amplifier, except where, due to the proximity of a powerful local transmitter, extreme selectivity is necessary. In such cases an efficient "high amplification" valve, of not much more than 50,000 ohms, may be chosen with advantage.

Grid bias is applied to this valve both to economise in anode current and to prevent damping. With the high magnification valve mentioned above, this must be reduced, or, in the case of valves where such currents do not flow until the grid is made appreciably positive, may be eliminated altogether.

The detector valve will usually be of the high-magnification, high-impedance type, if it is to be resistance-coupled to the L.F. amplifier.

The aerial-grid transformer may be of the type used in the "Everyman Four," and several other receivers recently described in this journal, with a low-resistance secondary and a spaced aerial winding of fine wire. To cover the normal broadcast waveband, for which the set under discussion is primarily designed, a 0.0003 mfd. tuning condenser is suitable.

The high-frequency transformer may also with advantage be of the design used in the receiver already mentioned; it has a low-resistance secondary, tuned by a 0.0003 mfd. condenser, and a space-wound primary of extremely fine wire to keep down capacity between the windings. Referring to (3), when the two circuits are brought into tune, oscillation would be produced. This is prevented by feeding back opposing voltages developed across the added neutralising winding shown in (4) through a balancing condenser (N.C.).

The prevention of interaction between the two transformers is a matter of the greatest importance; to overcome this difficulty an earthed metallic screen is usually interposed between the two coils.

CRYSTAL-CONTROLLED TRANSMITTER.

Practical Details of a 50 watt Installation Working on 45 Metres.

By R. W. H. BLOXHAM (5LS).

MUCH has been written in the technical journals regarding the piezo-electric properties of quartz crystals and the application of such crystals for the purpose of providing resonators giving a frequency standard, or for the stabilisation of transmitters.

It is not proposed, therefore, to go over this ground, and the reader is referred to the issues of *Experimental Wireless* for March 1926, December 1926, and January 1927, where a very full exposition of the theory of operation and practical working details of crystal oscillators and crystal-controlled transmitters is given by Messrs. Goyder and Hinderlich.

It is therefore the object of the present article to record a few practical details regarding the setting up of crystal-controlled transmitters, which are the result of much experiment and the trying out of various schemes, and also to describe a set which has been made to give excellent results, and is at the same time economical in the amount of apparatus required.

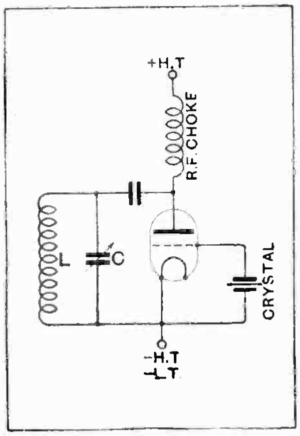


Fig. 1.—Crystal-controlled valve oscillator with "parallel" H.T feed.

Fig. 1 shows the conventional circuit arrangement of a crystal oscillator valve; in this case shown with "parallel" H.T. supply. When the circuit LC is tuned to the fundamental frequency of the crystal the valve will oscillate. As is well known, the oscillations are absolutely constant in frequency, and resist any tendency to frequency changes; so much so that, even with an unsmoothed rectified A.C. high-tension supply, a practically pure C.W. output is obtained.

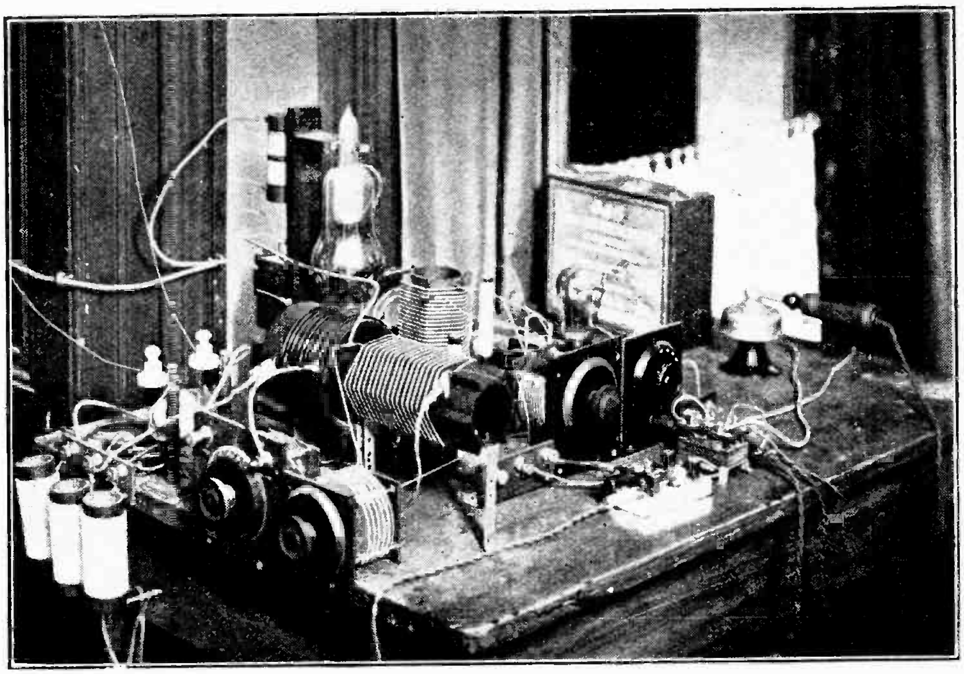
Since it is not possible to apply a voltage exceeding 400 to the crystal oscillator valve, on account of the danger of cracking the crystal, it becomes necessary to employ amplifying stages if the input to the aerial is to exceed 5 or 8 watts. Two alternative systems are available, the first being to employ a crystal with a fundamental frequency equal to that of the final output, and the second to employ a crystal oscillating at a harmonic of the final output frequency.

The first method is very difficult to put into operation, although the amplification per stage is somewhat higher than that obtained by the harmonic method. The difficulty is to prevent self-oscillation immediately the plate circuit of any valve is tuned to the same frequency as the grid circuit.

Keying.

Keying is the next problem requiring solution, and the usual method generally involves the stoppage of oscillations in the final amplifier. If all the valves are supplied with H.T. from a common supply (with the voltage suitably reduced by resistances for the various stages) the starting and stopping of oscillations in the valve taking most current will cause very considerable fluctuations of H.T. voltage applied to the other valves. This regulation will immediately upset the adjustment of the intermediate amplifying stages, if not the crystal oscillator itself, and self-oscillation sets in, the balance of the whole system being affected.

This can, of course, be overcome in two ways. Firstly, the set may be keyed at some point in the aerial circuit, although this is not easy to arrange where large R.F. currents are present in the station portion of the antenna leads. Also, unless the final amplifier is of very generous dimensions for the power it has to handle, trouble will be bound to occur through heating of the anode, since when



General view of the 45 metre, crystal-controlled transmitter at 5LS.

Crystal-controlled Transmitter.—
the key is up there is no opportunity for it to dissipate the energy generated. Secondly, the difficulty of the voltage regulation due to the keying of the final amplifier may be overcome entirely by arranging a separate H.T. supply for this valve, the crystal oscillator and any intermediate amplifiers being fed from one common but entirely separate source.

This is, however, an expensive system, since in the case of stations employing A.C. as a source of power, two separate H.T. transformers, with their attendant rectifying arrangements, are necessary, besides smoothing apparatus for each supply.

With harmonic operation the regulation trouble does not make itself nearly so apparent, and it is possible to key the amplifier in the usual manner and to work crystal oscillator and amplifier from one H.T. source. There is also very little tendency to self-oscillation of the amplifier, and any such tendency is fairly easily overcome.

The Crystal Oscillator.

Half the secret of getting proper control lies in working the crystal oscillator valve at full output. Referring to Fig. 1, it will be noted that no reaction arrangement is shown. If reaction is necessary, it may be applied in the usual manner, as explained fully by Mr. Hinderlich in *Experimental Wireless* (January 1927).

Full output from the crystal valve could not be obtained with the grid circuit arrangement as shown in Fig. 1. The crystal itself is a fairly good insulator, and the grid of the valve would become so negatively charged as to reduce the amplitude of the oscillations. If the amplifiers are to work at the fundamental frequency of the crystal, it is usually sufficient to connect a grid leak in series with an R.F. choke across the grid-filament circuit of the oscillator valve. Where harmonic amplification is to be employed, the grid leak should be replaced by a bias battery.

It will be found that the grid may be made very considerably negative without cutting down the output, and at the same time the high bias tends to produce a strong harmonic in the output at double the frequency of the crystal oscillation.

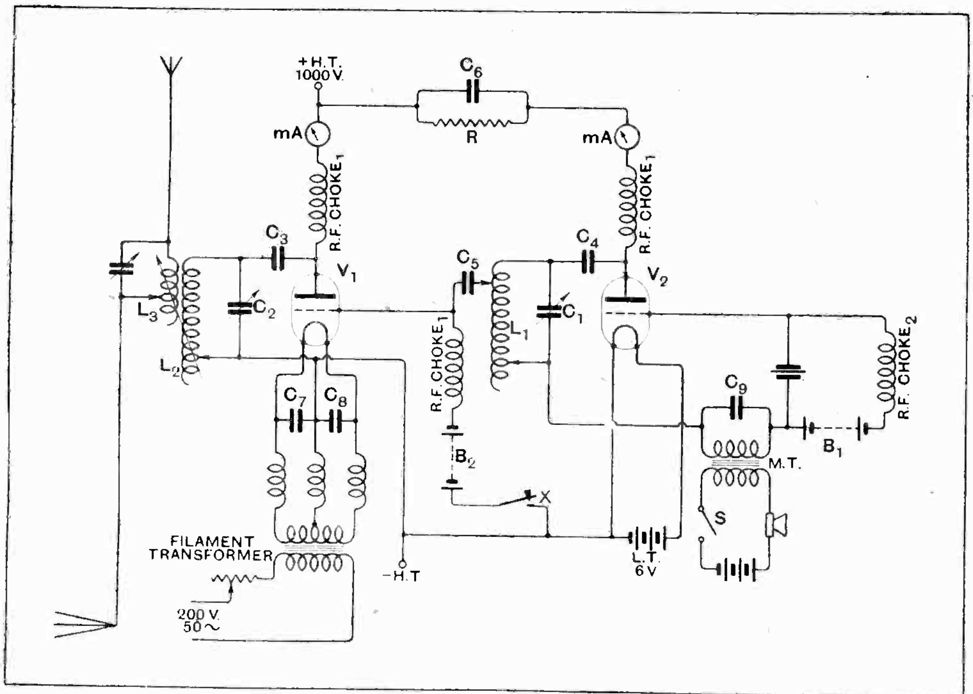


Fig. 2.—Circuit diagram of 50 watt crystal-controlled transmitter. R.F. choke$_1$, 3-inch windings of No. 30 D.S.C. on ⅜in. dia. formers; R.F. choke$_2$, 100 turns No. 30 S.W.G. random wound 1½in. long, ⅜in. dia.; C_1 0.00025 mfd.; C_2, 0.0001 mfd., double spacing; C_3, C_4, C_5, 0.0005 mfd.; C_6, 0.002 mfd.; C_7, C_8, 0.01 mfd., C_9, 0.002 mfd.; L_1, 25 turns No. 16 S.W.G., 3in. dia, spaced ¼in.; L_2, 18 turns No. 16 S.W.G., spaced 5 turns per inch.; L_3, 10 turns No. 12 S.W.G. 4 in. dia., spaced $\frac{3}{16}$in.; B_1, 45 volts; B_2, 120 volts; M.T., microphone transformer; S, battery switch; X, key provided with shorting switch for telephony.

It will be obvious that in order to secure the greatest output possible from the small available grid swing given by the crystal, it is necessary to employ a valve having a high amplification factor. At the same time it must be capable of giving full output power with the available 400 volts maximum H.T.

Fig. 2 shows the circuit and details of the transmitter at 5LS. This arrangement gives an input power to the amplifier of 54 watts, with an input of 8 watts to the crystal oscillator valve.

The crystal has a fundamental of 91.6 metres and rests between two steel plates ground dead flat, each 1¼in. square by ¼in. thick. The crystal is 1in. square. This particular crystal requires no reaction. The circuit L_1 C_1 is tuned to 90 metres. The crystal valve at present in use is an American type U.X.210, which is rated at 7½ watts and has an amplification factor of 30. A Mullard D.F.A.6 has been found quite suitable as a crystal oscillator valve. In accordance with the remarks previously made, a fairly high negative bias is used, in order to strengthen the 45 metre harmonic produced in L_1 C_1.

The resistance R for reducing the H.T. for the crystal valve has a value of 12,000 ohms. This resistance is of the well-known "Zenite" non-inductive type. It has been found that these resistances possess some slight residual inductance which falls near the frequency corresponding to 45 metres, and it is quite impossible to tune the set without the shunt condenser, the value of which may be anything over 0.002 mfd.

The amplifier valve V_1 is a Mullard type V.O.50, and the filament supply for this valve is obtained from a transformer. The input to the grid of this valve is regulated by the position of the tap on L_1. The tap is usually set one or two turns below the anode tap of V_2. It should, of course, be as near to this tap as possible, consistent with the prevention of self-oscillation.

Crystal-controlled Transmitter.—The circuit L_2 C_2 is tuned to 45 metres. It is important, of course, that both L_1 and L_2 be of "low-loss" construction, and in tuning a large number of turns with a small amount of parallel tuning capacity are desirable—particularly in the case of L_1 C_1.

It is necessary to restrict the fields of the various chokes employed as much as possible, and those used consist of 4½in. lengths of ½in. diameter ebonite tube, wound for a length of 3in. with No. 30 S.W.G. D.S.C. wire. The winding is "spaced" at three places for ⅛in., in order to reduce the self-capacity as much as possible.

These chokes are visible in the photograph. The three chokes seen in the photograph at the extreme left are in the filament transformer secondary leads.

Keying is performed in the grid bias circuit of the amplifier valve at X. This method allows the amplifier to continue oscillating weakly when the key is up, although not enough to give a strong spacing wave.

Being out of the radio-frequency portion of the circuit, the key leads may be made as long as is desired.

For telephony it has been found best to modulate into the grid circuit of the crystal oscillator valve, thus making use of the amplifying properties of this valve. With an ordinary master-oscillator system the introduction of the modulation transformer into the grid circuit of the master valve would undoubtedly upset the whole system, but owing to the resistance to frequency changes offered by the crystal it is quite practicable in this case. Also, owing to this property, it is possible to obtain good quality with grid circuit modulation.

Tuning Adjustments.

To adjust the transmitter the crystal valve should first be got working properly. The H.T. to the amplifier should be cut off, and L_1 C_1 and the grid bias adjusted until an absorption wavemeter lights at the maximum possible distance from L_1.

The H.T. may now be put on the amplifier, and the circuit L_2 C_2 adjusted for maximum oscillations by means of C_2 and adjustment of bias. Slight retuning of C_1 will be necessary, of course. The aerial circuit may then be coupled to L_2 and tuned in the usual manner.

The difficulties in building such a set are not great, and there is great satisfaction in knowing that no matter how much the aerial may be swinging the wave remains steady at the other end—even putting your hands near the inductances will not make the wave shift more than a few hundred cycles, and provided it is properly adjusted it is impossible for a crystal-controlled transmitter to be the perpetrator of those "chirpy" notes, than which there is nothing more dreadful to try to "copy."

ACCUMULATOR SULPHURIC ACID.[1]

Simple Chemical Tests for Purity of Water and Acid.

IMPURITIES are often present in water and acid, and decrease the life and efficiency of storage batteries.

The most common impurities are chlorine, nitrates, arsenic, ammonia, iron and lime.

Drinking water is not always suitable for batteries.

Before water is used for maintaining the level of the electrolyte in the cells, it should be tested as follows:—

Water.

Chloride Test.—Carefully clean a test tube with the water to be tested; half fill the tube with water, add a few drops of pure nitric acid and five drops of silver nitrate. The water should remain clear, or show a very faint opalescence only.

Ammonia Test.—Carefully clean a test tube with the water to be tested; thereafter half fill the tube with water, and add five drops of Nessler's solution; shake the mixture. The water should remain colourless.

Nitrate Test.—To half a test tube of the water add three to four drops of brucine sulphuric solution. The water on shaking must remain colourless.

Nitrite Test.—To half a test tube of the water add 5 c.c. of metaphenylene-diamine sulphuric solution. Water must not show a brown discolouration.

Iron Test.—Clean a porcelain evaporating basin with the water to be tested, and pour 100 c.c. of the water into the clean basin. Evaporate the water down to about 20 c.c. *Allow to cool*, then pour it into a clean test tube. Add one drop of pure concentrated sulphuric acid and one drop of pure concentrated nitric acid, then two drops of potassium sulphocyanide solution. If it remains clear and colourless, it may be used, but not otherwise.

Lime Test.—Clean a test tube with the water to be tested, half fill the tube with the water, and add ten drops of ammonium oxalate solution; shake the mixture.

Hold the test tube in a Bunsen or spirit lamp flame for about half a minute. Allow the tube to cool for five minutes. The water should remain clear.

Acid.

Acid before being filled into storage batteries ought to be subjected to the following tests.

If the acid be of a higher specific gravity than 1.220, reduce it to that figure, or thereabouts, and proceed as follows:—

Chlorine Test.—Clean a test tube with the acid to be tested, half fill the tube with acid, add three drops of pure nitric acid, then add five drops of silver nitrate solution. If the acid becomes milky, it contains chlorides in excess. If, however, there is only a faint opalescence it may be used.

Ammonia Test.—Clean a test tube with the acid, and fill it a quarter full with acid. The acid in the tube must be neutralised; in order to do so add caustic potash solution until the tube is three-quarters full, then shake the mixture. Test for neutralisation by means of red litmus paper, which should just turn blue when immersed in the solution.

[1] Abstract from a pamphlet issued by the D.P. Battery Co., Ltd., Bakewell, Derbyshire.

Accumulator Sulphuric Acid.—

Add three drops of Nessler's solution, when the mixture ought to be of a light lemon colour. If the colour approaches that of dark yellow, the acid contains too much ammonia, and must not be used.

Nitrate Test.—Clean a test tube with the acid, and pour acid into the clean tube until it is about half full. Add three drops of indigo sulphuric solution; shake the mixture. Pour half of the mixture into another clean test tube, and heat one of the tubes in a Bunsen or spirit lamp flame for about two minutes, holding the tube in the flame by means of the test tube holder; do not allow the mixture to boil and spurt out of the tube.

Compare the colour of the acid in the two tubes.

If the colour of the acid in the tube that has been heated is much lighter than that in the other, the acid contains an excess of nitrates, and must be rejected.

Confirm by brucine sulphuric tests given under water analysis, or this test alone is sufficient.

Iron Test.—Clean a test tube as before, and half fill it with the acid to be tested; add five drops of potassium ferrocyanide solution, and shake the mixture. The colour of the acid ought not to change beyond a light blue. If it changes to a dark blue, iron is present in excess, and the acid must not, therefore, be used.

Confirm the iron test by cleaning another test tube, and half fill it with the acid as before. Now add five drops of potassium sulphocyanide solution, and shake the mixture. If the acid changes to a light red colour it may be used; should it change to a blood-red colour the iron present in the acid is in excess of what is permissible; such acid must not, therefore, be used.

Arsenic Test.—Clean a test tube as before, and half fill it with the acid. Moisten a small piece of filter paper, of a size sufficient to cover the mouth of the tube, with two drops of silver nitrate.

Drop a piece of *pure granulated zinc* (guaranteed free from arsenic) into the tube, and cover the mouth with the moistened filter paper. Allow the tube to stand for half an hour.

Examine the damp filter paper; if a dark brown colouration has formed, allow a drop of pure nitric acid to fall on the discolouration. Should this colouration entirely disappear, arsenic is absent; if, however, it still remains, arsenic is present in the acid. The acid may be used if there is not more than a very faint yellow colouration left on the filter paper.

Alternative Arsenic Test.—Put a few pieces of zinc in the arsenic test bottle, moisten a small piece of filter paper with a few drops of mercuric chloride solution, place this paper upon the end of the glass tube (into which another piece of filter paper has been inserted about half-way up), and hold it in position by means of a rubber ring, the other end of the glass tube being attached to test bottle by means of rubber stopper. Add acid to bottle, insert stopper, and leave for fifteen minutes. If more than a faint yellow tinge is imparted to the paper, too much arsenic is present.

NOTE.—The prepared filter paper in the tube must be moistened with water before using the apparatus, and if it gets black, remove and moisten another piece with lead acetate solution and insert into tube.

MATERIALS REQUIRED FOR THE TEST.

1 Spirit lamp and stand.
1 Wire gauze.
1 4in. diameter porcelain evaporating basin.
1 Wood test tube holder with test tubes.
1 Vulcanite and rubber test tube cleaner.
1 Test tube holder.
100 Filter papers.
1 50 c.c. graduated glass measuring cylinder.
1 Small bottle of pure granulated zinc, free from arsenic.
2 Litmus books—red and blue.
1 Arsenic testing bottle, with glass tube and rubber stopper.
1 Bottle of 20 per cent. caustic potash solution.
1 Bottle of pure sulphuric acid.
1 Bottle of pure nitric acid.
1 Bottle potassium sulphocyanide solution.
1 Bottle potassium ferrocyanide solution.
1 Bottle ammonium oxalate solution.
1 Small bottle silver nitrate solution.
1 Small bottle Nessler's solution.
1 Small bottle lead acetate solution.
1 Small bottle metaphenylene-diamine.
1 Small bottle brucine sulphuric solution.
1 Small bottle mercuric chloride solution.
1 Small bottle indigo solution.

NOTE.—It is highly important that all apparatus and the hands be perfectly clean before making the tests, otherwise false results may be obtained.

Suitable sized bottles of the above chemicals would be 100 c.c. and 50 c.c.

L.F. TRANSFORMER CONNECTIONS.

THE majority of manufacturers of low-frequency transformers include with their products definite instructions as to how these components should be connected in circuit. These should be followed implicitly, as a reversal will affect adversely the performance of a well-designed instrument. Failing any definite recommendations on the subject, however the transformer should be connected up as follows:—

O.P to plate, I.P. to H T +, O.S. to grid, I.S. to grid bias negative.

This arrangement is correct for probably the majority of instruments, though it is as well to try experimental reversals of both primary and secondary in turn.

Comparatively few makers give recommendations as to the capacity of the condenser, which is normally shunted across the primary winding of the first transformer; this is, nevertheless, a matter of some importance, and the effect of various capacities should be carefully noted. A value of 0.0003 or 0.0005 mfd. is generally sufficient.

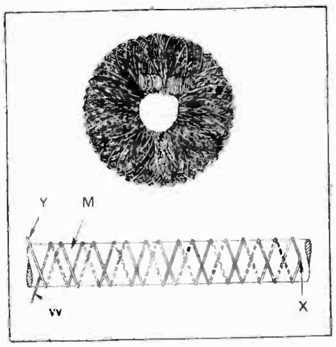
INVENTIONS OF WIRELESS INTEREST

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 1/- each.

Toroidal Coil.
(No. 257,564.)

Convention date (U.S.A.): Aug. 31st, 1925.

A form of toroidal coil suitable for high-frequency circuits is described by the Coto-Coil Co. and E. F. Parks in the above British patent. In the diagram M



Toroidal coil winding. (No. 257,564.)

represents a mandrel or axially rotated spindle of the winding machine on which the wire W is wound, the turns being spaced in a similar manner to those of a honeycomb or duolateral coil. The wire is wound along the mandrel with a constant pitch until it reaches the point X, when the direction is reversed, the wire returning at Y. A number of layers may be wound in a similar manner, so that a multilayer coil is obtained. The winding is then removed from the mandrel, and the coil is bent into a ring so that a toroidal winding results having an appearance similar to that shown in the diagram.

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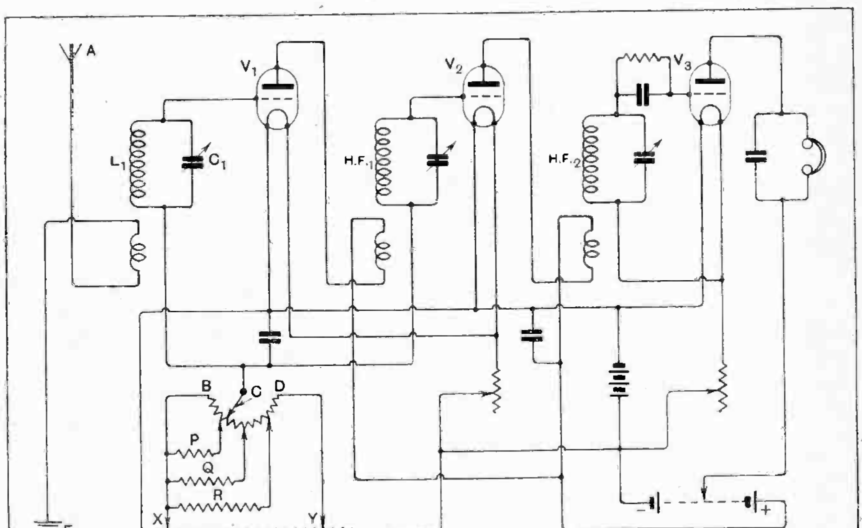
Controlling Reaction.
(No. 253,072.)

Convention date (U.S.A.): June 4th, 1925.

The Lovejoy Corporation and D. R. Lovejoy described in the above British patent a method of controlling reaction in a receiver by mechanically coupling the tuning control with some arrangement such as a potentiometer. The specification points out that the amount of regeneration existing in a high-frequency amplifier may be dependent upon the position of the tuning condenser. As the condenser is varied so must the reaction control be appropriately adjusted. The particular invention utilises a potentiometer method of controlling the reaction by damping the grid circuit by applying a positive potential. In the diagram the aerial circuit AE is coupled to the input circuit L_1 C_1 of the first valve V_1. This is coupled to the next valve V_2 by means of a high-frequency transformer H.F.$_1$, the secondary of which is tuned. A similar transformer H.F.$_2$ is used between the second valve V_2 and the detector valve V_3. The lower end of the input circuit of the valve V_1 and the secondary winding of the transformer H.F.$_1$ are connected to the slider arm C of a potentiometer BCD. The ends BD of the potentiometer are connected across two variable tappings XY on a resistance connected across the filament battery, so that accurate adjustment of the potential drop along the windings can easily be obtained. By mechanically linking the condensed shaft with the potentiometer arm the positive potential applied to the grids is increased as the condenser is decreased. Unfortunately, however, the setting of the condenser and the potentiometer does not follow a straight-line law, which means that it is necessary to wind a potentiometer so that the resistance drop across it is not constant. In order to overcome this difficulty the desired law is obtained by connecting in parallel with the potentiometer BCD auxiliary resistances P, Q and R. The effect of this is equivalent to winding the potentiometer in sections having different ohmic resistances. The specification also provides for linking the condenser with a filament rheostat for the purpose of dimming the filament instead of using a potentiometer.

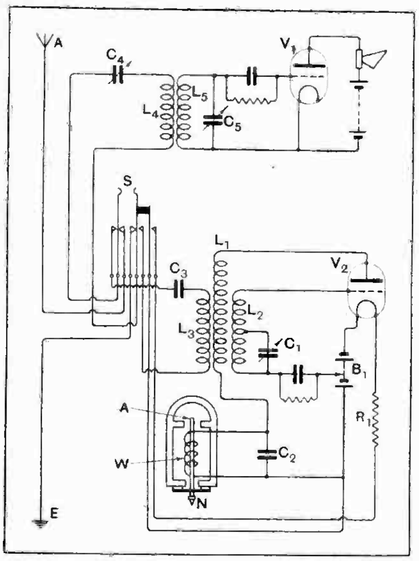


Potentiometer control of reaction in a H.F. amplifier. (No. 253,072.)

Electrical Gramophone Reproducer. (No. 253,096.)

Convention date (U.S.A.): June 2nd, 1925.

A system comprising an electric gramophone reproducer and an ordinary wireless receiving system is described by Marconi's Wireless Telegraph Co., Ltd., and J. Weinberger in the above British patent. The electric pick-up arrangement from the record comprises a needle or stylus N, which works on the sound trace of the record, and is connected to a balanced electromagnetic system consisting of an armature A pivoted about its centre point, and working between a pair of poles at each end. A valve V_2 is arranged as an oscillator, the anode circuit containing an inductance L_1 and the grid circuit an inductance L_2, part of which is tuned by a condenser C_1. The windings W of the electromagnetic system are also included in the anode circuit of the valve, and are shunted by a condenser C_2 to pass the high-frequency oscillations existing in that circuit. A battery B_1 supplies both filament and anode voltages, the filament current being controlled by a resistance R_1. Movement of the needle N will cause the armature to move in the magnetic field, thereby causing a considerable change in flux, which will cause potentials to be produced across the winding W. This will mean that the anode voltage of the oscillator valve will vary, thereby modulating its output. The output of the oscillator valve, however, is transferred through an inductance L_3 and a condenser C_3 to another tuned circuit L_4 C_4 which is



Circuit for electrically reproducing gramophone records. (No. 253,096.)

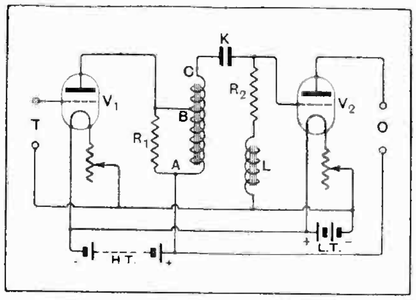
coupled to the input L_5 C_5 of a detector valve V_1. When both the valves are functioning a portion of the output of the oscillator will be rectified by the detector valve. However, since this output is modulated, the modulation will be detected by the valve V_1, thereby working the telephone receivers. The system can also be used for broadcast reception, when an aerial and earth system AE is included, and a master switch S is used to connect the detector valve either to the aerial system or to the oscillator valve associated with the pick-up arrangement.

oooo

An Auto-coupled Transformer. (No. 264,910.)

Application date: October 23rd, 1925.

E. A. Graham and L. H. Paddle described in the above British patent specification a particular form of auto-coupled transformer. The amplifying valve V_1 is



Auto-transformer valve coupling circuit. (No. 264,910.)

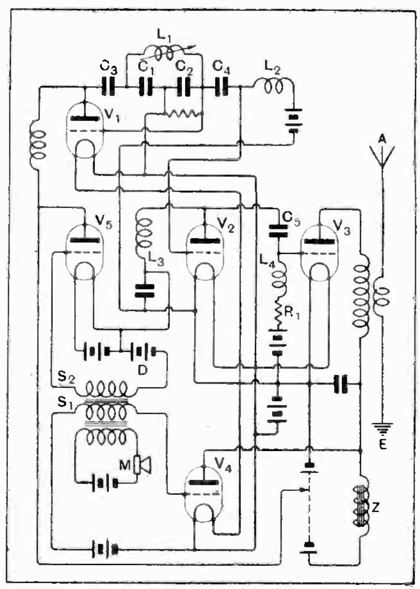
provided with input terminals T, and the anode circuit contains the primary AB of an auto-coupled transformer. This winding AB is shunted by a resistance R_1. The secondary winding of the transformer AC is connected to the grid circuit of the next valve through a stopping condenser K to prevent the positive potential from the anode battery being applied to the grid of the next valve. Owing to the presence of this condenser a grid leak R_2 has to be employed, and is shown connected in series with a low-frequency choke L. The output of the second valve is shown at O, and can be connected to another similar auto-coupled transformer. Alternative systems are given in the specification in which the transformer is provided with tappings, so that the degree of amplification can be varied, while, in another modification, the secondary or full winding is shunted by a potentiometer, the slider arm of which is connected to the coupling condenser, in this way controlling the potential applied to the grid of the next valve.

oooo

Quiescent Telephony. (No. 252,027.)

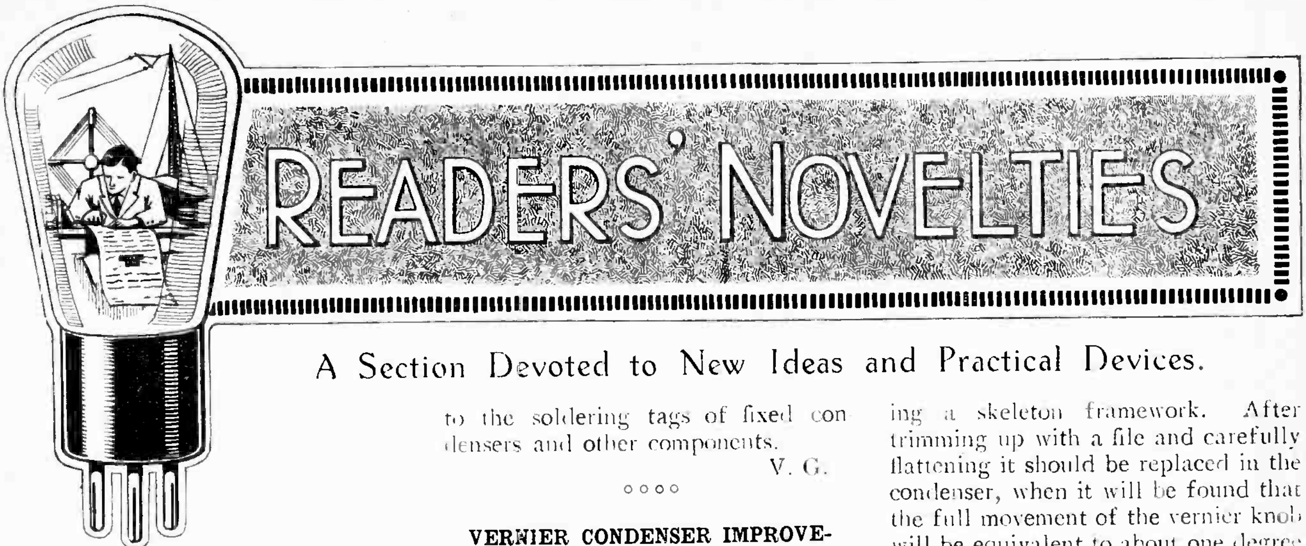
Convention date (U.S.A.): May 11th, 1925.

A system of quiescent telephony control suitable for duplex work is described by the British Thomson-Houston Co., Ltd., and I. F. Byrnes in the above British patent. The circuit should make the invention quite clear. The transmitting system is of the drive or master oscillator type, an intermediate amplifier being used between the master oscillator and the final valves connected to the aerial circuit. The drive valve V_1 is provided with a tuned circuit L_1 C_1 C_2, one end being connected to the grid and the other through a condenser C_3 to the anode, the filament centre point being taken to the two condensers C_1 and C_2. The output of the oscillator is coupled to the first high-frequency amplifier V_2 through a coupling condenser C_4 and a grid choke L_2. The output circuit of the valve V_2 comprises an inductance L_3 which is coupled through a condenser C_5 to the grid circuit of the main amplifying valve V_3, which includes a grid choke and resistance L_4 R_1. The last valve V_3 is coupled in the usual manner to the aerial system AE. A microphone M is connected to the primary winding of a special transformer having two secondaries S_1 and S_2. The first secondary S_1 is connected to the grid-filament circuit of the modulator valve V_4, the anode of which is connected to the source of supply B through a modulation choke Z, this valve modulating the output of the last valve in the normal manner. The other secondary S_2 is connected to the input circuit of a valve V_5, which is normally provided with a large negative bias, thereby making the internal resistance very high. This valve, however, is in series with the anode supply to the first amplifying valve V_2. When there are no speech currents the valve V_5 will offer a very high impedance, and, consequently, the output of the amplifying system will be very small, so small, in fact, that the whole system will hardly radiate. As soon as speech potentials are applied to the valve V_5, however, they will overcome



Circuit of quiescent telephony transmitter. (No. 252,027.)

the negative bias and allow the valve V_5 to pass sufficient current, and, therefore, cause the system to amplify and radiate considerably. Since, however, speech voltages will be applied by the secondary S_1 to the modulator valve, it will, therefore, modulate the output of the system. In this manner a quiescent system is obtained; *i.e.*, there is only appreciable radiation when microphone potentials are actually existent.



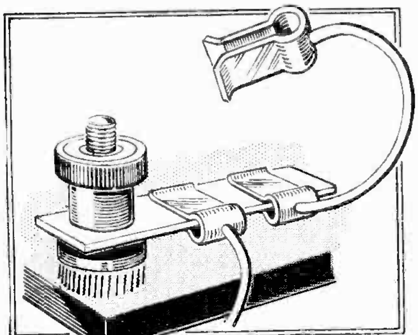
READERS' NOVELTIES

A Section Devoted to New Ideas and Practical Devices.

EXPERIMENTAL CONNECTIONS.

When trying out new circuits it is useful to have a collection of flexible connecting wires of various lengths for joining up the various components which may be screwed to a temporary baseboard and panel.

The use of spade terminals at the ends of the connecting wires has been suggested, but with this system difficulties are likely to arise when adding a new wire to a terminal already loaded with three or four other leads. In the system shown in the diagram small brass clips are substituted for the spade terminals, by means of which it will be possible to make any number of connections to a terminal by fixing a short strip of brass as shown in the diagram. Connections may be added to or removed from this strip without in any way interfering with the remainder of the clips.



Terminal clips for experimental connecting wires.

Another advantage of this method is that clips can be connected directly to the soldering tags of fixed condensers and other components.

V. G.

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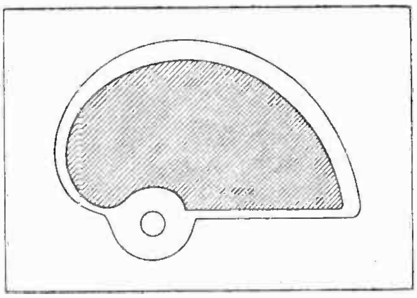
VERNIER CONDENSER IMPROVEMENT.

Before vernier dials became available it was customary to fit variable condensers with an auxiliary vane operated independently of the main condenser vanes by a small knob.



Vernier condenser vane with central portion removed to give smaller rate of change of capacity.

For short-wave work the variation of capacity provided by the single-plate vernier is frequently found to be greater than is required for accurate tuning. In these circumstances it will be found an advantage to dismantle the auxiliary condenser and to remove the central shaded portion of the vane, as shown in the diagram, leaving a skeleton framework. After trimming up with a file and carefully flattening it should be replaced in the condenser, when it will be found that the full movement of the vernier knob will be equivalent to about one degree on the dial of a 0.0003 mfd. condenser.

J. N.

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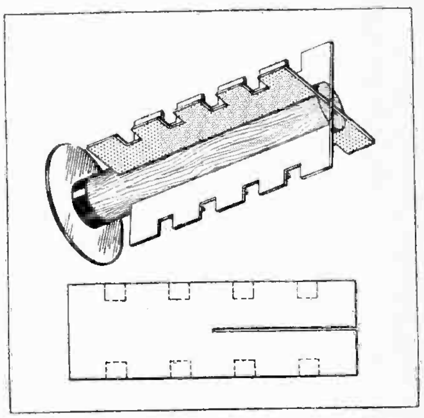
H.F. CHOKE FORMER.

Discarded photographic film spools with a centre core constructed of wood can be used to support the windings of a H.F. choke.

First obtain two pieces of fibre or other suitable material about 3in. long and 1in. wide and saw out each piece for half its length so that the two may be interlocked. One metal end-piece of the spool, which should be of the quarter-plate size, is cut off, and two saw cuts at right angles are made in the wooden core to within about $\frac{1}{2}$in. of the base. The fibre pieces are then fitted into the slots in the wooden spool and secured with a trace of glue or shellac varnish. The wire is wound on in sections in steps cut in the edges of the fibre supports.

A. A. H.



Photographic film spool used as H.F. choke former.

Valves for Readers.

For every practical idea submitted by a reader and accepted for publication in this section the Editor will forward by post a receiving valve of British make.

CURRENT TOPICS

Events of the Week in Brief Review.

WIRELESS EXHIBITION.

We are able to state that the annual Wireless Exhibition held under the auspices of the N.A.R.M.A.T. will open at Olympia on September 21st and continue until October 1st.

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NEW STATION DIRECTOR FOR BOMBAY.

We understand that Mr. Leslie B. Page, who was well known as the station director at the Hull Broadcasting Station, has been appointed to a similar post under the Indian Broadcasting Company for their Bombay Station.

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SO NEAR, AND YET SO FAR!

The freakish nature of short waves sometimes causes remarkable and curious vagaries in the transmission of messages. A story reaches us from California that an amateur in San José, wishing to communicate with a friend in Carmel, about 50 miles distant, found himself unable to get into touch with him: this he ascribed to the habit of short waves visiting the upper atmosphere before being reflected back to earth. However, he determined not to be beaten, and, remembering that his friend kept a regular schedule with another amateur in Singapore, he relayed his message via Asia and received an answer by the same route, each message having to travel over 1,600 miles to bridge a 50-mile gap.

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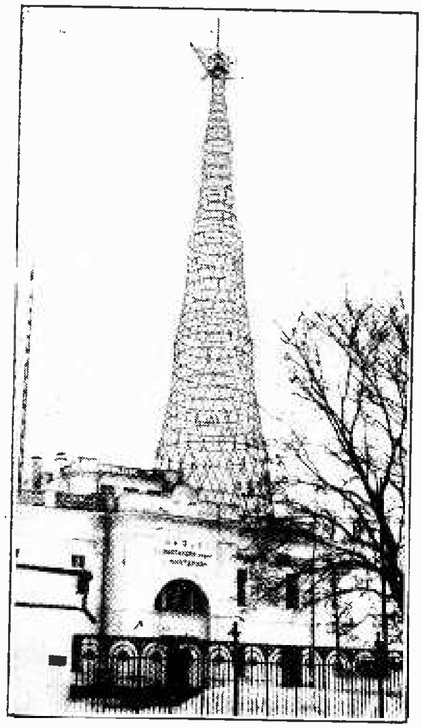
NORTHERN LIGHTS NOT TO BE BLAMED.

It is often supposed that wireless reception is adversely affected by the Aurora Borealis, but Lieut. H. Holten Moller, the engineer in charge of Godhavn Station in Greenland, disagrees with this theory. His station is said to be the most northern in the world, and throughout the winter the sun is not seen. The Danish Government has instructed him to carry out a number of tests to investigate the effect, if any, of the Northern Lights, but, so far, he cannot find that they are responsible for fading, weakness of signals or poor reception. He states, in fact, that though he has had eleven years experience of wireless in all parts of the world he has never before experienced such ideal conditions—presumably only from a wireless point of view—as in his present station.

RUSSIA'S NEW STATION.

The new Moscow station, "Great Komintern," which will work with a power of 40 kW., will certainly enable the voice of Moscow to be heard throughout Europe. It has been constructed according to plans prepared by Professor Bonch Brouevitch, and was lately officially opened. We are able to show a general view of the building with one of the huge lattice masts in the foreground and another more distant.



Russia's "Daventry," the Great Komintern Broadcasting Station in Moscow.

"CROYDON CALLING"—WITH A NEW VOICE.

The new station, which is to be erected for the Air Ministry by the Marconi Co., will replace the one that has done duty for the last seven years and considerably extend the range of communication with other aerodromes and with aeroplanes in flight.

The installation will consist of a group of four 3 kW. transmitters operated in conjunction with a direction-finding receiver. Independent drive circuits will maintain constancy of frequency and wavelength. The new wireless D.F. receiver is so arranged that, if required, two or three circuits can be operated on different wavelengths for the reception of telephony and telegraphy on the same aerial.

The masts and transmitters will be erected two or three miles from the Aerodrome, and operated by remote control.

It is expected that this new station will be in operation before the end of the coming season.

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AN OBLIGING MILKMAN.

Amateur wireless in America is conducted on more commercial lines than in this country and is recognised as a convenient way of transmitting public messages. Even eavesdroppers join in the game. We hear that at Hartford, Connecticut, a milkman listening on his broadcast receiver chanced to pick up a message from an amateur station intended for Mr. K. B. Warner, the secretary of the A.R.R.L., who happened to be one of his regular customers. The message was duly delivered with the morning milk.

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AN EXAMPLE WORTH FOLLOWING.

Listeners in Denmark are congratulating themselves on the fact that, since the number of licences of valve receivers has exceeded that estimated in the budget, the authorities have decided to reduce the fee from 15 to 10 kroner, thus bringing it down to the level of crystal set owners.

A kroner is equivalent to about eleven pence, so it will be seen that the Danes will now pay even less for their entertainment than we do in Great Britain.

It is also stated that the Danish Broadcasting authorities will transmit a special late programme from Soro on 1,153 metres for the benefit of their countrymen resident abroad. This transmission will probably be given between midnight and 2 a.m., so that it may not interfere with other European stations.

THE BRITISH LEGION'S WIRELESS PRIZES.

The Birmingham No. 1 branch of the British Legion, of which H.R.H. the Prince of Wales is Patron and Field Marshal Earl Haig President, is endeavouring to enlist the sympathies of wireless enthusiasts in the scheme for giving 500 children a day's outing in the country. Contributors of 6d. to their Children's Outing Fund will be entitled to participate in the draw for a complete 3-valve set which is being offered as a prize. The drawing will take place on Friday, July 15th, and will be performed by Mr. J. Smedley Crooke, M.P. Donations may be sent to the No. 1 Branch Headquarters at the "Hope and Anchor," New Canal Street, Birmingham.

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BROADCASTING IN ELEMENTARY SCHOOLS.

The educational value of broadcasting is now recognised by the L.C.C., whose Education Committee has sanctioned, as an experiment, the reception of broadcast talks from three o'clock onwards on Friday afternoons in their elementary schools. The experiment is to be tried for a year, and it will be interesting to see whether the scholars will profit by this recreative form of instruction. It is understood that in one hundred of the Council's schools wireless apparatus has been installed without expense to the Committee, the sets being either free gifts from the teachers and others, or paid for out of the school funds.

Judging from the letters in the daily Press there is a vast number among grown-up listeners who resent any attempt on the part of the B.B.C. to impart useful knowledge—they don't know and they don't want to know—but the youthful mind is generally of a more inquiring nature and more eager for information, especially if it can be assimilated in a pleasant manner.

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THE AUSTRALIAN BEAM SERVICE.

The Anglo-Australian Beam Service, which was opened for public service on April 8th, establishes for the first time in history a direct line of public communication between Australia and London, and is the longest direct telegraph service of the world. Secrecy of communication is ensured by the speed at which messages will be transmitted. The automatic apparatus is capable of transmitting and receiving from 500 to 2,000 letters per minute. The change-over periods during which communication is at present somewhat uncertain occur, fortunately, between 9 p.m. and midnight and between 9 a.m. and noon (by Australian time)—that is, during the time when nearly all business houses in one country or the other are closed.

A second beam station is now being completed in Australia for direct service to Montreal.

Messages for the beam service can be handed in at any postal telegraph office in the cities, suburbs, or country towns of Australia.

SHADRACH, MESHACH AND ABEDNEGO.

The apparent paradox of "cold heat" is exemplified by electric furnaces such as that used in the research laboratory of the General Electric Co. in Schenectady. Men thrust their hands casually into a furnace which melts metal with ease, and white mice will stay in it even though the current is on, but it is a simple matter for them to run out if they so desire.

It should be noted, however, that the men are careful to remove any rings from their fingers and the metal drinking cup for the mice is outside the furnaces. The explanation of the apparent mystery is that the high frequency furnace heats electrical conductors only.

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PERSONALLY CONDUCTED.

The Royal Mail Steam Packet Co.'s motor vessel "Asturias," now on a cruise round the world, is fitted with all the latest wireless luxuries. Loud-speakers are installed in various positions on the promenade deck, and one of the officers on the bridge can direct the attention of the passengers to objects of interest in the passing scenery in the same manner as the conductor of a char-a-banc instructs his flock. The vessel is also supplied with a Marconi "band repeater" equipment so that reproduction of music and talks may be turned on whenever the passengers seem to need cheering up.

The ordinary programmes broadcast from land stations can, of course, be picked up and relayed to various parts of the vessel. The Saturday evening programme from WGY was clearly heard while in harbour at Durban.

WIRELESS AT WESTMINSTER.

By Our Parliamentary Correspondent.

In answer to Mr. Johnston, who asked whether he had any complaints from owners of wireless sets in Arbroath regarding difficulties of listening in to the programmes of the Dundee broadcasting station since the recent alterations in the wavelength, Sir W. Mitchell-Thomson said he had received no such complaints, but he had no doubt the British Broadcasting Corporation would be ready to investigate the matter.

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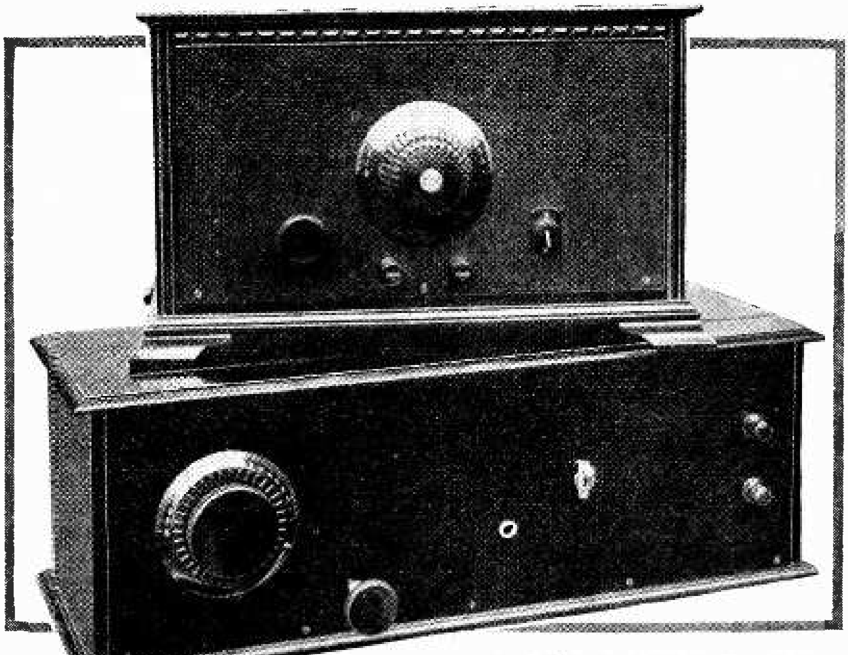
Daventry and Crystal Users.

Mr. Day asked the Postmaster-General whether, in view of the fact that the licence fee paid by owners of wireless crystal sets was the same fee as that paid by owners of wireless valve sets, and that the London transmitting station 2LO shut down some nights at 11 p.m., he would arrange for the programme sent out from Daventry after this hour, and which was only available to valve-set owners, to be relaid from the London station so as to give owners of crystal sets the same benefits as owners of valve sets?

Sir W. Mitchell-Thomson said that this was a matter within the discretion of the British Broadcasting Corporation. He understood that at times when Daventry was working and London was not most persons using crystal sets in London or other places within a radius of 100 miles of Daventry could receive the Daventry programmes with little alteration of their sets.



RECOMMENDED BY THE B.B.C.

In next week's issue will appear full constructional details of the two- and three-valve receivers recommended by the B.B.C. for good quality broadcast reception. The circuit systems of these receivers which have already been described in the pages of this journal have created considerable interest and it will be remembered that specimen sets were demonstrated by the B.B.C. on their stand at the recent Ideal Home Exhibition held at Olympia

OSCILLATING CRYSTALS.

Recent Research with Low-frequency Oscillations.

RESEARCHES upon piezo-electric crystals, which can be excited into mechanical oscillations by means of H.F. oscillations, as well as those upon the oscillating crystals of Lossev, have already been dealt with several times in this journal. In both cases, however, high-frequency oscillations are dealt with, whereas new experiments of Dr. Franziska Seidl at Vienna show that with a crystal detector relatively slow oscillations of audible frequency can be generated. Such a detector might almost be termed a "diaphragmless telephone."

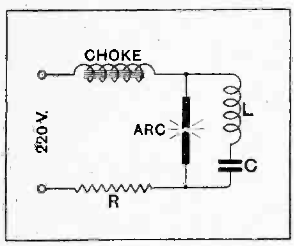


Fig. 1.—Circuit of Duddell's "singing arc."

The arrangements in Dr. Seidl's experiments are apparently just the same as with the "singing arc" discovered about 25 years ago by Duddell. Duddell noticed that an electric arc-lamp in parallel with which a condenser and inductance are connected is excited into oscillations which can be heard as a loud note if they are within the range of audibility. For purposes of comparison Duddell's circuit is given in Fig. 1. The part played by this circuit in wireless telegraphy is well known, for it is possible to attain quite high frequencies by this means and to excite an aerial directly. The reason for the arc's capability of oscillating lies in its falling characteristic, which is diagramatically represented in Fig. 2. Contrary to the usual "ohmic" resistance the terminal voltage of the arc falls if the current increases, *i.e.*, the arc has a "negative resistance" just as in the case of a triode valve provided with regenerative coupling.

If we now look at the characteristic of a crystal detector in Fig. 3, taken by Dr. Seidl, we see that the detector also has a falling characteristic, and therefore a negative resistance, over a certain range and that it can be made to oscillate thereby. The detector which furnished the characteristic in Fig. 3 consisted of zincite and a steel point. For steel points certain gramophone needles prove satisfactory, and various other known detecting substances can be used as crystals. It is, however, always important to adjust extremely carefully the pressure with which the steel point is pressed against the crystal. Further, Fig. 3 shows that the characteristics for the two possible directions of current are of similar form but with different slopes, *i.e.*, it is easier to make the crystal oscillate in one direction than in the other.

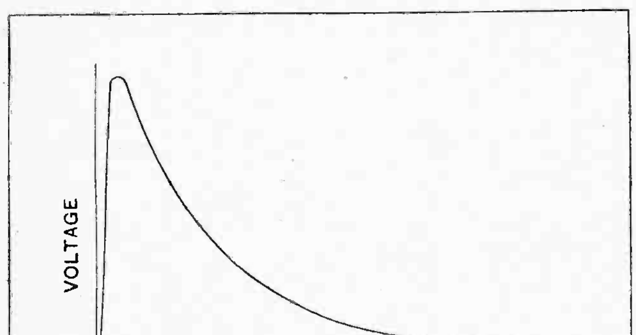


Fig 2.—Falling characteristic of the Duddell arc.

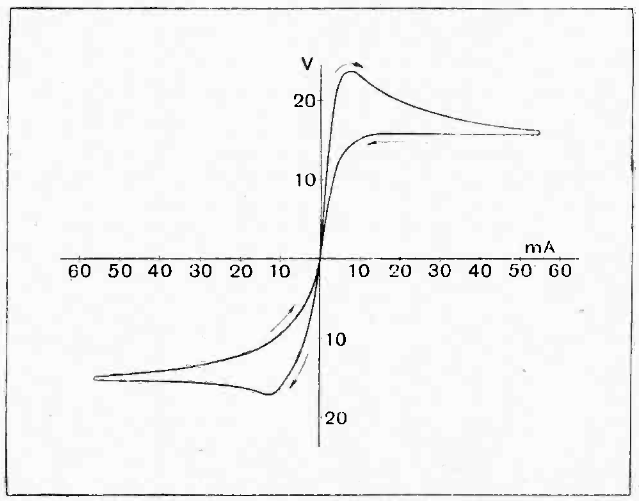


Fig. 3.—Characteristic of the oscillating crystal used by Dr. Seidl.

The circuit in which the crystal is made to oscillate at audio frequency is given in Fig. 4. Contrary to the experiments of Lossev, in which a small biassing potential is used on the crystal, a fairly high potential is employed with the low-frequency oscillations of Seidl, as indicated in Fig 3. It is necessary also to adjust the potential carefully, preferably with a potentiometer, P, placed somewhere in the current supply lead. In parallel with the detector D there may be a condenser C of 0.3 mfd. and an inductance L of 0.1 henry. In the lead to the oscillatory circuit is an iron-cored choke-coil which is useful but not absolutely necessary.

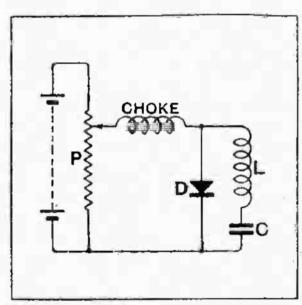


Fig. 4.—Oscillating crystal circuit for audio frequencies.

The similarity of the oscillations in this circuit

Oscillating Crystals.—

to the oscillations of the "singing arc" is brought out by the fact that the frequency of the circuit C L D is not determined solely by the capacity and inductance but depends to a considerable extent upon the pressure of the steel point against the crystal. With the above-mentioned values, a potential of 59 volts and a current of 25 milliamperes a frequency of 853 was produced, while with a potential of 47.8 volts and 12 milliamperes the frequency was 795. Once the crystal is set neither frequency nor current vary over a long period of time (two hours, for instance).

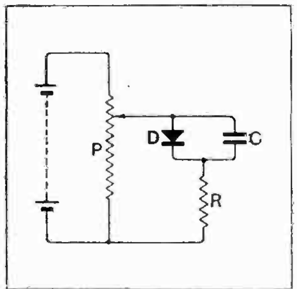


Fig. 5.—Modified circuit dispensing with inductance L.

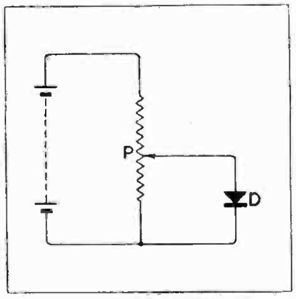


Fig. 6.—Simple crystal circuit which has been made to produce oscillations.

Sometimes it is found that the oscillation of the crystal starts and stops periodically. In such a case it is found that the potential across the crystal falls at the same time to 3 volts. If the capacity was altered the periodicity of the oscillations changed and, in fact, the smaller the capacity the more rapidly the oscillations followed each other.

The similarity of this phenomenon to the known arrangement for producing oscillations by means of a glow-discharge lamp suggested to Dr. Seidl the circuit in Fig. 5, where only the condenser C is in parallel with the detector D, a high resistance R being placed in series with these. The resistance was 100,000 ohms, while the condenser could be adjusted between 0.001 and 1.0 mfd. This circuit gave a pure and constant musical frequency depending upon the voltage and the size of the condenser. It was even possible to short-circuit the resistance R completely; a clear and steady note was still obtainable by careful adjustment of the detector. In this case, however, the potential across the crystal must not be too great—about 8 volts was enough on the average—in order to make the detector oscillate. Surprising as it may seem, it was even possible to do away with the condenser as well, thus simply supplying the detector with a D.C. potential across a potentiometer (Fig. 6). It was found that the detector could often be made to oscillate, though not very easily; a high-pitched note was produced, but the conditions for oscillation were unstable and made the further investigation of the problem a matter of considerable difficulty.—H. K.

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.

A Satisfactory Report.

The fourth annual meeting of the **City of Belfast Y.M.C.A. Radio Club** was held on the 29th March, 1927. The hon. secretary in his résumé of the club's activities during the year mentioned that the club had now a transmitting licence and experimental work was being carried out at the week-ends. A Morse class had been run during the winter season for those interested, and a course of monthly lectures had been given during the same period, principally by members of the club. The hon. treasurer reported that there was a substantial balance in hand, notwithstanding the outlay on the transmitter, which included DET valve, and a three-valve short-wave receiving set.

The following officers and committee were appointed to conduct the affairs of the club for the year 1927-28:—President, Mr. J. S. B. Shaw; Vice-presidents, Messrs. C. Allen, J. B. Dolphin, J. Forsythe, J. Lockhart and J. White; hon. secretary, Mr. J. J. Cowley; hon treasurer, Mr. E. G. Diamond; committee, Messrs. E. Beat, W. C. Haddick, R. Holden, S. Johnston and G. Kirkwood.

Hon. secretary: Mr. John J. Cowley, Y.M.C.A. Radio Club, 4, St. Paul's Street, Belfast.

A Talk on Direction Finding.

On Friday, April 1st, Mr. S. Atkinson, B.Sc., Tech., gave the members of the **Radio Experimental Society of Manchester** a most interesting talk on "Direction Finding."—The speaker graphically illustrated the directional properties of the frame aerial, and proceeded to show mathematically how the induced E.M.F. in the frame for a given signal strength varies, and can be calculated, as the frame rotates. He then explained how to allow for and also how to overcome "vertical effect" in ordinary frame reception, and how to utilise the "vertical effect" in D.F. work. The "Robinson System" as used in the Air Force was next described and fully explained, and the speaker followed with the "Bellini-Tosi system," with the dual fixed frames. The problem of night effect and fading of signals in coastal D.F. stations due to deflection of the waves by the Heaviside layer, was also dealt with. Mr. Atkinson concluded with the methods used in counteracting these effects.

Hon. secretary: Mr. J. Levy, 19, Landsdowne Road, West Didsbury.

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A Champion of R.C.C.

Speaking in favour of resistance capacity coupling in a lecture before the **Bristol and District Radio Society** on March 25th, Mr. John Rhee, of Messrs. Mullard Wireless Service Co., Ltd., said that the advantages of this form of coupling were simplicity, compactness, light weight, small consumption of high-tension current, and uniform amplification at all frequencies. The chief disadvantages were that the amplification per stage would never exceed the amplification factor per valve, and there was a serious danger of rectification taking place in the low-frequency amplifier. The lecturer gave recommendations as to the values of coupling condensers and grid-leaks.

This was the final meeting of the winter session and an interesting summer programme is now being arranged.

Hon. secretary: Mr. S. J. Hurley, 46, Cotswold Road, Bedminster, Bristol.

Quality in Reproduction.

At the meeting of the **Muswell Hill & District Radio Society,** held March 30th, Mr. L. Hirschfeld, B.Sc., brought a three-valve set of his own make, worked entirely off the mains. A 20,000 ohm wire-wound tapped resistance was used for H.T., while the valves were fed through a 60-watt lamp. The set was resistance-coupled and gave pure reproduction of London, Daventry and Radio Paris. The most surprising fact was that Mr. Hirschfeld had entirely eliminated all ripple; the final slight hum being excluded by fitting a potentiometer across the detector valve filament. A small variable condenser (neutrodyne type) was inserted between the grid of the detector valve and the plate of the 1st L.F. valve.

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

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A New Continental Receiver.

An interesting talk was given by Mr. A. W. Knight before the members of the **Croydon Wireless and Physical Society** on a new type of radio receiver embodying resistance-capacity coupled high frequency amplifiers now being marketed on the Continent. Unsuccessful attempts at high-frequency amplification by means of resistance-capacity coupling have been tried for some time, and only recently has any real progress been achieved in this direction. The lecturer gave an account of the Loewe duplex and triplex valves and how they functioned, and brought with him for demonstration purposes a three-valve set, which he had just received from abroad, consisting of detector and two stages of low-frequency amplification. Although the set was tried out on an indoor aerial, yet good amplification was obtained sufficient to work a loud-speaker on the local broadcast, and members heard items from the 2LO programme.

The three valves were enclosed in a nickel-plated container, which acts as a protection for the valves and also as a holder for the other components, and this container was opened in order that members could inspect the valves and lay-out and compare the latest Continental practice of radio assembly with that in vogue over here. Much interest was aroused in the construction of the receiver and valves.

Mr. Knight was heartily thanked for his very interesting talk and demonstration, and for giving the members an opportunity of seeing the form of receiver that might become popular on these shores in the near future.

Hon. secretary, Mr. H. T. P. Gee, 51-52, Chancery Lane, W.C.2.

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Service for Blind Listeners.

Several months ago Capt. Ian Fraser broadcast an appeal for wireless receivers for the use of the blind. The project was taken up with enthusiasm by the **Tottenham Wireless Society** with the result that in nearly 30 cases blind people in the locality have been provided with a service of set construction and maintenance. In every case the pleasure given repaid the labour and time expended by members of the Society. The case of the blind person who is also partially deaf has also received attention, but fortunately it has been discovered that such cases are very few.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 13th.

Edinburgh and District Radio Society.—At 117, George Street, Edinburgh. "Electrical Measuring Instruments," by W. D. Oliphant. At 8 p.m.

Muswell Hill and District Radio Society.—At Tollington School, Tetherdown. "The General Design of Broadcast Receivers," by F. H. Haynes. At 8 p.m.

THURSDAY, APRIL 14th.

Northampton and District Radio Society.—At 8 p.m. "The Ferranti Transformer," by Mr. Garrick (of Ferranti, Ltd.).

WEDNESDAY, APRIL 20th.

Edinburgh and District Radio Society.—"Some Methods of Measuring Signal Strength and Application," by J. B. Davidson.

Tottenham Wireless Society.—At The Institute, Bruce Grove, Tottenham. Lecture: "Reinartz Receivers," by T. Vickery. At 8 p.m.

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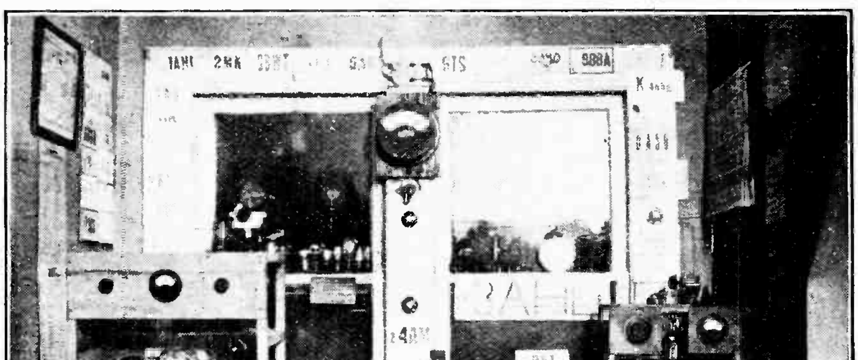
Grid Leaks and Condensers.

A most interesting lecture was given to the **Tottenham Wireless Society** on Wednesday, March 30th, by Mr. Parr, of the Ediswan Valve Co. He took as his subject "Resistance capacity amplification." He explained very fully the theory and practice of the subject, and demonstrated most of his points on a "R.C. Threesome" receiver. Valves having any impedance desired could be constructed, but after a point any increase was not beneficial. In theory, to connect to the grid one only required a condenser; any condenser would do provided it had a high degree of insulation; in practice, however, while not being very critical, there were points which governed its size. If it were too small the set would distort very badly, and practically all the lower tones would be cut out. The higher notes, also, would not be amplified to any extent, for the circuit capacities would provide a leakage path of lower impedance. The same "snags" were encountered if one increased the anode resistance unduly. They had found that a three to five megohm anode resistance gave the best results. The most suitable size for the coupling condenser was 0.0003 mfd. Curves were shown which gave the amplification at various frequencies, and it was noted that these appeared to be extremely good.

Suitable values of H.T. were discussed and demonstrated on the receiver. Grid bias was an important question, and experiments were conducted to show the effect of an alteration from the recommended values. Suitable values of grid leaks were given. If these were mounted on ebonite of poor quality or proper mounts which were dirty or dusty, it might be found that the set would function equally well without a grid leak. This was obviously due to the fact that the leakage path across the ebonite was acting as a grid leak.

Some interesting facts were given regarding the construction of the grid leaks used by Messrs. Ediswan. The method of manufacture was explained and results of life tests given. It was noted that these seemed to be extremely good. They had been tested with 200 volts across them. Curves showed that after several thousand hours they suddenly gave out. The old type of grid leak gradually varied in use until its resistance was infinity. The new grid leaks used in the set remained perfectly constant during the whole of their useful life.

Hon. secretary, Mr. A. G. Tucker, 42, Drayton Road, Tottenham, N.17.



A COMPACT STATION. U 3AHL is a station often picked up on this side of the Atlantic. It is owned and operated by Messrs. F. F. Priest and C. B. Knight at 903, Hanover Avenue, Norfolk, Virginia. The smaller set uses one 203A valve with 150 watts input and works on 80 metres. The larger set transmits on 40 metres with a single 250 watt valve.

Semi-portable Set for Long-distance Reception with Loud-speaker or Phones.

As the name implies, the Neutrosonic Seven is a supersonic heterodyne receiver employing seven valves in which the well-known principle of "neutrodyning" or balancing out stray capacities has been applied to the H.F. and intermediate amplifying valves. It is designed for long-distance reception on a frame aerial, and can be used either as a permanent receiver in the home or as a portable set. It is not, however, a portable set *per se*—that is, no quality of performance has been sacrificed to the end of portability; but, the design having been perfected, the makers have very wisely decided to build it in portable form, thereby greatly extending its utility. Although rather too heavy to be carried far without fatigue it seems to us an ideal set for motoring or boating expeditions.

Durable Finish.

There will be few who will object to the workmanlike appearance of the set, but if it is thought in certain circumstances that it does not quite conform to "period" ideas in furnishing or interior decoration, it can be housed in a suitable cabinet and used in conjunction with the Igranic folding frame aerial. Where A.C. supply mains are available, it is a good plan to make use of the Igranic H.T. supply units in order that the dry cell batteries may be conserved for outdoor use.

The full equipment is contained in two black leatherette-covered cases complete with carrying straps and handles. The photographic illustrations to this article give a good idea of the general appearance of the set and show it packed for transport and opened up for use.

One of the boxes contains the H.T. and L.T. batteries, which are connected to the receiver through a multiple cable terminating in a six-way plug. A central spigot and keyway ensure that the plug is always correctly inserted. The H.T. batteries are of the small-capacity type supplying 8.5 milliamperes at 162 volts. A total filament current of 1.4 amp. is drawn from the 2-volt, 40-ampere-hour accumulator, which is of the unspillable type.

The lid of the battery box is readily detachable, and contains the frame aerial. This can be mounted to rotate on a pivot fixed to the top of the battery compartment, and is connected to the set through flex leads spaced apart with ebonite cleats. Incidentally, we found that these cleats caused a certain amount of trouble when shutting down the lid of the battery box unless they were all lying flat. In future models this trouble will no doubt be overcome by allowing a little more space inside the lid. A switch on the frame aerial box gives three wavelength ranges, and the reader should not forget to move this switch into the appropriate position when changing the tuning units in the set.

Before leaving the topic of batteries a word of praise is due to the "Springmore" wander plugs, which give a firm electrical contact in H.T. and grid bias battery sockets. They have been adopted also for the frame aerial and loud-speaker connections to the set, and are much superior to the ordinary type of wander plug.

Constructional Details of Receiver.

The receiver case is well designed. The front panel is detachable, and slides into a recess under the panel, thus serving as a convenient rest for the hand while making tuning adjustments or for spreading out the calibration charts for examination. Special fittings are provided inside the lid for carrying the spare tuning unit and a pair of telephones.

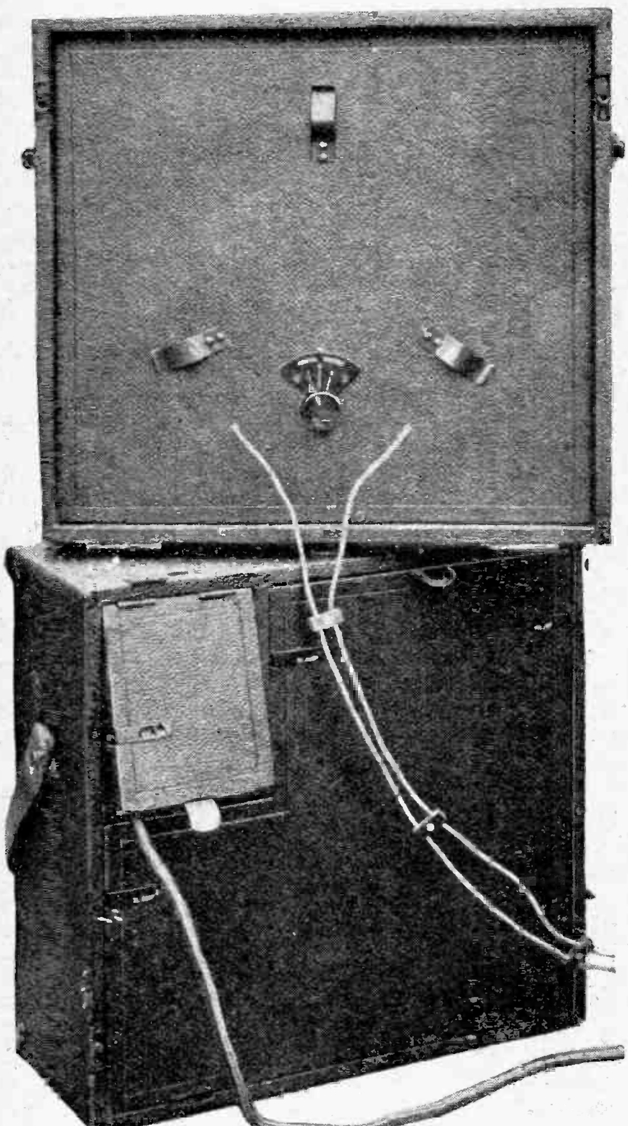
The seven valves function as follow:—*First valve* (Cosmos S.P.18/B): H.F. amplifier for incoming signals from frame. *Second valve* (S.P.16/R): Oscillator. *Third valve* (S.P.18/B): First detector. *Fourth and fifth valves* (S.P.18/B): Intermediate frequency amplifiers. *Sixth valve* (S.P.18/B): Second detector. *Seventh valve* (S.P.18/Brown): Power output valve.

Broadcast Receiver—Igranic Neutrosonic Seven.—

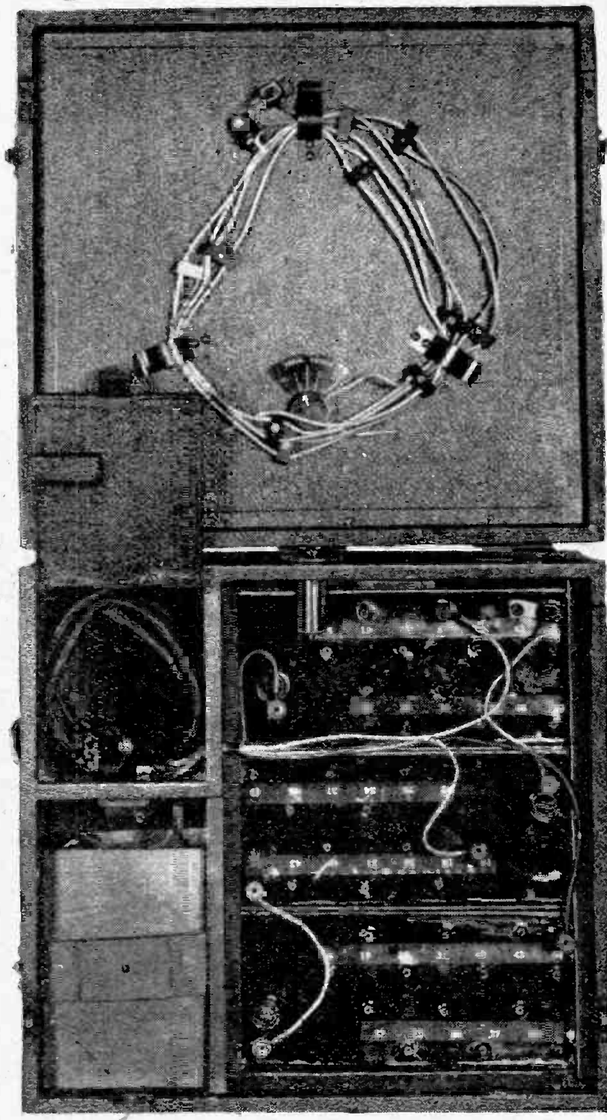
Both detectors are mounted in rubber-sprung holders, the remaining valve holders being rigid. The valves behaved themselves very well indeed, and no trouble was experienced from microphonic noises unless the balancing condenser were thrown out of adjustment to obtain reaction effects. Manipulation of the balancing condenser in this way, although mentioned in the instruction book, is hardly necessary; all the results mentioned later in the article were obtained with the balancing condenser in the normal position.

Tuning coils for the oscillator and H.F. amplifier are boxed in neat moulded units which fit into a well at the extreme left of the valve panel. The top of one of these units *in situ* can be seen in the photograph of the open receiver; the same photograph shows the long-wave unit in the lid of the case.

From left to right the three main tuning controls are as follow: "Frame," "H.F. tuner," and "Oscillator." In the top left-hand corner is the balancing condenser which, once set, does not require further adjustment. The corresponding knob in the top right-hand corner operates a filament rheostat. At the bottom of the panel immediately below the H.F. tuner dial is a volume control. On the left of this is a filament switch, and on the right a telephone jack which automatically cuts out the loud-speaker.



The battery box and frame aerial as they appear in use. Note the ebonite cleats separating the frame aerial leads.



Front cover removed from battery box, showing compartments for cable connector and L.T. and H.T. batteries.

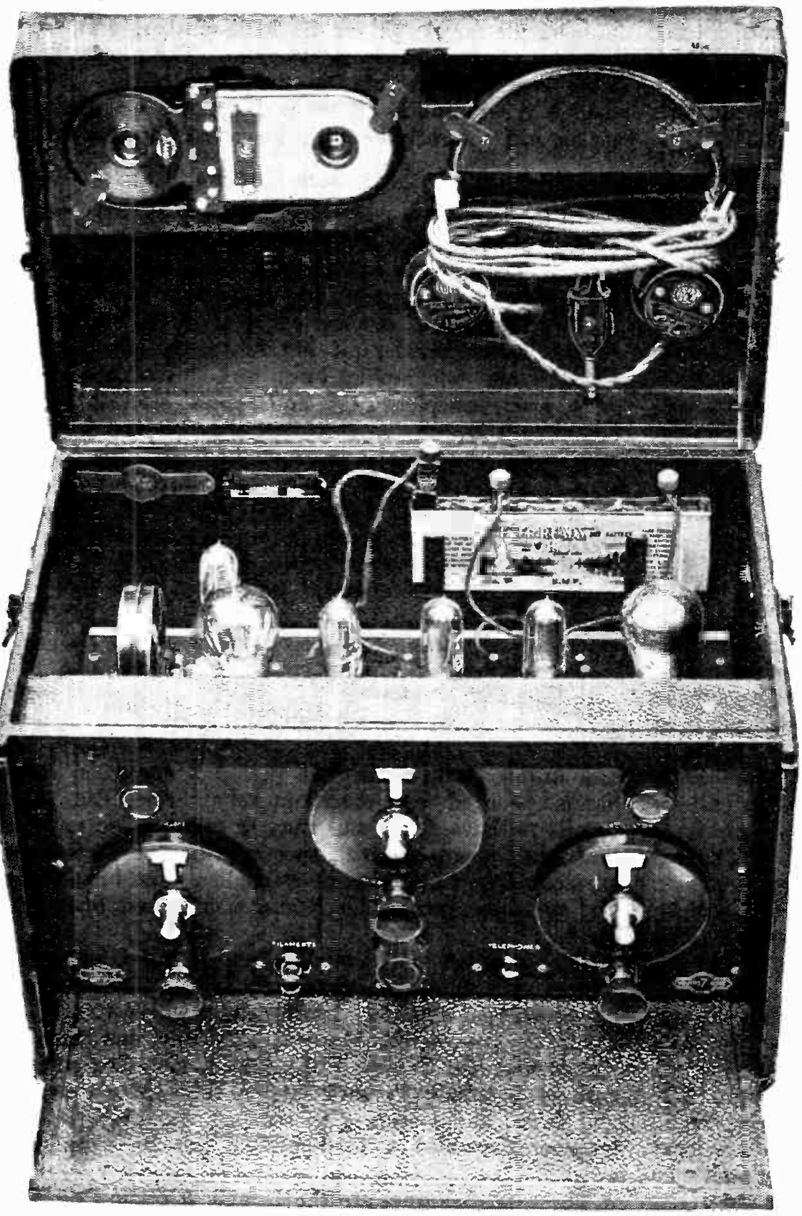
All these controls are mounted on a metal panel which effectively screens the circuits in the interior of the set from hand capacity effects.

The manipulation of three tuning controls calls for considerable skill, which can only be acquired by practice. The single-control receiver is, of course, the ideal to which all manufacturers aspire, but receivers of this type are generally suitable only for local station reception. The manipulation of two controls is soon mastered, and

Broadcast Receiver—Igranic Neutrosonic Seven.—

it is probable that in the future sets with two controls will predominate. The addition of a third tuning control greatly adds to the difficulties of tuning, and the difference in this respect between two controls and three controls is much wider than that between one and two. Add to this the fact that rotation of the "Indigraph" dials in a *clockwise* direction results in a *decrease* in the scale reading, and the confusion of a humble beginner is complete. Still we cannot have it all ways, and three controls is the inevitable price we pay for the unquestionable advantages—increased sensitivity, selectivity, and freedom from low-frequency interference—conferred by the use of a high-frequency stage preceding the first detector. In any case, the tuning difficulties associated with three controls are experienced only when "searching" at random for distant stations. Tuning charts drawn with great precision on squared paper are issued with each set showing the settings of all three dials for any wavelength. These certainly give sufficient data to get somewhere near the required station, but that is all. We found the accuracy of draughtsmanship to be justified only in the case of the "oscillator" settings; the other two curves were by comparison unreliable, due no doubt to variations in the capacity of the leads to the frame and of the balancing condenser.

On the subject of tuning the instruction book is brief. The reader is referred to the calibration charts for dial settings, and the only useful hint regarding the niceties of tuning is in connection with the sequence in which the three main adjustments should be made. The order given is as follows: (1) "Oscillator," (2) "Frame," (3) "H.F. Tuner." To anyone whose previous experience has been with simple "straight" receivers, this order will seem strange, and they will wonder why the frame should not be tuned first to get some strong signals on to the grid of the first valve before playing about with the subsidiary process of heterodyning the signals by means of the oscillator. The sequence recommended by the makers immediately becomes logical, however, when it is realised that we have in the local oscillator a first-class heterodyne wavemeter, the calibration of which is much more likely to remain constant than the frame aerial circuit with its flexible leads. The H.F. circuit is tuned last because its tuning, due to the shunting resistance of the anode current of the valve, is probably somewhat flatter than that of the frame circuit.



General view of the receiver opened up for use. Battery, frame aerial and loud-speaker connections are made to a socket and terminals on a small panel situated at the back of the cabinet.

Alternative Oscillator Settings.

The frequency of the local oscillator always differs from the frequency of the incoming signal by a fixed number of cycles per second, this number being the frequency to which the intermediate amplifier valves are tuned. It is immaterial whether the frequency of the oscillator is higher or lower than the incoming signal (frame and H.F. tuner circuits) provided that the *difference* in frequency between the two groups of circuits is the same. Consequently, it will be found that any station can be tuned in at two distinct settings on the oscillator dial, one above and one below the frequency to which the other two dials are tuned. (The numbering of the graduations is arbitrary, and it must not be assumed that the oscillator dial settings will be numerically above and below those of the other two dials.)

Broadcast Receiver—Igranic Neutrosonic Seven.—

Only one of the two possible series of oscillator settings has been plotted on the calibration chart, which seems a pity, as the alternative settings are often invaluable in eliminating interference from other stations adjacent in wavelength. However, the reader can easily plot the missing curve by taking a few points on well-known stations. It will be as well to take the wavelength for these new points from the existing "oscillator" curve rather than from the official value assigned to the station, which may be temporarily off its wavelength.

Selectivity.

An excellent example of the value of the alternative oscillator setting was afforded while listening in to Cardiff (353 metres) at a distance of only 1¾ miles from 2LO (361.4 metres). With the recommended oscillator setting of 40.5 (according to the chart), the Cardiff station came in at loud-speaker strength, but with a slight background from 2LO, which could only be eliminated by turning the frame to the minimum position for the London station, a manœuvre which naturally resulted in a decrease in signal strength from Cardiff, and would have entirely extinguished the latter if the two stations happened to have the same bearing at the receiver. On the alternative oscillator setting of 48 no trace of the London station could be heard, even though the frame were deliberately pointed in its direction. Anyone who has tried to cut out London at this distance, and has noticed how the emanations from the Oxford Street transmitter seem to permeate into a set in spite of the most careful precautions, will realise that this performance is a high tribute to the selectivity of the Neutrosonic Seven. It seems a pity to think that someone may be deprived of this wonderful performance through not knowing the use of the alternative series of oscillator settings.

Tuning Out the Local Station.

While on the subject of oscillator settings it may be as well to refer to a phenomenon which may mystify the beginner while searching for distant stations on wavelengths close to that of the local station. Let us assume that the "Frame" and "H.F. Tuner" dials have been set to a wavelength, say, 5 metres above that of the local station. On swinging the "Oscillator" dial the usual two positions at which the set becomes sensitive will be observed and will be characterised by strong signals from the local station. If the "Frame" and "H.F. Tuner" circuits are now reset so that they are, say, 8 metres different from the local station, the same effect will be observed on rotating the "Oscillator" control. The *prima facie* conclusion is that one is handling a most unselective receiver, and that it is useless to attempt to receive anything within 10 metres of the local station. This conclusion, though natural, is quite false; the two positions at which the local station is received are spurious "sensitive spots," and are caused by the oscillator beating with the *forced* oscillations in the frame and H.F. circuits induced by the strong signals from the local station. The true "sensitive spots" where the oscillator beats with the *resonant* frequency of the frame and H.F. circuits must be looked for between or just outside the spurious settings. They will be easily found, and distant stations tuned in without a trace of the local station; but it is as well to know the little tricks of which the local station is capable in trying to bluff the listener into believing that nothing else is to be heard within ten metres or ten miles. Further observation will show that the two spurious local station oscillator settings always occur at the same points, whatever the settings of the "Frame" and "H.F. Tuner" dials, and the reader should have no difficulty in avoiding these if he follows the maker's advice in setting the "Oscillator" dial first; it is only when searching at random in the wavelength vicinity of the local station that confusion is likely to arise.

With a thorough mastery of the niceties of tuning, an exploration of the wavelength range of the receiver will yield a rich harvest of stations. During the course of a single evening 40 stations were received on the lower wavelength range, 30 on the loud-speaker, and the remainder at good telephone strength. There must be few European stations outside the range of this receiver, though the reception of low-power stations at great distances will naturally be subject to atmospheric conditions.

Long-wave Stations.

On the long-wave range the following stations were received at loud-speaker strength: Radio-Paris (1,759 metres), Daventry (1,600 metres), Moscow (1,450 metres), Karlsborg (1,375 metres), and Hilversum (1,060 metres).

A further test of the receiver was carried out in Fleet Street, where considerable interference is usually experienced from telegraphic lines and instruments. Very little noise was picked up, and several stations were received in spite of the fact that the receiver was being used underground in a basement. What little interference there was entered the receiver through the frame aerial, and it was found possible to eliminate the extraneous noise completely by making use of the directional properties of the frame. Incidentally, it may be mentioned that throughout the tests no trouble was experienced through interference from long-wave C.W. stations which are frequently picked up by the intermediate circuits in superheterodyne receivers.

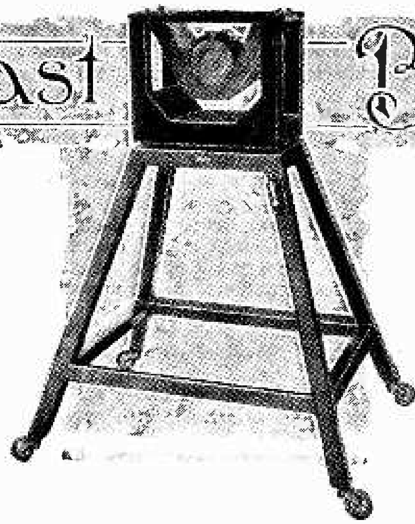
General Impressions.

The whole equipment gives an impression of soundness and utility, and, during the period it has been in our hands, behaved with consistent reliability. The several details we have felt it our duty to criticise are unimportant when compared with such qualities of performance as sensitivity, selectivity, and freedom from interference, and on these points the Neutrosonic Seven scores full marks.

The price of the receiving set, inclusive of valves, phones, and spare long-wave unit, is £40, to which must be added £5 17s. 6d. for royalties which the Igranic Company pay to the Marconi Company and Standard Telephones and Cables, Ltd. The battery box complete with H.T. and L.T. batteries, multiple cable connector, and frame aerial costs £10 10s. A special battery box incorporating also a loud-speaker can be supplied to order.

The manufacturers are the Igranic Electric Co., Ltd., Bedford, the London office being at 147, Queen Victoria Street, E.C.4.

Broadcast Brevities



NEWS FROM ALL QUARTERS.

By Our Special Correspondents.

Melody and Muscle.

The commentators for the Cup Final at the Stadium, Wembley, on April 23 are to be Mr. G. F. Allison and Mr. Derek McCulloch. There will be community singing before the game and during the interval.

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Old and New Favourites.

Miss Fay Marbe will appear in the variety programme from 2LO on April 18. Other artists taking part are Elsie Carlisle and Bobby Alderson (at the piano), Jock Glen (Scotch comedian), and Ann Penn in impersonations.

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England and Wales Contribute.

The oratorio, "Emmaus," by Sir Herbert Brewer, organist of Gloucester Cathedral, will be performed at Cardiff station on April 24th. Sir Herbert will conduct, and the artists will be Hilda Blake and Parry Jones.

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A Royal Broadcast.

The speech of H.M. The King will be broadcast from Cardiff on April 21st on the occasion of the formal opening of the National Museum of Wales. He will be accompanied by the Queen and will be received by Lord Kenyon, the President of the Museum. In addition to the speeches a descriptive commentary will be relayed to Daventry of the arrival of Their Majesties and of others parts of the ceremony that would not otherwise be distinguishable if the sounds only were broadcast, such as the Inspection of the Guard of Honour and the reception by the President and officials of the Museum.

A programme of music has been arranged by Sir Walford Davies. I understand that the fine buildings have already cost over a quarter of a million pounds.

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Eastertide Programmes.

The B.C.C. has, as usual, given careful attention to the provision of excellent programmes during the Easter holiday. On Good Friday, a Children's Service, suitable to the occasion, will begin at 4.30 p.m., and will be conducted by St. Christopher's Training College. This will be followed at 5.0 p.m. by unaccompanied evensong relayed from Christ Church, Oxford, where the choir is perhaps unequalled in the artistic rendering of unaccompanied music. At 6.0 p.m. the Aeolian Chamber Orchestra will play, and at 7.15 p.m. a service will be broadcast from St. Martin's in the Fields with an address by our good friend and "wireless vicar" the Rev. "Dick" Sheppard.

FUTURE FEATURES.

Sunday, April 17th.

LONDON.—Religious Service from Carlisle Cathedral.

BOURNEMOUTH.—Afternoon Concert relayed from King's Hall Rooms.

Monday, April 18th.

LONDON.—Military Band Concert.

MANCHESTER.—Serenades and Lullabies.

Tuesday, April 19th.

LONDON.—Symphony Concert S.B. from Liverpool.

CARDIFF.—"An S.O.S. Announcement," played by Station Radio Players.

MANCHESTER.—"The Sultan of Mocha," Comic Opera by Alfred Cellier.

Wednesday, April 20th.

LONDON.—"The Spell," a Comedy in one act by Bernard Duffy.

CARDIFF.—The Madrigal, with examples by the Cymric Madrigalists.

Thursday, April 21st.

LONDON.—"Violoncello Recital by Luigi Gasparini with Minnie Hamblett (pianoforte).

BIRMINGHAM. — "The Constant Lover," by St. John Hankin.

NEWCASTLE.—"Q" Farce in one act by Stephen Leacock and Basil MacDonald Hastings.

Friday, April 22nd.

LONDON. — "The Merchant of Venice" (Shakespeare).

CARDIFF.—Organ Recital by Arthur M. Sims from Central Hall, Newport.

Saturday, April 23rd.

LONDON.—Press Club Concert.

CARDIFF —Concert by the St. George's Society, relayed from Whitehall Rooms.

The "Dream of Gerontius" will be relayed from the Bishopsgate Institute at 8.15, conducted by the composer, Sir Edward Elgar, and I can imagine no more suitable work for concluding a Good Friday programme.

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A Frivolous Interlude.

The Saturday programme is, of course, of an hilarious nature, the chief attraction being the revue "Advanced Sparks," written by the well-known "L. G." of *Punch*. This contains what is said to be the first "Petrol" song ever written, and is entitled "Honk, Honk." The cast includes Miss Jean Alliston, whose stage experience began at the early age of eleven, when, as a child actress, she was engaged at His Majesty's Theatre by the late Sir Herbert Tree. The difficulty of giving her an efficient school training during this period was surmounted by the provision of a school room under the dome of the building, where, in addition to excellent general instruction, the children often enjoyed the advantage of reading lessons given by Tree himself. Hard work must have been the order of the day, for when lessons in the dome were over it was generally time for a rehearsal in the theatre.

The remainder of the evening programme will include Mr. Bransby Williams in his impersonations of Dickens' characters, Messrs. Hatch and Carpenter, Miss Marie Dainton, and the ever-popular Tom Clare.

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Easter Services.

Bach's great Passion Music will be broadcast during the afternoon of Easter Sunday from York Minster. The interpretation of this noble work, descriptive of the narrative taken from St. Matthew's Gospel, will, without doubt, be most ably rendered by the notable choir of the Minster.

The North Country will also contribute the evening service, which will be relayed from Carlisle Cathedral.

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More Laughter and Jollity.

Of the programme for Easter Monday little need be said beyond the fact that the general tone will be one of variety and light entertainment suitable to the prevalent holiday atmosphere.

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A Hair-raising Programme?

Mr. A. J. Alan, the mystery story-teller whose broadcasts of hair-raisers were a feature of 2LO's programmes some time ago, will reappear before the microphone on April 20th, when he will make a contribution to the "My Programme" series.

"He Knows Me, Like the Cuckoo, by the Bad (?) Voice."

Mr. Glyn Eastman, who is broadcasting from Bournemouth on April 17th, was with his regiment in a wood behind the lines one night during the war when some of the men got up an impromptu concert. Mr. Glyn Eastman's contribution to the entertainment was the Toreador's song from "Carmen." As he was singing a party of mounted men came down the road, and, on hearing the song coming from the wood, one of them jumped off his horse and ran towards the singer. The rider was Mr. Glyn Eastman's brother, who had recognised the singer's voice. The coincidence was the more remarkable because the brothers had not met for more than a year, and neither knew that the other was at that time in France.

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Apropos the "Variety" War.

Experience is said to show that the broadcasting of excerpts from plays tends to increase the box office receipts, provides a means of super-publicity for any play, and reaches the public ear more effectively than any other kind of advertisement. Having listened out of curiosity to the broadcasting of a popular actor and heard the laughter and applause with which his by-play is greeted, a listener is probably fired with a desire to see the play of which he has only heard a small part, and that without the action which may be even more intriguing than the bare words.

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Training the Youthful Mind.

I understand that the B.B.C. will co-operate with the Education Committee of the L.C.C. in the preparation of suitable talks and instructions for the Friday afternoon broadcasting to the Council schools. Probably the whole of Friday afternoon will be devoted to broadcast lessons and not merely the last school hour. The B.B.C. will give advice and the benefit of their wide experience in the choice of suitable installations and their upkeep. I understand that the course of instruction will begin directly after the Easter holidays and will include school concerts by the People's Concert Society, bright descriptions of travel and foreign countries, explanations concerning the making of English laws and their necessity for the well-being of a civilised nation, the meaning of the British Constitution, talks on English folk music, dancing, etc., and other subjects tending to broaden the minds of the rising generation and encourage them to take a pride in their citizenship and a wider view of their "duty towards their neighbour" than they might otherwise be able to acquire in their, possibly, narrow surroundings.

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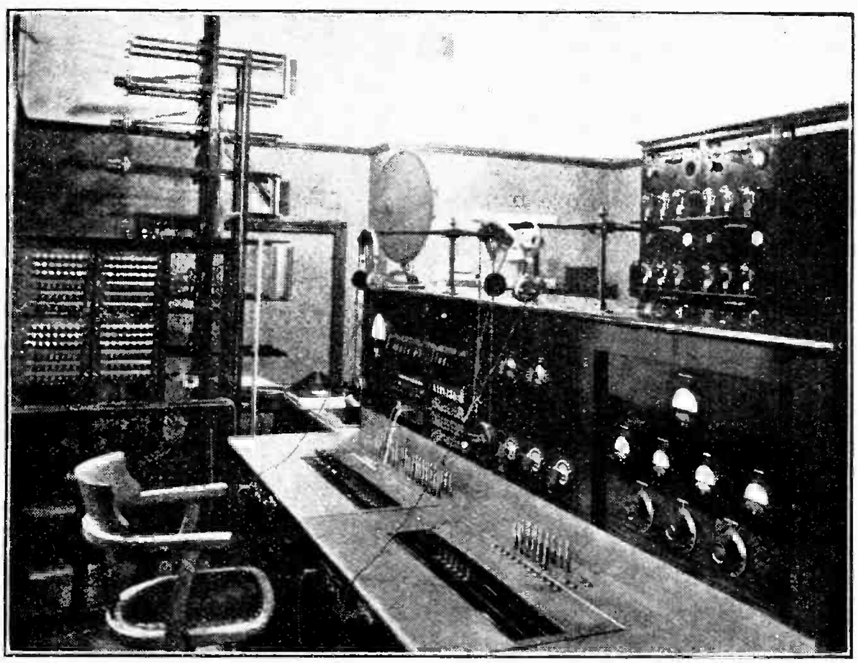
Opinion on the National Concerts.

A mistaken impression has been gaining ground that the National Concerts have not been considered a success. The idea was probably engendered by the sparse attendances at the Albert Hall, but the B.B.C. are confident that the attendances are not a true criterion. Incidentally, the audience at these concerts has never dropped below 3,000, but the Albert Hall looks half empty with double that number! Thus it exhibits the opposite characteristic to that of a pint pot which, alas, always appears to hold more than is actually the case.



THE GLOUCESTER REPEATER STATION. This almost unknown link in the simultaneous broadcast system of the B.B.C. controls the bridging together of stations giving the same programme as well as providing the intermediate amplification necessary when working over long distance land lines.

A Reminiscence of Wagner.

Richard Wagner, the father of the conductor at the concert on April 7, himself conducted a series of six concerts at the Albert Hall in 1877. Richard Wagner's orchestra "worked zealously from beginning to end," according to the critics. During these concerts Wagner in spite of his strong objections to repetitions of any passages from his works, allowed encore after encore. Many royal personages were present.

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A Whiff of Fresh Air.

I understand that during the coming summer the experiment of broadcasting sounds from seaside places will be repeated, and probably extended. Last year the noise of the sea and other cheery sounds from Eastbourne, Brighton, Dover, Ramsgate, Bexhill, Yarmouth and Felixstowe were brought to the jaded ears of listeners in our great cities, and it is thought that they will again welcome these heartening and, perhaps, reminiscent sounds when shut up in big towns on hot summer evenings—assuming, of course, that we get any real summer this year.

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A Tentative Change of Programme.

Do listeners want dance music in preference to talks, variety or orchestral performances? The B.B.C. propose to put this to the test by introducing a slight variation in their programme timings on Tuesday evenings. Dance music has hitherto been given between 10.30 and midnight, after the regular studio transmissions. It is now intended to broadcast dance music from 9.30 to 11.0 p.m., and transfer that part of the programme which is at present given between 9.30 and 10.30 to follow on from 11.0 p.m. until midnight. This later part of the programme will provide a distinct contrast to the dance music, being probably confined to light classical music. Dancers will no doubt appreciate the evident desire of the B.B.C. to satisfy their wishes, even at the expense of keeping their announcers and musicians from their needful slumbers for an extra hour and a half.

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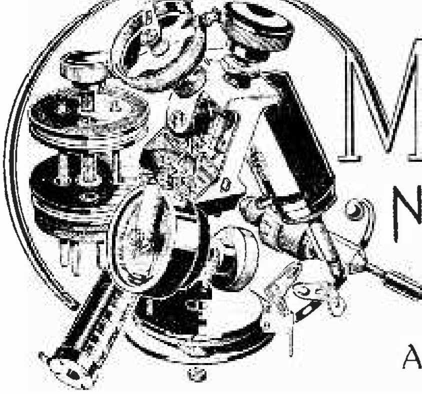
The Queen's Hall.

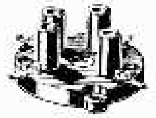
At the moment of writing nothing has bourgeoned forth in the shape of an arrangement between the B.B.C. and Messrs. Chappell regarding the future of the Queen's Hall.

From a broadcasting, if not from a musical, point of view, the matter is not vitally urgent. The summer season will soon be upon us, and few folks will fret if large orchestral concerts are missing from the programmes during the "dog days."

As winter approaches, however, the B.B.C. will be seeking a successor to the Albert Hall, which will not be used to the same extent as hitherto. If negotiations for the use of the Queen's Hall fail through the Corporation will not be at the end of its resources. Covent Garden Opera House has been mentioned in connection with some interesting proposals.



MANUFACTURERS' NEW APPARATUS

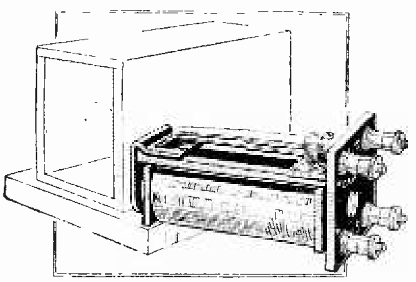


HIND

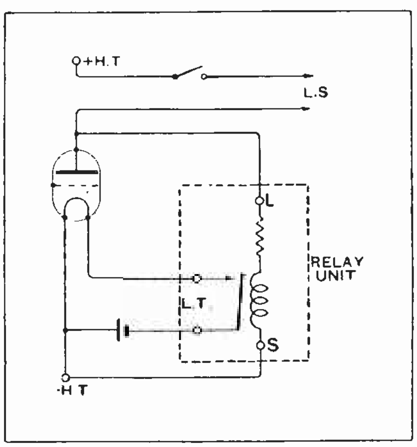
A Review of the Latest Products of the Manufacturers.

SIMPLE REMOTE CONTROL UNIT.

It is now becoming common practice to distribute leads from receiving sets so that telephone or loud-speaker reception can be obtained in various points remote from the set. Many systems have been devised for controlling the receiver from distant listening points, and although the most obvious system would make use of a pair of wires additional to those operating the loud-speaker, a controlling arrangement is required in which the wires carrying the speech currents also control the relay connected to the current supply to the receiving set.

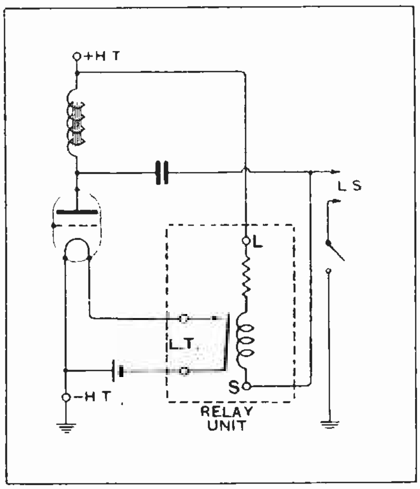


The distant control unit of Messrs. Baily, Grundy & Barrett, Ltd. No additional leads are required to those feeding the loud-speakers



Circuit connections of the remote control unit when the loud-speaker is connected directly in the plate circuit of the last valve

A relay control unit is obtainable from Baily, Grundy & Barrett, Ltd., 2, Saint Mary's Passage, Cambridge, which can be easily introduced into the outgoing loud-speaker leads, so that the actual control is obtained by a switch placed in a loud-speaker circuit. When the circuit is completed through a loud-speaker the relay pulls over, closing the local circuit controlling the filament current. Circuit arrangements are shown in the accompanying diagrams, one of which provides for connecting the loud-speaker directly in the plate circuit of the output valve, and the other where the loud-speaker is fed through a condenser.



A modified circuit arrangement for remote control in which the loud-speaker is fed through a condenser. In this instance a single wire is used for both controlling the relay and conveying the speech or music.

The introduction of the relay unit into the output of receiving set was found to have no effect on either the volume or the quality, which is not surprising in view of the very high impedance of the relay windings. The relay is of a similar pattern to a telephone switchboard relay, and is, consequently, robust and entirely reliable in operation. The unit is intended for use with a normal H.T. potential of 120 volts when the operating current is 2 mA., though voltages as high as 200 can be used without injury to the windings. It is advisable, however, to use an additional series resistance for voltages over 150 to restrict the current in the relay circuit to about 2 mA. The lower limit of voltage required to operate the relay was found to be about 80, so that the unit also serves to give warning when the H.T. battery requires renewing or recharging, similar to the arrangement described in a recent issue entitled "An Automatic Receiver."[1] The unit retails at a moderate price, and can be relied upon to give trouble-free service.

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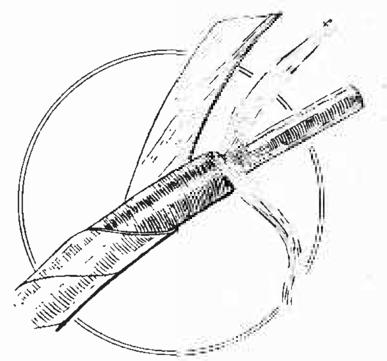
SCREENED WIRE.

A carefully considered layout must be adopted in constructing a battery eliminator in order to prevent the leads carrying alternating current taking paths near to or parallel with wires connected in the smoothed D.C. output circuit. It is sometimes recommended that the output leads should be screened in metallic sleeving, though the wire available for this purpose is usually very difficult to handle and occupies considerable space.

Messrs. Ward & Goldstone, Ltd., Frederick Road, Pendleton, Manchester, have recently placed on the market screened wire carrying a covering of metal foil. The wire, which is No. 18 tinned copper, carries a double covering of cotton, and after treatment with wax is spirally wrapped with moderately thick tin foil. Leads carrying alternating



Wire carrying metallic covering for screening is useful in the construction of battery eliminators. This view is enlarged, the copper conductor being No. 18 S.W.G

[1] June 9th, 1926, page 756.

current can, with advantage, be connected in pairs and bound together along their length, and in spite of the adoption of screened wire should be kept apart from the leads carrying the rectified output. Screened D.C. leads may also be bound together with a bare copper wire and connected to an earthing terminal.

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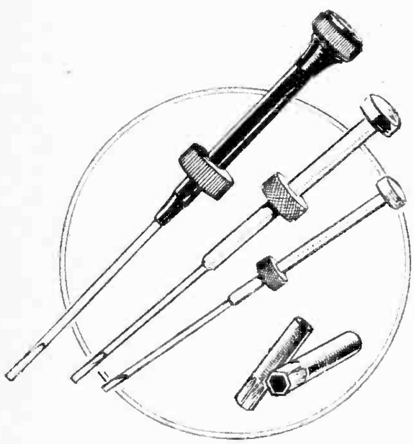
INSTRUMENT SCREWDRIVERS.

The amateur is often handicapped by possessing few working tools, and even with the most modest workshop equipment the possession of a good screwdriver is essential. To use an inferior screwdriver often results in the spoiling of good components and mars the appearance of an otherwise good set by damaging the screw heads.

An attractive range of screwdrivers particularly handy for wireless work are obtainable from Atalanta, Ltd., 1-3, Brixton Road, London, S.W.9. Three sizes are available, the largest being provided with a moulded Bakelite handle.



A useful series of screwdrivers and box spanners suitable for wireless constructional work

A milled ring which can be set at any convenient position along the handle gives an easy turning movement, whilst the handle which presses into the palm of the hand is arranged to revolve. The blade is well shaped and does not slip out of the slot of the screw, while the advantages gained by the particular form of handle are quickly appreciated when using this form of driver.

The smallest of the three types is obtainable with a set of three box spanners for turning B.A. nuts. The spanners merely fit over the blade of the driver, and not only are they useful for turning nuts in otherwise inaccessible positions but there is less chance of injuring the faces of the nuts as compared with the use of pliers or other forms of spanner.

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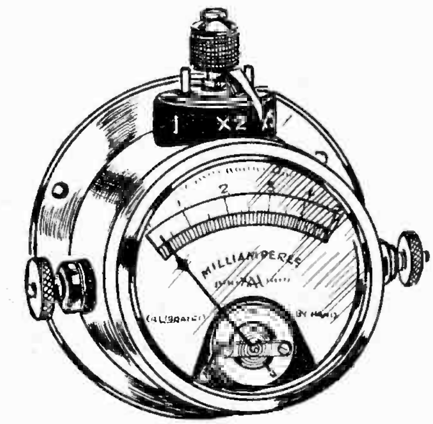
THREE RANGE MILLIAMMETER.

To meet the requirements of the amateur particularly when testing valves, A. H. Hunt, Ltd., H. A. H. Works, Tunstall Road, Croydon, have introduced a three-range milliammeter.

The scale reading as marked reads to 5 mA, and by means of a rotating switch the maximum range is extended to read



Three-range milliammeter useful for plate current determinations.

either 10 or 25 mA. As the scale of the instrument has been individually calibrated the reading can be relied upon to be accurate to within small limits. The movement pointer is dead beat coming to rest quickly when taking readings.

The aim of the manufacturers has been to provide the amateur with an instrument useful for making measurements in connection with wireless receiving sets and a saving of expense is effected by combining three scales in a single instrument.

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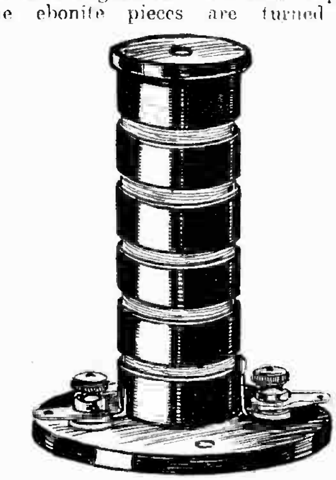
HIGH-FREQUENCY CHOKE.

A useful form of high frequency choke coil, designed for baseboard mounting, is manufactured by the Premier Supply Stores, 20-22, High Street, Clapham, London, S.W.

It is of simple yet reliable construction, the winding being sectioned and wound into grooves in an ebonite pillar. The ebonite pieces are turned and



The Premier baseboard mounting H.F. choke coil

polished and made from ebonite sheet and rod, a pair of terminals being accommodated on the ebonite base piece to facilitate the running of the connecting wires near the surface of the baseboard. In bringing the end of the wire from the top of the spool to one of the terminals a slot is provided down the edge of the spool which on reaching the bottom section is held in position by making a turn round the surface of the winding of the bottom section. The undesirable stray capacity presented between the two ends of the spool by this arrangement of the connecting leads is, however, quite small, owing to the fineness of the wire, but it would be an improvement were this wire to be taken down the centre of the former or connected to a stiff wire slightly spaced from the winding. The spool measures about 3in. in height and the circular base covers an area 2in. in diameter.

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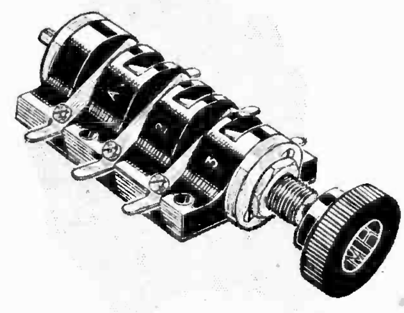
NEW M.H. SWITCHES.

Not only in radio-frequency circuits, but also in circuits associated with audio-frequency currents is it necessary when using switches to ensure that only very small stray capacities are introduced. It is no longer considered safe to make use



M.H. low capacity switch. The tags being near the surface of the baseboard provide for neat wiring while their distribution on either side of the ebonite bar will be found generally convenient for making the circuit connection.

of the ordinary Dewar key for switching an L.F. amplifier so that although the practice of introducing switches into high frequency circuits may be declining, and the need for a really low capacity switch for use in L.F. circuits has arisen.

To meet the demand L. McMichael, Ltd., Wexham Road, Slough, Bucks, have recently designed a novel form of switch possessing several points of merit. The contacts lie in grooves along the sides of an ebonite piece in the centre of which is an insulating spindle carrying a brass sleeve. The knob, which is operated like a plunger, moves the sleeve so as to make connection between the various contacts and the rubbing movement, together with a liberal area of contact ensures reliable connection without danger of noise being created in a receiving circuit by intermittent or high resistance connection with the springs. The switch is arranged for either one hole panel mounting or for screwing down to a baseboard, and the position of the tags near the surface of the board is a great convenience when connecting up.

The switch moves with a snap action, the spindle being supported by substantial brass bearing plates. The metal parts are nickel-plated, and the operating knob polished and engraved. This new component can be safely employed in practically any circuit system where it is desired to produce changes in the circuit arrangement by means of switching. It is supplied as a single or two-pole two-position switch, and can probably be extended to include any number of contacts according to requirements.

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A SHORT-WAVE RECEIVER.

There are comparatively few short-wave receiving sets on the market, and although amateurs interested in short-wave reception usually construct sets for themselves, there is a considerable demand for a made-up short-wave set.

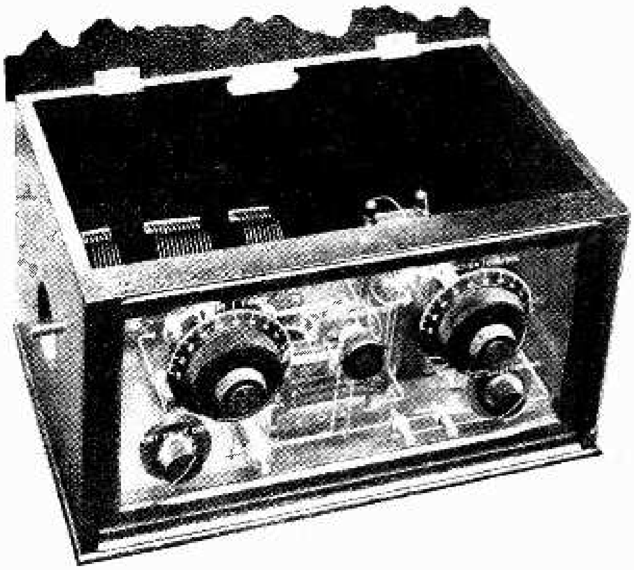
A complete two-valve short-wave receiver is manufactured by Stratton & Co., Ltd., Balmoral Works, Bromsgrove Street, Birmingham. The circuit arrangement employed is that most universally adopted by amateurs and comprises an aerial coil, inductively coupled to a tuned closed circuit with a variable capacity reaction.

To cover a wide range of wavelengths interchangeable plug-in coils must be adopted, and the simple form of coil mount which is fitted is a feature of the set which will recommend it to the short-wave enthusiasts. It comprises a series of sockets arranged along an ebonite strip, some of which are connected across in order to accommodate the pin connectors of coils differing in length. The coils are of No. 16 enamelled wire rigidly supported between ebonite strips, and although only a minimum of solid dielectric material is used in the construction the coils are perfectly durable and robust. Coils and coil holder are obtainable if required as separate components. The high-frequency choke coil connected in the plate circuit of the detector valve is also of special construction, and as well as being provided with a two-pin mount, is an air-spaced winding carried on ebonite rods.

An unusual and attractive feature is that of employing a glass panel for carrying the controls, which, as well as displaying a well-finished interior, permits of the tuning coils being viewed so that the tuning range can be estimated.

In addition to the reaction condenser a control of self-oscillation is provided by a potentiometer connected to the grid leak. If the size of the reaction coil is not suitably chosen some degree of overlap may occur when adjusting the reaction condenser close to the oscillating point, and the potentiometer will be found useful for providing a critical adjustment under such circumstances, though a slight falling off in signal strength results when the valve becomes an anode band detector by being negatively biased.

This receiver is suitable for the reception of amateur transmissions, and on test both 2XAF and KDKA were readily tuned in at a satisfactory telephone strength, signals being easily separated from the heterodyned carrier wave.



Eddystone short-wave receiver. Plug-in coils provide a wide wave range. Reaction is controlled by potentiometer and variable condenser.

TRADE NOTES.

"Radio for the Million."

"Radio for the Million," Vol. 1, No. 2, issued by the Mullard Wireless Service Co., Ltd., maintains the standard set by the first issue. Constructional details are given in connection with the "Drake" P.M. and "Columbus" P.M. receiving sets, while an illustrated article deals with the Mullard P.M. speaker and its abilities in the reproduction of instrumental and vocal music. We understand that copies may be obtained free of charge on application to the Editor, 63, Lincoln's Inn Fields, London, E.C., or by filling in a coupon obtainable from local dealers.

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B.B.C. Ideal Receivers.

We understand from the General Electric Co., Ltd., of Magnet House, Kingsway, W.C.2, that the valves used in the B.B.C. Ideal receiving sets on show at the *Daily Mail* Ideal Home Exhibition were the *Osram* types DE5, DE5a, DE5b, and LS5.

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New Address.

A rapid increase in business has led Messrs. The Electron Co., Ltd., manufacturers of the Six-Sixty valves, to seek fresh fields and pastures new. Their new address is 122-124, Charing Cross Road, London, W.C.2.

B.T.H. Constructors' Sets.

Messrs. The British Thomson-Houston Co., Ltd., of Coventry, have produced an attractive booklet giving complete details for the home construction of "Resistor" B.T.H. constructors' sets.

The building of each set is carefully described with the aid of diagrams and photographs. The reader is also instructed in the assembly of the "Resistor" amplifier intended for use with crystal receivers.

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Holland and Java Telephony.

Wireless telephonic communication has been established for the first time between Messrs. Philips' Laboratories, Eindhoven, Holland, and Bandoeng, Java, Dutch East Indies. Messrs. Philips Lamps, Ltd., 145, Charing Cross Road, London, W.C.2, state that a telegram was received in reply from the Dutch East Indian Government congratulating Messrs. Philips on their splendid transmission, which was carried out on a wavelength of about 30 metres.

London Guide for Motor Owners.

A booklet which should prove of considerable service and interest to private motor owners in the London district has been issued by the Hart Accumulator Co., Ltd., of Marshgate Lane, London, E.15. It is known as the "Nearest Garage Guide" (London district). The booklet provides useful information regarding railway stations, theatres, hotels, etc., and an ingenious system of classification provides instant information as to the garages nearest to the various places of importance and interest.

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"The Brown Budget."

The Brown Budget for March includes an interesting contribution entitled "Bringing the Loud-speaker to the Masses," and describes the "Brown" Ideal wireless set, which consists of a combined amplifier and crystal receiver. The issue is of greater interest to the wireless dealer than to the amateur.

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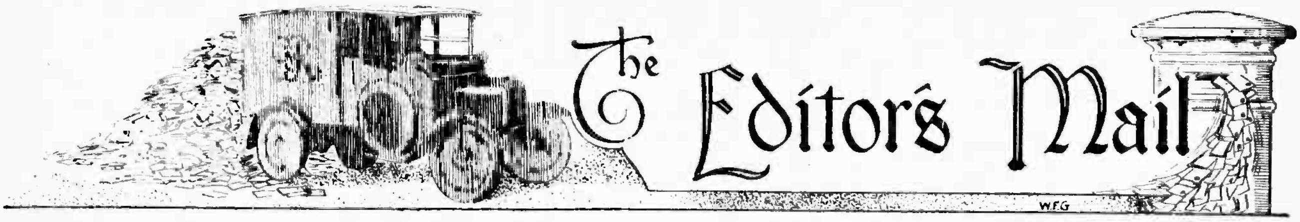
Loewe Valves.—A Correction.

In our issue of March 9th last it was stated that the London agency for Loewe valves had been secured by Mr. J. Dorn. We now learn from the manufacturers, Messrs. Loewe-Radio G.m.b.H., Wiesenweg 10, Steglitz, Berlin, that the statement was incorrect, and we regret the error.



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.

B.B.C. HIGH-POWER STATIONS.

Sir,—Being one of the earliest advocates of a system of five high-power broadcast stations for Great Britain, even in the days of the mushroom growth of the relay stations, I note with alarm in Capt. Eckersley's letter, published in your issue of March 30th, that what the B.B.C. really mean is *ten* transmitters, two at each point, radiating on apparently widely different wavelengths with equal power. Both in my own opinion and from a study of a recent article by Dr. A. N. Goldsmith in the Proceedings of the I.R.E. on the interference caused by the American 50 kW. station at Boundbrook, I am sure that five or six 50 to 100 kW. stations located in suitable spots midway between populated areas would only cause less than half the interference of the present multiplicity of stations mostly located in towns.

This new proposal, however, of five double-wave stations is worse almost than the existing system, and would tend to limit most listeners to the two alternative programmes of the nearest station by blocking both ends of the wavebands with a transmission of high field strength. The original scheme, however, which is sane practicable policy, is for, say, six single-wave transmitters spread equally as regards frequency over the present broadcast wave-band to all broadcast alternative programmes every day of the week. This would give two alternative programmes to the crystal set from the nearest town, and practically unlimited choice to the valve user. A good while back when the N.A.R.M.A.T. were inviting suggestions as to improvements on the present system, I drew up the following schedule of operation over a period of a week for six high-power stations. It brings out very prominently the value of the scheme :—

Day.	Station. 1	2	3	4	5	6	
Mon.	A	F	E	D	C	B	
Tues.	B	A	F	E	D	C	
Wed.	C	B	A	F	E	D	
Thurs.	D	C	B	A	F	E	Programme.
Fri.	E	D	C	B	A	F	
Sat.	F	E	D	C	B	A	
Sun.	G_1	G_2	G_3	G_4	G_5	G_6	

A, dance music; B, variety and light entertainment; C, opera and symphony concerts; D, talks and educational matter; E, military bands and orchestral music; F, vocal and instrumental solos; G_1, G_2, G_3, etc., Sunday programmes, all different, of appropriate type.

This at one blow practically solves the programme difficulties, as, while the crystal user has a better service than at present, a set with probably only two valves can choose at least four alternatives and a modern selective type the whole six. Hence every night a listener may have his talks, his dance music, or his symphony concert as the mood takes him merely by tuning in the scheduled station, which, using high power, would come in from anywhere in Great Britain. W. J. RANDALL.

Nottingham, March 31st, 1927.

Sir,—In your issue of March 2nd you are sorry for those who will live under the aerial of the new regional London station, surely it is better that a few people should be handicapped than that the vast majority of London listeners should be deprived of an alternative programme?

I have been a listener for over three years, and have longed for the time when 2LO would be moved outside London. I live about a mile from 2LO's aerial, and it is impossible to cut them out unless one uses a very expensive set.

London, W.8. (MISS) A. M. J. SHORTER.

April 4th, 1927.

AMATEUR INTERNATIONAL PREFIXES.

Sir,—I have been following with interest the discussions by your correspondents and your editorial comments in *The Wireless World* on the subject of the new amateur international intermediates launched by the I.A.R.U. on February 1st. There seems to be quite a tempest on this topic in your country. The discussion in your columns has now sufficiently crystallised to indicate the existence of several fundamental misconceptions, and I beg enough space in your valuable pages to comment on some of these subjects in the hope that the misunderstanding may be cleared away.

It seems to be a common impression in England that the new amateur intermediates were drawn up hastily, without due consultation with other people, and that in general "the Yankee in his usual high-handed manner pushed the new intermediates on us." At Paris in April of 1925 the first International Amateur Congress was held, with representatives present from twenty-odd nations, including a substantial representation from the British Isles second in number to the French representatives only. It was at this Congress that the International Amateur Radio Union was formed, its constitution adopted, and many subjects studied involving international amateur co-operation. The questions on which action was not taken by the Union itself at this Congress were referred to the Executive Committee of the Union for action. As a result the question of international intermediates was studied by the Executive Committee for something over a year and a half, views exchanged between the various members, and several alternative schemes for intermediates discussed. The scheme eventually determined upon was adopted by a vote of the Executive Committee of the Union. As this Committee has but five members, there were many nations not directly represented upon it, but England was, in the person of the Vice-president of the Union, Mr. Gerald Marcuse, who, with the reservation that British adoption of the new system was dependent upon the approval of the General Post Office, voted in favour of the action. The new system was announced on November 30th, 1926, to go into effect February 1st, 1927, and complete information on it was immediately forwarded to all sections and officers of the I.A.R.U., to all national amateur societies, and to every amateur magazine whose address was known to the headquarters of the Union. I submit that this action was constitutional, that rather than being a hasty plan it was the result of long and careful study, and that rather than being an American idea perpetrated by Americans and fitted only for Americans, it represents the best thought of a representative international group.

Your correspondents also make it quite clear that it is believed that it was quite untactful of the Union to announce a system of intermediates without ascertaining the views of the Governments concerned, that members in many countries run a risk of trouble with their authorities by adopting the new plan, and in general that it was another Yankee mistake to think that because such a system was acceptable in the United States it would be acceptable in all other Governments. In the consideration of this question I believe there is a truly fundamental misconception of the nature and status of an intermediate. I am very strongly of the opinion that the matter of international amateur intermediates is no concern of any Government. It is the inalienable right of a Government to assign its *calls* in any fashion it sees fit, but the intermediate is *not* part of the call. One of the alternative plans considered when intermediates were under discussion was a proposal to get the co-operation of the Governments of the world in the assigning of calls that would be so constructed as to indicate in themselves the nationality of the sending stations. The Union abandoned this proposal for the very reason that it does not believe that it is any concern of the amateurs how the Governments assign their calls—that is the business of the various Governments. On the other hand, the Governments having assigned calls, it is very much the business of the amateur to arrange for his international identification. Imagine an amateur in Czecho-Slovakia, with a call assigned by his Government. That amateur can get on the air and operate with that call and then laboriously say, "I am in Czecho-Slovakia," if he pleases. On the other hand, if he is assured that all of his fellows will understand him, he may simplify this practice by transmitting the letters "ec" before his call, thus shortening his labour. It is to be emphasised that the "ec" is not a part of the call, and is not a prefix to the call, as your General Post Office has seemed to view it. The British Postmaster-General has stated, in connection with his disapproval of the new amateur intermediates, that prefixes have already been allocated by agreements between the various Governments concerned. It is to be presumed that he is referring to the international agreement for the assignment of the initial letters of calls for commercial stations amongst the various nations of the world, as now managed by the Berne Bureau. Of course, this is quite proper and binding amongst calls of this nature, but the amateur calls of most nations, including Great Britain, are not so derived. The new intermediates are not part of the call, they do not involve a change in the call itself, and they may not even be considered as a prefix to the call. They must be considered as a new series of amateur abbreviations, co-operatively agreed upon by the amateurs of the world, through their co-operative associations, for the purpose of indicating nationality regardless of the call which a Government assigns. It was because it was so clearly established in the minds of the officers of the Union that the intermediate was not a part of the call that no effort was made by the Union to secure the assent of the Governments of the various nations before inaugurating the new system. On the contrary, it was regarded as one of those strictly co-operative amateur problems for the solution of which the I.A.R.U. was organised. It is to be noted that in all the world the only Government agency that thinks it is concerned with the matter is the British General Post Office. The Headquarters Office of the Union hopes that it will become apparent to the officials of your Post Office Department that there is nothing in the intermediates which operates contrary to the international agreement to which Great Britain is a party, and that the scheme was, in fact, planned to avoid such embarrassment.

There are many criticisms of the system itself: that it is a muddleheaded system, that the "e" for Europe is no good and won't get through, that the system is not adaptable to Swedish calls, etc. No man-made scheme for anything is ever perfect, and it is not pretended that this is a perfect system. It is merely the best proposal that has been advanced, considering the varying needs and conditions around the world. There will doubtless some day have to be some small adjustments and some additions to the list. There have been various little difficulties occurring in its inauguration, based for the most part on petty national jealousies, but I am glad to say that now amateur radio around the world is generally settling down into an acceptance and a practical use of the system, which has already demonstrated its merit. The practical use of the system has demonstrated that there is no difficulty about the letter "e" in the intermediate for European countries—it does get through entirely satisfactorily; in fact, this was demonstrated before the new system by the use of the single letter "e" by Spain for some years previous. As to the new system not being adaptable to Swedish calls, of course it is. [illegible] it makes no difference what the call is, and this comment is part of the same mistaken assumption commented upon above, that the intermediate is part of the call.

It is perhaps worthy of comment that practically all of the British stations that are heard regularly in the United States are employing this new plan of intermediates. I sincerely trust that as time wears on and British amateurs appreciate that they were represented in the adoption of the new plan, and that it does not conflict with the system of calls of the General Post Office, they will think better of the plan and abandon their position as the only group in the world which is protesting against it.

K. B. WARNER,
International Secretary-Treasurer.

Hartford,
Conn., U.S.A.
March 21st, 1927.

LOUD-SPEAKER REPRODUCTION.

Sir,—In connection with the article in the March 23rd issue by Dr. N. W. McLachlan, may I suggest a little more attention to what our U.S.A. brothers call the "orthophonic" horn.

About a year ago I came across a report of work carried out on sound by the "U.S.A. Army School of Sound," and was misguided enough to calculate (not a very difficult matter with the help of a mathematically inclined friend) the figures for a 6ft. horn on the exponential curve to fit a three-guinea "Amplion" gramophone attachment I had in use.

The plan was handed to a carpenter and the horn produced in $\frac{1}{4}$in. cypress at a cost of 25s. The total cost was therefore £4 8s.

I have a special two-valve receiver for the local station, 2ZY, on a good outside aerial, and believe I can amplify all frequencies transmitted, although I do not claim that the speaker does actually give the very lowest notes.

The loud-speaker has many times been compared with other speakers costing as much or more and of standard manufacture, in every case beating them hollow in every way.

The orthophonic horn 6ft. long transmits vibrations of 100 to 5,000 per second, covering practically all musical notes. Middle C is, of course, 256, and an octave lower is 128, the fourth octave above is 4,096 vibrations per second. The average horn-type speaker transmits vibrations of 275 to 2,500, and the average cone type 150 to 600 vibrations approximately.

In my opinion cone speakers will disappear, especially when means are found of fitting a 6ft. or longer orthophonic horn into a comparatively small compass.

My only trouble during the last twelve months has been the varying amount of modulation (under-modulation) put on the carrier wave of 2ZY, my best results always being obtained when the set has some power to handle.

Timperley. ARTHUR F. WILLIAMS.
March 25th, 1927.

WOOD STAIN AND POLISH.

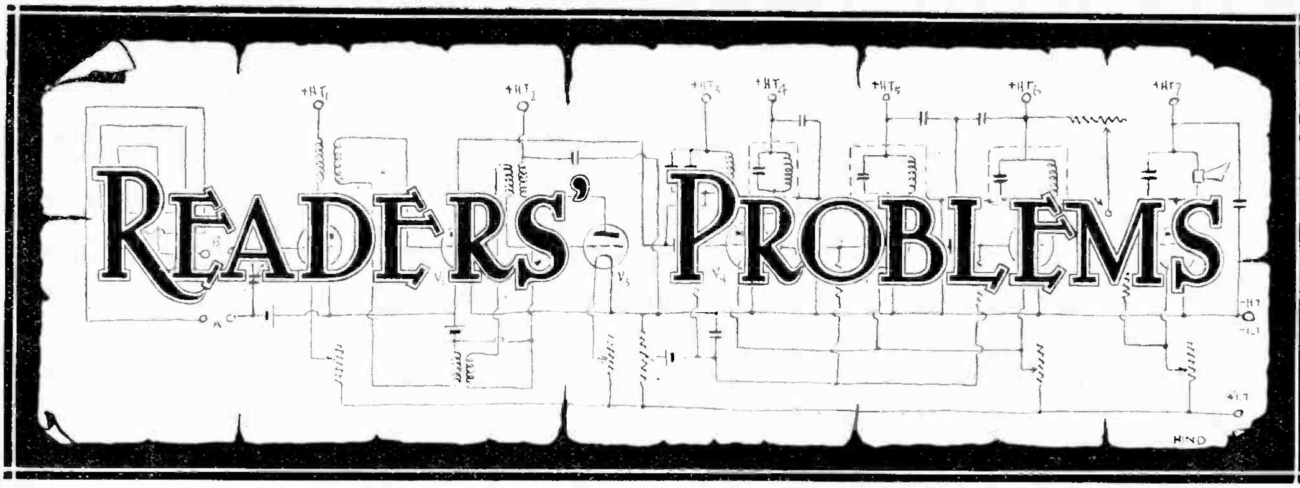
Sir,—I read with interest your article on "Wood Stains and Polish," and also your correspondent's letter in March 30th issue. May I state that the best mahogany stain obtainable—and the cheapest—is made from bichromate of potash dissolved in water to the strength required? I say this is the best simply because I have found it so myself, having made and polished a large number of wireless cabinets and other furniture, that being my trade.

It is easy to use, being just wiped on with a small piece of sponge or rag, and left to dry. Garnet polish is the best all-round polish to use, but if a "red" mahogany is wanted a little red polish can be worked in, but too much red does not look well.

The first and second coat of polish can be applied with the brush, but after that, to get a good finish, use a rubber of cottonwool covered with a piece of rag soaked in the polish, with just a touch of oil on the face to prevent it from sticking. This process is quite easy and gives a good finish, which a good set deserves.

W. R. N. KING.

Eastbourne.
March 31st, 1927.



Readers' Problems

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

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

A Matter of Taste.

I notice that in the diagram of the B.B.C. three-valve set there is a fixed condenser having a value of 0.01 mfd. connected between the bottom end of the tuned grid circuit of the detector valve and L.T.—whereas in the diagram published by you on page 318 of your March 16 issue this is omitted. Can you tell me whether this condenser is not absolutely essential? D. N. C.

The purpose of this condenser is to conduct all H.F. energy direct to the negative side of the filament of the valve *viâ* this condenser, instead of leading it over to the wander plug inserted in the grid bias battery and thus forcing it to get back to filament as it were *viâ* the grid bias battery. In the case of receivers employing an H.F. stage in which the H.F. valve is given a negative bias from a grid bias battery at the opposite end of the receiver, this condenser is very desirable to avoid setting up instability by leading H.F. currents right across the set to the grid battery. When a receiver employs no H.F., however, no such trouble should be caused, and we doubt if any difference would be perceived between a receiver built with this condenser and a similar one built without it.

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An "All-wave" Receiver.

I have decided to construct either the "Everyman Four" receiver or the "Wireless World Five." Would it be possible to use interchangeable transformers for both long and short waves, either home-made or of proprietary manufacture? In this locality I find that there is frequent Morse interference on every wavelength except that of Daventry. D. S. N.

We agree with you that on the South Coast it is almost essential to have a set designed for working on the long wavelengths at maximum efficiency. We consider, however, that it would be unwise to recommend you to attempt to modify either of the receivers mentioned. We think you would be well advised to wait for the published description of a four-valve all-wave set which will appear in this journal at a very early date.

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Tantalum Rectifiers.

Please give me full details of the operation of a tantalum rectifier, and also details for the construction of suitable apparatus for charging a 4-volt accumulator from 240-volt A.C. mains. N. C. E.

We are afraid that it would be quite beyond the scope of a letter to treat this subject adequately. We think you would be well advised to read a very practical article on the subject which appeared in the November, 1925, issue of our companion journal, *Experimental Wireless.*

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Music or Mush.

I have built a five-valve receiver using two H.F. stages which is giving me very good results indeed, and an enormous number of distant stations come in on the loud-speaker. I notice, however, that when receiving my local station at good loud-speaker strength reception is all that could be desired, but I find that although I can easily pick up and tune in distant Continental stations on the loud-speaker at fully the same volume as my local station, there is a continuous background of a kind of hissing and rushing noise. Why is this, and how can I eliminate it? S. D. R.

The noise which you hear is possibly due to a large extent to what is known as mush from high power arc stations, but the broadcasting station to which you are listening also contributes greatly towards it. Now when you are receiving your local station obviously you make drastic use of your volume control, or otherwise desensitise the set, because with the local station going at full blast with your set in its most sensitive state, signals would be far too loud for comfort. Having thus desensitised the set, you pick up only the transmission from the local station without any concomitant hissing. When trying to receive a distant station, however, at full loud-speaker strength, it is obvious that your set must be put into its most sensitive state, and it is unfortunately unavoidable that these noises are picked up. Indeed, if you will listen to your local station with the set in its most sensitive state, we think that you will readily hear this hissing noise, although of course the signals will be much louder. Even on a local station receiver the hissing noise can be heard at those times when speech or music is not being actually transmitted.

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Transmitting Licences.

I have been a keen wireless enthusiast and a reader of your paper since 1919, and should now like to try my hand at transmitting. Unfortunately, however, I have no knowledge as to the procedure to be adopted in obtaining the necessary Post Office licence. I pride myself that I have a fair theoretical knowledge of the subject. K. L. F.

While there seem to be no hard-and-fast rules governing the issue of amateur transmitting licences, the Postmaster-General requires that applicants should have sufficient knowledge to satisfy him that they are capable of doing serious experimental work. Ability to read and transmit Morse signals is essential, and the prospective transmitter must have some definite line of research in view. Should your application (which should be addressed to the Secretary, G.P.O., London, E.C.) not be admitted, you may nevertheless be able to secure an artificial aerial permit, and later to obtain the full transmitting licence.

Crystals that Oscillate.

I wish to build an "oscillating crystal receiver," and shall be glad if you could give me the necessary details for constructing this. T. G. L.

We think that by far the best advice we can give you is to refer you to our issue dated September 2nd, 1925, where you will find full constructional details, together with the usual photographs, wiring diagrams both practical and theoretical, of an instrument such as you desire.

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High or Low?

I am in possession of two loud-speakers, one of a high resistance type, and the other of a low resistance type. I should like if possible to arrange to throw either of these instruments into circuit instantaneously by means of a simple switch. Needless to say, I am using a proper step-down transformer for my low resistance instrument. T. P. U.

It will be quite in order for you to fix up the arrangement you desire by following the arrangement we give in Fig. 1. It will be seen that the primary of the step-down transformer is used as a choke when using the high resistance instrument. You can, as is shown in Fig. 1, make use of the single wire loud-speaker extension system, which was described in full in an article entitled "Music without Muffling" in our issue of February 10th, 1926, or, alternatively, instead of returning the loud-speaker wire to a separate earth, you can return it to the earth terminal or any of the battery terminals of your receiver. Thus, either a high or low resistance loud-speaker may be connected to the output terminals of your set, the two-way switch being thrown over to the relevant position.

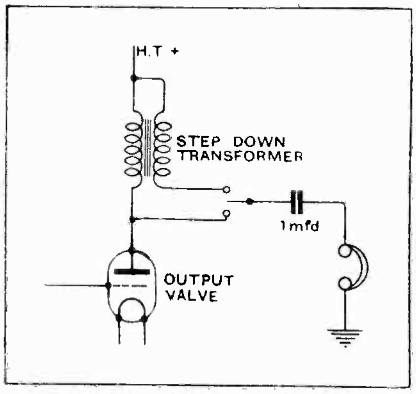

Fig. 1—A high or low resistance output.

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"Everyman Four."

I am constructing the "Everyman Four" receiver, and intend to use 2-volt valves throughout. Will the rheostat as specified by the designer be suitable? P. A. J.

The 2-ohm master rheostat can certainly be used, but 30 ohms is rather a high value for R_2, which controls the H.F. valve and incidentally acts as a form of volume control. The use of this rheostat would be possible, but control would be very critical, due to the considerable variation of filament current resulting from a small movement of the control knob. Indeed, it is possible that a 30-ohm rheostat might have an excessive minimum value, and you would be well advised to use one of, say, 10 ohms.

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An Ambitious Project.

I am considering the construction of a speech amplifier having five or six valves, which is to be used for both gramophone and broadcast reproduction. Please let me have a circuit diagram of a suitable arrangement. F. P. W.

It should be stated emphatically that the construction of an ambitious instrument of this sort is not to be undertaken lightly, and the subject is certainly too large a one to be dealt with in a letter. It would, of course, be an easy matter to give you a circuit diagram, but without a lengthy discussion as to valve impedance, coupling components, and anode voltages, we should probably be doing you a disservice by doing so. If you will give us a few further indications as to your requirements, and the H.T. voltage available, we will endeavour to suggest modifications of one or other of the descriptions published in recent back numbers.

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The "Everyman Three" on Long Waves.

I have just completed the "Everyman Three" receiver, from which results are all that could be desired. There is, however, a good deal of interference and fading on the broadcast waveband in this locality, and I should like to modify it for the reception of Daventry. T. R. L.

This receiver may be modified for long-wave reception in the same way as the "Everyman Four." This subject was discussed in the "Hints and Tips" section of *The Wireless World* for December 8th last; but at your very considerable distance from the transmitting station we are fairly confident that you would not obtain good results.

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Air or Mica?

I have built a modified Reinartz receiver in which I have used a commercial choke of very good make, but I find that even with the reaction condenser at minimum position the set will not stop oscillating. Can you tell me where I have gone wrong? I might mention that the reaction condenser is 0.0005 mfd. mica dielectric condenser. It does not appear that the trouble is due to choke resonance, or due to too many turns on the reaction coil; actually I have only 15 turns on the reaction coil. M. T. N.

It appears to us that your trouble lies in your reaction condenser. Of course, in any case 0.0005 mfd. is rather a large condenser to use as a reaction condenser, 0.0003 mfd. being a better size, although we admit that 0.0005 mfd. has frequently been used successfully. The point is this: a good 0.0005 mfd. variable condenser of modern type has a very low minimum and reaction feed back is practically cut off when the condenser is at its minimum setting, but we think you will find that many mica dielectric condensers have an exceedingly high minimum; in fact, in some we have tested the minimum capacity has been almost 50 per cent. of the maximum. The state of affairs is then similar to that which would exist if you used a good modern 0.0005 mfd. air dielectric condenser, and owing to some mechanical effect were unable to move the dial more than about half-way round towards the minimum position.

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"Free" Grid Bias.

I have decided to make up the "Everyman Four receiver, and intend to use two-volt valves throughout. It seems to me that certain modifications will be necessary, and I should appreciate information on this point. A. L. C.

When using two-volt valves throughout, it will no longer be possible to take "free" grid bias for the detector from the drop in voltage across one of the fixed resistors. These should accordingly be omitted, and, instead of returning the

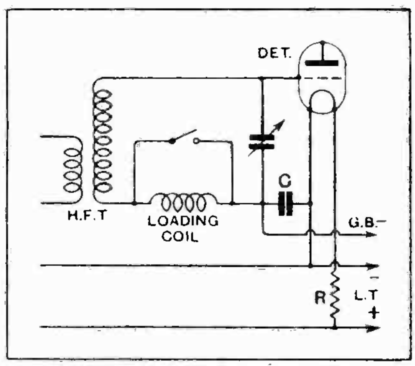

Fig. 2.—Modifying the "Everyman Four."

low-potential end of the tuned circuit to the junction between them, it should be taken to a suitable negative tapping point on the common bias battery. The necessary modifications are shown in Fig. 2. A large condenser, of from 0.01 mfd. upwards, may with advantage be connected as shown at C, in order to restrict the circulation of H.F. currents.

Although we have stated above that the filament resistors may be omitted, it should be remembered that the detector valve has a high resistance in its anode circuit; thus the full emission is not required, and in the interests of economy, a resistor of some five ohms or more may be inserted as shown at R. If your detector valve normally takes only 0.1 amp., a ten-ohm resistor will be suitable. At the same time, it would be desirable to replace the rheostat R_2 by one having a maximum resistance of 10 or 15 ohms.

Beware of Big Aerials.

I have constructed a straightforward detector and 2-L.F. receiver with the ordinary type of reaction, and I am experiencing the following curious phenomena with it, which I should be glad if you could assist me to unravel. At a point which is midway between London and Daventry I find that I can get very powerful signals from both stations, the aerial used being only about 50ft. in total length. In a locality, however, which is considerably nearer to London, but further from Daventry, and where the aerial used is of a generous 100 ft. length, I find that Daventry is excellent, and is practically as loud as before, whilst London only comes in comparatively feebly and I cannot get the set to oscillate on London. One would have expected, of course, that London signals would have been increased and Daventry decreased. Why is this? R. H. T.

The cause of your trouble is not hard to see. On the point midway between the two stations, both of them come in at excellent strength, even though the aerial be a small one, as one would normally expect. The vital clue is given by your statement that in the locality nearer to London the aerial is of a generous 100 ft. This will be all to the good on Daventry's wavelength, but on London's wavelength the aerial damping is probably far too high, which accounts for your failure to make the set oscillate. We are of the opinion that you will not get the set to oscillate no matter how large a reaction coil you use; probably, in fact, if you attempt to use a large coil you will obtain some very curious phenomena. If you had a shorter aerial at your second locality we think things would be normal. We advise, however, that you try the experiment of simply connecting a 0.0002 mfd. fixed condenser in series between the aerial lead-in and the aerial terminal of your set. This will have the effect of greatly reducing aerial damping, and you will find that the set will oscillate readily and receive London at great strength; whilst in spite of the small capacity of the condenser, you will find that Daventry will still come in at great strength as before. It may be possible for you to use the same aerial coil in the case of both London and Daventry, although your tuning condenser setting will be greatly different, but we should advise also that you try the effect of using a size larger coil in each case when using this small condenser. In all cases of reaction troubles caused by high-resistance earth connections, unduly long aerials, multi-wire aerials, or aerials running parallel to or in close proximity to walls, it is advisable that trial be made of this simple cure. In most cases, of course, such causes as we have mentioned will bring about these troubles only on the normal broadcasting wavelengths, while Daventry reception and other long-wave reception will be perfectly normal, which accounts for the puzzlement of many readers on this point.

An Important Precaution.

I am contemplating the substitution of a resistance-coupled stage to my existing two-valve Reinartz receiver in place of the transformer coupling now used. Will you indicate the correct connections?* H. L.

In order to effect this change it is only necessary that the anode resistance be put in the place previously occupied by the transformer primary, the grid leak be put in the place previously occupied by the transformer secondary, with the coupling condenser uniting their respective high potential ends, as is shown in Fig. 3. Be very careful to connect up the coupling condenser in the position shown. Obviously, if the coupling condenser were connected direct to the detector valve plate, that is, on the other side of the H.F. choke, the reaction control would be wiped out, since, of course, a wire runs from this side of the H.F. choke to the reaction coil and condenser, the H.F. energy being forced round this path by the H.F. choke; whereas, if you were to make a wrong connection such as we have mentioned, part of the H.F. energy would be forced along to the grid of the L.F. valve, not only robbing the reaction circuit of H.F. energy, but also causing instability and bad quality by introducing H.F. energy into the L.F. part of the receiver.

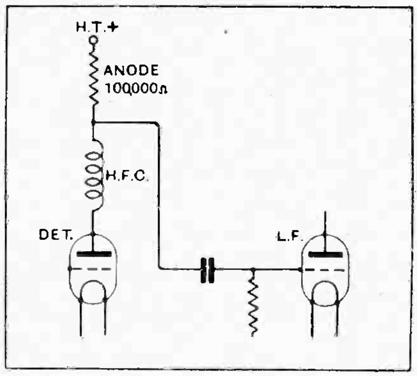

Fig. 3.—Coupling condenser connections.

A Reason for Everything.

I should be glad if you will explain why, in your "Everyman" series of receivers, you have made it a habit of mounting your valve holders on four small ebonite pillars, and whether it is possible to obtain the same results with the set without adopting this procedure. C. H. R.

The principal reason for our mounting the valve holders was in order to raise the valves more clear of the wiring on the level of the baseboard in order to facilitate the insertion and withdrawal of the valves without coming into contact with any of the wiring. Doubtless, of course, by the exercise of a little ingenuity, it would be possible to use ordinary valve holders, and still avoid this trouble.

Reaction Backlash.

The reaction control in my receiver is not nearly as smooth as it might be. The circuit is of the Hartley type, with a centre-tapped frame aerial, and comprises a detector with two stages of transformer-coupled L.F. amplification. I have always understood that this arrangement of capacity reaction should give very smooth regeneration. M. A. E.

Although this method of controlling reaction can be extremely satisfactory, it will only give good results when the values of the various components associated with the detector valve are carefully chosen, and—most important of all—when the working voltage of the grid is suitably chosen with regard to the leak resistance. Instead of returning the lower end of the grid leak to the positive side of the filament or to the positive L.T. battery lead, you are strongly recommended to join it to the slider of a potentiometer, the windings of which will be joined across the low tension battery. By adopting this plan it will be possible to find an adjustment which gives both good detection and smooth control of reaction. At the same time you should experiment with various values of H.T. voltage.

Multi-stranded Cable.

I have some Litz wire with 27 strands of No. 42 gauge wire, each strand being enamelled, with a double silk covering over all. This, except for the fact that individual strands are silk covered, is similar to that specified in several of your recent articles, and I should be glad to know if it is likely to give satisfactory results. S. S. G.

This wire should be fairly satisfactory, although its use is not recommended by several designers, due to the possibilities of short circuits between individual conductors.

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TELEVISION.

IN contemplating the fascinating subject of television one is very soon brought to the point of wondering just how far we have actually succeeded along the path of solution of this problem. If one goes solely by the popular reports which are published at frequent intervals, one is led to suppose that television is already accomplished, and that there only remain matters of minor detail to be attended to before a living cinematograph becomes a reality.

We cannot help feeling regret that in a matter of this kind, which is of such scientific interest, those who are working on the problem do not seem to realise the extent to which confidence in their inventive efforts, however humbly they may regard them themselves, is shaken when the inventor gives us a gilded story through the medium of an over-imaginative and perhaps wholly unscientific journalist who is far more concerned in being able to justify startling headlines than in giving the bare, and perhaps somewhat dry, facts with which he is supplied. We believe that, although a good deal of interesting work is being done in the direction of solving the problem of television, yet up to the present little of real practical value has been achieved. It is true that crude representations of objects have been reproduced over a distance by one or two different systems, but we have no proof as yet that any one of these systems is likely to produce results much beyond their present stage of development. From the point of view of the scientific tackling of the problem, the most interesting of the methods recently discussed is no doubt that of Dr. Alexanderson, of America. Dr. Alexanderson appears to have a very thorough grasp of the problems involved, and he has undertaken a series of experiments to ascertain what are the limitations of the apparatus at our disposal wherewith the problem must be tackled. We fully expect that if Dr. Alexanderson continues his researches with the unrivalled resources which are at his disposal, developments of first-rate importance are likely to result.

CONTENTS.

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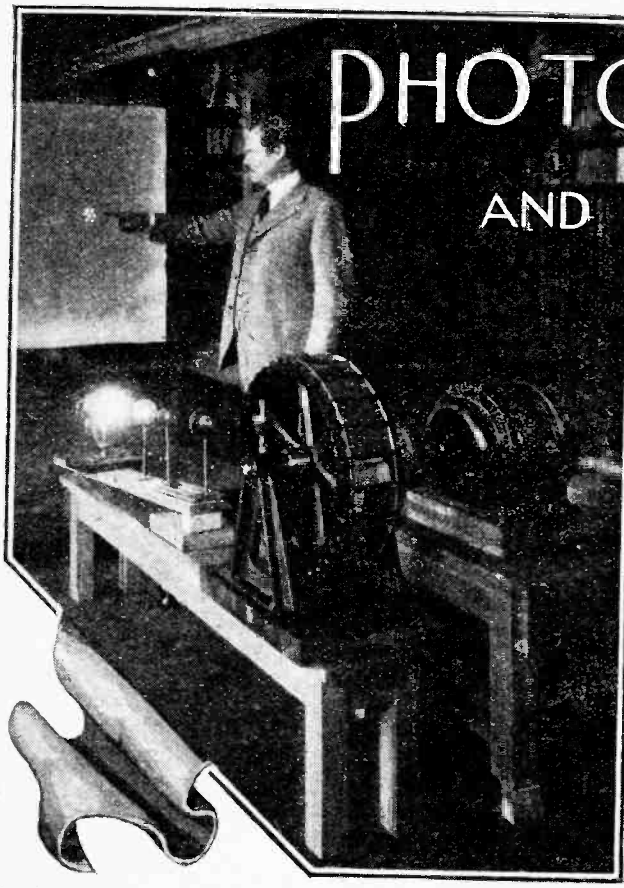
THE B.B.C. RECEIVERS.

SO much interest has been shown in the three wireless receivers demonstrated by the B.B.C. at the Ideal Home Exhibition at Olympia that we decided to give the circuits of these receivers in *The Wireless World*, and they were published in our issue of March 16th. Since those circuits appeared there has been a keen demand for constructional articles on building these sets. It is, of course, understood that the actual B.B.C. sets could not be described in this way, for the reason that the B.B.C. was not prepared to disclose the make of the various components used in building the sets. We have, therefore, taken the B.B.C. circuits with the values indicated and built up receivers using components of our own choice, and these sets are now being described. The two- and three-valve sets are dealt with in this issue, and the four-valve receiver will form the subject of an article in an issue to appear shortly.



PHOTOTELEGRAPHY AND TELEVISION

An Account of Dr. E. F. W. Alexanderson's Experiments.

By A. DINSDALE.

CONTEMPLATION of the works of great imaginative authors inevitably leads one to the conclusion that the really great discoveries and inventions of our modern civilisation are first visualised by them long before they become accomplished facts. Jules Verne's descriptions of submarines and aircraft are cases in point. Under the stimulus of such imaginative writings it would appear that scientists then set about the business of making the author's dreams come true.

In the realm of television many fiction stories have been written in which television, in some form or another, has been brought in as an accomplished fact. An outstanding example of this is to be found in George Bernard Shaw's well-known play, "Back to Methuselah," in which is described a scene taking place in the year 2170, where the head of the British Government holds conferences with his Cabinet ministers several hundred miles away. At his desk is a switchboard, and in the background is a screen upon which, when he selects the right key at the switchboard, a life-size picture appears of the man to whom he is talking, a picture which portrays faithfully all the movements of the distant minister.

Work Based upon Phototelegraphy.

Taking this incident in Shaw's play as his "text," Dr. E. F. W. Alexanderson, of the General Electric Company, Schenectady, N.Y., has embarked upon a line of experimental research to see if he cannot make Shaw's vision an actual demonstrable fact.

There is no reason why such an apparently impossible dream should not come true, and come true within a relatively short space of time. It is not so many years ago since Owen D. Young, of the Radio Corporation of America, expressed, at a banquet, the hope that radio would soon give us visual means of communication. This idea seemed rather far-fetched to several technical men who were present, but work upon these lines was immediately started, and to-day there is a commercial wireless picture service in regular operation between London and New York.

It takes about twenty minutes to transmit one of these pictures across the Atlantic, whereas Bernard Shaw's imaginative scene foretells the direct vision of distant moving objects. Our experience of the cinematograph indicates that in order to portray a scene in such a manner that all movement is faithfully reproduced, sixteen complete pictures per second must be flashed upon the screen.

Retentivity of Vision.

Each succeeding picture is slightly different from its predecessor, and, due to the phenomenon known as "retentivity of vision," the observer sees, not sixteen separate pictures, but one single picture full of smoothly flowing movement.

Thus, in order to achieve television, we must speed up our phototelegraphy system so that a single picture can be transmitted in one-sixteenth of a second instead of twenty minutes. From twenty minutes to one-sixteenth of a second is a tremendous stride, but one which Dr. Alexanderson has set about trying to make, starting with phototelegraphy as the art is already known to-day.

There is nothing particularly novel in Dr. Alexanderson's phototelegraphy apparatus, which is of the well-known revolving cylinder type. His researches in this direction have tended rather to investigate and solve the problems involved in the transmission of the picture impulses over great distances by wireless. The accompanying photographs, which were made at Schenectady at a rate of sixteen square inches per minute, will serve to give some idea of the degree of success which has

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attended his efforts. They were made as a preliminary study of the commercial transmission of photographs by wireless over long distances.

The recording instrument used in making the originals of these pictures is a standard General Electric oscillograph, with some adaptations.

The Radio Link.

Up to the present radio communication has been carried out by means of two distinct methods of signalling: by modulation and by interruption. The older of these two methods, and by far the more sensitive and economical, is that of interruption, and it has been developed to a high degree of efficiency, as is evident from the example shown below.

The modulation method, on the other hand, is comparatively new, and not nearly so sensitive and economical. It is the method employed by our broadcasting stations, and for a given power the effective range of the modulated signal is only about one-third or one-quarter that of the interrupted signal.

Picture transmission by wireless has been tried by both these methods of modulation. The transatlantic picture service is operated by the interrupted method of signalling.

Dr. Alexanderson has experimented with both methods, and on this page is shown a comparison of the results obtainable. On the left is a picture clipped from a newspaper and transmitted by means of a modulated signal. On the right is the same picture transmitted by interrupted, or telegraph, signal. The other pictures reproduced here were transmitted by the modulated method, a modulation frequency of 3,000 being employed. This frequency was superimposed upon a carrier wave, just as is done in broadcasting.

Although better results appear to have been obtained by the modulation method, Dr. Alexanderson states that his researches have tended to make him consider the adaptation of the telegraphic method of communication to picture transmission as one of the essential problems. Only in this way, he thinks, can the deleterious effects of fading and static be eliminated, and he has devised a method of sending half-tones which takes advantage of the more efficient methods used in radiotelegraphy. It is obvious that fading and static would seriously distort or mutilate a picture being sent by wireless over a great distance. Dr. Alexanderson's method makes use of the latest devices of long-distance, high-speed radiotelegraphic practice, wherein it is equally important to prevent mutilation of signals in order that the automatic signal recording apparatus shall be able to produce unblemished records of the transmitted telegraphic signals.

[*Courtesy G.E.C. of America.*

Comparison between pictures transmitted (left) by the modulation method and (right) by the interruption method.

Briefly put, radiotelegraph engineers overcome fading by using at all times sufficient amplification to produce a readable signal during the worst intervals of fading. The output signal is prevented from rising above a predetermined value, sufficient for recording, during periods of strong incoming signals, by throttling it down by means of a circuit arrangement employing a limiting valve. The output signal of the receiver thus remains constant at all times. Static is taken care of by introducing a threshold value of signal into the receiver, so that nothing is received unless the signal exceeds this value. In this way, so long as the signal strength exceeds that of the prevailing static, the effects of static are eliminated from the signal record.

Thus far it has not been possible to adapt these devices to modulation methods of communication, so that for picture transmission by wireless over long distances the interruption, or telegraphic, method is obviously better fitted to give unblemished results.

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Producing Half-tone Effects.

Dr. Alexanderson obtains half-tone effects by causing his transmitting mechanism to analyse the picture into five or more separate shades, such as white, light grey, medium grey, dark grey, and black. This is done automatically, and the receiving mechanism also reassembles the shades automatically.

Various methods can be designed for translating these different light values into radio signals. One method is to use a separate wavelength for each shade, requiring, in this case, five wavelengths. The pictures shown here, however, were made by a process which employs only one wavelength.

This is accomplished by causing the transmitting mechanism, at every moment, to select automatically the shade that comes nearest to one of the five shades. A telegraphic signal is then sent out which selects the corresponding shade in the receiving machine. This process is not so complicated as it sounds, for the telegraphic code by which the various shades are selected depends upon the synchronism of the two machines, which synchronism is necessary under all circumstances.

Thus black areas in the picture at the transmitting end are reproduced at the receiver by exposure of the sensitive paper to the recording light spot during four successive revolutions of the paper-carrying cylinder. Light grey is produced by a single exposure during one revolution only, and no exposure during the three succeeding revolutions. It will be seen, therefore, that the receiving cylinder must be run at four times the speed of the transmitting cylinder, but with the same speed of axial movement.

The overlapping exposure is progressive and the whole thing is a continuous process, tending to graduate evenly the various degrees of light and shade in the picture.

Speed Limitations in Television.

Turning now to the question of television, Dr. Alexanderson queries whether the medium with which we are dealing is capable of functioning at the enormous speeds of signalling required in television work. Necessary units in the system are the photoelectric cell, the amplifier, the aerial and the wireless wave. Of these, the first two employ the medium of the electron, which is extremely fast; but the use of wireless waves imposes certain speed limitations on account of the limited number of wavelengths available.

The lines upon which Dr. Alexanderson is working appear to indicate that, in order to obtain high quality reproduction of a television image, it will be necessary to make use of several wavelengths, each carrying an imperfect image. At the receiving end all these imperfect or crude images will be combined to produce a single image of high quality definition.

This conclusion has been reached as a result of some experiments made in the transmission of single pictures at different speeds on a single wavelength of 12,000 metres, or 25 kilocycles. Pictures sent in two minutes were reproduced somewhat crudely; those sent in four minutes very much better, and when the time of transmission was extended to eight minutes for the same picture the reproduction was well-nigh perfect.

[*Courtesy G.E.C. of America.*]

Picture transmitted by wireless with the modulated system. The modulation frequency was 3,000 and the time taken for transmission four minutes

The relative difference in definition between these pictures is due, according to Dr. Alexanderson, to the effect of the sluggishness of the tuned transmitting aerial. The two-minute picture was not nearly so sharp as the eight-minute picture, but was, nevertheless, sufficiently so to be acceptable for ordinary television purposes, supposing such a degree of definition could be obtained at television speeds of transmission.

Since there is so much sluggishness on a wavelength of 12,000 metres, let us examine the effect of reducing the wavelength to 12 metres, equivalent to a frequency of 25,000 k.c. If the photoelectric cell, amplifier and the light control can keep up with this enormous frequency, the wireless wave will perform its task and transmit a single picture, the definition of which will be equal to the two-minute picture as transmitted on the longer wave, in one-thousandth part of two minutes, *i.e.*, in approximately one-eighth of a second. This is not equivalent to cinematograph speed, but it is sufficiently close to give us a fairly good picture.

Another difficulty, where a life-size television image is required, as suggested by Bernard Shaw, is in sufficiently illuminating the screen at the receiving end in the extremely limited amount of time available.

In any television receiver so far developed or suggested, the incoming picture impulses control the degree of brilliancy of a source of light which is focussed upon the screen and caused, by optical means, to sweep rapidly up

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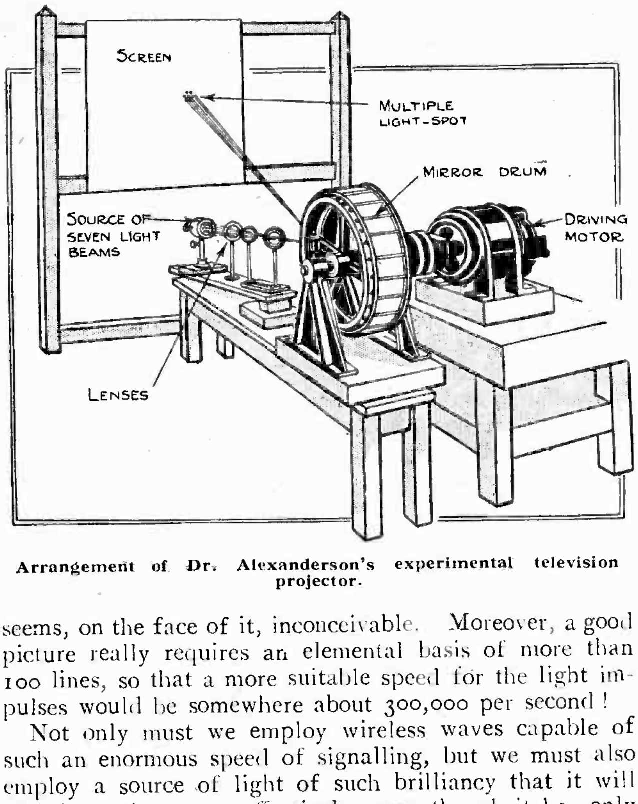
and down and across the screen, gradually covering it all with varying intensities of light. In order to give the observer the impression of a complete picture this traversal of the screen must be arranged to take place practically instantaneously; otherwise the observer would see what actually occurs—a spot of light gradually crossing the screen as it swings rapidly up and down.

In order to get an image of fair quality the least we can be satisfied with is ten thousand different values of light intensity. This may mean that the spot of light will pass across the screen in 100 parallel paths, each path being sub-divided into 100 different light values.

If this process is repeated over and over again at the moving picture speed of sixteen separate pictures per second it means that 160,000 changes of light value, or picture impulses, are required per second. Such a speed



Arrangement of Dr. Alexanderson's experimental television projector.

seems, on the face of it, inconceivable. Moreover, a good picture really requires an elemental basis of more than 100 lines, so that a more suitable speed for the light impulses would be somewhere about 300,000 per second!

Not only must we employ wireless waves capable of such an enormous speed of signalling, but we must also employ a source of light of such brilliancy that it will illuminate the screen effectively, even though it has only 1-300,000th of a second in which to illuminate any one given spot.

Dr. Alexanderson admits that, given the most brilliant arc lamp we know of, no matter how we design the optical system for sweeping this light across the screen, we cannot obtain sufficient brilliancy to illuminate a large screen with a single spot of light.

Dr. Alexanderson's Experimental Television Projector.

For the purpose of examining this particular problem and attempting to solve it, Dr. Alexanderson has built an experimental television projector consisting of a source of light, a lens and a revolving drum carrying a number of mirrors. The drum is built after the style of a flywheel, about 2½ft. in diameter, with a flange about ten inches wide, around which are mounted twenty-four mirrors each measuring about eight inches by four. This drum is direct-coupled to a high-speed electric motor.

When the drum is stationary a spot of light is reflected on to the screen, which is about four feet square, and this spot of light is the brush that paints the picture. As the drum revolves the light spot passes vertically across the screen, and then, as a new mirror, set at a slightly different angle, comes into line, the light spot passes across the screen again, but on a track closely adjacent to that of its first traversal. This action goes on until the entire screen has been covered. Such mirror mechanisms have been used by several television workers, and there is nothing about this one which is of particularly novel interest.

The novelty of Dr. Alexanderson's experiments lies in the method being tried by him to overcome the difficulty of sufficiently illuminating a large screen in the extremely short period of time available.

As explained above, it is impossible to do this by means of a single spot of light, using any known methods of illumination and optical distribution of the light beam, so Dr. Alexanderson has been experimenting with seven light spots instead of one, for by so doing 49 times as much useful illumination can be obtained.

At first glance it is not easy to see why the gain in light should be as the square of the number of light spots used, but on consideration it will be seen that, with one light spot in use, and a drum carrying 24 mirrors, the spot of light will pass over the screen 24 times. If seven light sources and seven spots of light are used, however, there will be a total of 168 light-spot passages over the screen for every revolution of the drum.

Multiple Light-spots.

The advantage of using seven beams of light in this fashion is two-fold. First of all there is a direct gain of illumination of 7 to 1. Secondly, there is the further advantage that the speed at which the light beam must travel over the screen can be reduced approximately one-seventh, for each individual light spot now has only 24 tracks to cover instead of 168.

Although the light itself may travel at any conceivable speed, there are limitations to the speed at which the mirror drum can be driven. This also holds good for any other mechanical method of causing a light beam to traverse a screen. The mirror drum used by Dr. Alexanderson has already been designed to run at the highest possible speed.

The only way to speed up the movement of the light beam, therefore, would be to reduce the diameter of the drum and also the size of the mirrors, but mirrors one-seventh as large as those at present in use would only reflect one-seventh as much light and thus neutralise the advantage gained by using seven light spots instead of one.

There is another advantage arising out of the use of the multiple light beam. Since each individual light-spot need only move at one-seventh of the speed necessary when a single spot only has to cover the entire screen, the total number of light impressions to be made on the screen can also be divided up amongst the seven beams.

As described above, it is necessary, for a well-defined

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picture, to make at least 300,000 light impressions on the screen per second. If only one light-spot is employed it must be capable of handling this enormous number of light changes. By using seven light-spots, however, each individual beam need handle only 43,000 impressions per second.

A modulation speed of 43,000 per second is high, according to our present radio practice, but it is more within reason than 300,000, being only about ten times as high as the speed we use in broadcasting.

There is yet another point in favour of the multiple beam system.

It is easy to design a television system that will give something like 40,000 picture units per second, but the results would be so crude as to have no practical value, for work already done on phototelegraphy has shown that at least 300,000 units per second will be necessary to give satisfactory results for television purposes.

This speeding-up process, unfortunately, is one of those cases where the difficulties increase as the square of the speed, and the main cause of the trouble is the fact that we have to depend upon moving mechanical apparatus. If some means were available for sweeping a beam of light across a screen at ultra-high speed without the use of mechanical apparatus, the problem would be easier of solution. But such means are not available at present, so the ideal picture on a large screen, containing at least 300,000 picture units, cannot be obtained by means of mechanical apparatus and a single light-beam.

Dr. Alexanderson's way out of the difficulty, then, consists of reproducing on the screen seven crude pictures, containing only 40,000 picture units each, and so interlacing them optically that the combination effect is that of a single good picture containing 300,000 units.

In his experimental projector Dr. Alexanderson has arranged his seven light sources close together in star formation, so that the multiple beam, when seen stationary upon the screen, shows seven points of light arranged like the end section of a piece of seven-stranded wire.

Tests have been made with this model television projector to demonstrate the method of covering the screen with seven beams working simultaneously in parallel. As the mirror drum revolves, these seven beams trace seven lines at once on the screen, and then pass over another adjacent track of seven lines until the entire screen has been covered.

In a complete television apparatus, of course, each of the seven light-spots would have to be independently controlled by the distant transmitter, so that each traced its own individual crude picture. For this purpose seven photoelectric cells would have to be arranged in a cluster at the transmitter, each cell controlling one channel of a multiplex radio system.

Seven Channels Required.

For this purpose Dr. Alexanderson suggests that a Hammond multiplex system could be used with seven intermediate carrier waves, which, as he puts it, are "scrambled" and sent out by a single transmitter, and unscrambled at the receiving station so that each controls one of the seven light beams.

He further suggests that seven television carrier waves may be spaced 100 kilocycles apart, so that a complete television wave-band should be 700 k.c. wide. Such a radio channel might be placed between 20 and 21 metres, and he is of the opinion that if the use of such a waveband will enable us to see across the ocean it will be assigned to a worthy purpose.

No details of Dr. Alexanderson's transmitting mechanism are available, and he lays no claim to having completely solved the problem of television. He merely states that "Our work has, however, already proved that the expectation of television is not unreasonable, and that it may be accomplished with means that are in our possession at the present day."

TRADE NOTES.

Electric Furnaces.

The subject of electric furnaces may seem only indirectly connected with wireless, but, as they are used to a considerable extent in the manufacture of valves and in research work generally, the description of the Wild-Barfield small electric furnaces for laboratories and works, lately issued by Messrs. Automatic and Electric Furnaces, Ltd., 173-175, Farringdon Road, E.C.1, will probably interest many of our readers. This well-illustrated pamphlet describes the various furnaces and temperature-controlling apparatus supplied by the firm and covers a wide range.

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Coils for Constructors.

From Messrs. Collinson's Precision Screw Co., Ltd., Macdonald Rd., London, E.17, we have received a descriptive price list of their "Colvern Coils for Every Modern Radio Circuit," the sixteen pages of which are devoted to useful data covering their various coils, formers and condensers, with practical notes on suitable circuits.

A Portable Frame Aerial.

Now that "summer is y-comen in" the thoughts of wireless enthusiasts naturally turn to portable receivers. A useful adjunct to these is the "Climax Folding Frame Aerial" manufactured by Messrs. Climax Radio Electric, Ltd., Quill Works, Putney, S.W.15. Two models are made—the standard type suitable for wavelengths of 250 to 750 metres, and the series-parallel model for 300 to 750 and 750 to 1,650 metres.

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The Helping Hand.

Messrs. Leslie McMichael, Ltd., have issued a convenient little booklet describing their well-known wireless components and giving useful information concerning their use to the best advantage. The contents include their latest H.F. chokes and multiple switches.

A New Battery Eliminator.

The use of battery eliminators is daily becoming more and more popular, the ordinary dry H.T. battery having the obvious defect of gradual deterioration and sometimes letting one down at an awkward and unprepared moment. Messrs. Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, London, W.C.1, have sent us a descriptive leaflet of their new H.T. battery eliminators for either A.C. or D.C. supply, giving alternatively the price for the complete apparatus and of the components necessary for those preferring to build up their own H.T. eliminators. The leaflet is entitled "The RIght Mains Supply Unit," and will be supplied in quantities to interested dealers.

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Change of Address.

The Automatic Coil Winder and Electrical Equipment Co., Ltd., to "Winder House," Rochester Row, S.W.1. They ask us to state that they still retain their old telephone number—Victoria 4350.

COUPLING CONDENSERS AND LEAKS.

How to Calculate the Correct Values for Any Frequency.

By A. L. M. SOWERBY, M.Sc.

IN the matter of the coupling condensers and grid leaks to be used in choke and resistance coupled low-frequency amplifiers, there are at present two distinct schools of thought, resulting in the recommendation of utterly different values from these small but important components. It is the purpose of the present article to trace the reasons for the older views, and to define clearly the values actually desirable.

The old values that have been accepted unquestioningly until recently are, roughly speaking, 0.05 to 0.25 mfd. for the coupling condenser, and 0.25 to 0.5 megohm for the leak. Two reasons are usually given for these values. First, that if a grid leak of higher resistance is used any charge that may appear on the grid will leak away only slowly, and that until this charge has leaked away the amplifier will be "choked," or at least will deliver signals of poor quality. Further, it is commonly believed that a low-resistance leak is necessary to "allow the grid bias to get to the grid." Secondly, the high value of a coupling condenser is explained by stating that since it is necessary to pass, more or less equally, signals of all frequencies down to, say, 50 cycles per second, a large condenser is required, for a small one would have too high an impedance, and so would prevent the lower musical notes from reaching the grid of the valve, resulting in partial suppression of the lower notes.

Two Common Fallacies.

Let us analyse these statements a little more closely and try to see exactly how far they are justified.

Evidently, if a charge collects on the grid of the valve during reception, and then leaks away again through the grid leak, grid current is flowing. In the early days of broadcasting, when power-valves were ruinously expensive, and very little used by the ordinary amateur, valves were habitually overloaded, so that grid current was almost inevitable. Moreover, it was then of no great consequence, because the early loud-speakers gave such poor quality that a little grid-current distortion more or less made no audible difference. Nowadays, however, conditions have changed; we use power valves in place of R-valves to operate our excellent modern loud-speakers, and no avoidable distortion, no matter how small, can be tolerated.

Since in any modern amplifier grid current is eliminated by proper adjustment of grid bias, in conjunction with high H.T. voltage, and an avoidance of overloading, the coupling condenser will never acquire a charge. The grid leak, then, need not on this account be made of low resistance. And further, if no grid current flows, the value of the grid leak need *not* be low "to allow the grid bias to get to the grid," for in a circuit where no current flows there is no voltage drop across even the highest resistance, as a moment's consideration of Ohm's Law will show. The grid bias actually applied to the grid of the valve in such a circuit is exactly that of the grid bias battery, even if a 10-megohm resistance intervenes between the battery and the grid.

So far as the D.C. aspect of the circuit is concerned, then, the resistance of the grid leak is of no significance whatever; it remains to consider it from the standpoint of the signals themselves.

Fixing the Grid Leak Resistance.

Reference to the skeleton diagram of Fig. 1 will show that the leak is connected between a point of high A.C. (signal) potential (namely, the grid of the valve) and earth, so that a certain small alternating current will flow through it. This alternating current in no way assists in the operation of the amplifier; on the contrary, by tending to lower the potential of the grid it is a source of loss, and must therefore be kept sufficiently small to be negligible. This implies, of course, a high-resistance leak, which, as we have already seen, is perfectly suited to the D.C. conditions of the circuit.

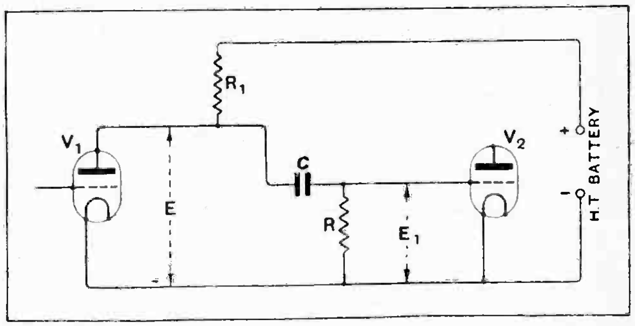


Fig. 1.—Schematic diagram of resistance-capacity coupling between two valves.

To fix on a suitable value for this leak we must take into consideration the fact that it is more or less in parallel with the anode resistance or choke, which is also connected between a point of high signal potential and earth. (Note that "H.T. +" is, if we neglect the resistance of the H.T. battery, at the same signal potential as the filament, despite the difference in D.C. potential.) It will suffice, then, to make the resistance of the grid leak high compared with that of the anode circuit; if the grid leak has not less than ten times the resistance of the anode resistance we can regard any losses produced by it as negligible. A higher resistance than this, though it may not appreciably increase the overall amplification, will not be in any way detrimental.

To take a concrete case, if the anode resistance has a value of 150,000 ohms, as recommended by the makers for use with D.E.5B type valves, the grid leak should have a resistance of not less than 1½-megohm, and any value above this may be used.

Coupling Condensers and Leaks.—

If a choke is used in place of an anode resistance, the calculation of a minimum value for the grid leak is not easy, even in the rare case when the inductance of the choke is known. However, this is of no importance whatever, since a 5-megohm resistance is not likely to be too small for even the most massive choke, and may be used in all cases.

Having dealt with the question of the grid leak, consideration of suitable values for the coupling condensers is our next concern.

It has been stated, by those who advocate the use of coupling condensers of the order of 0.0005 mfd., that it is only necessary to use a condenser of capacity large compared with the grid-filament capacity of the succeeding valve. Actually, it will be seen that the capacity required is chiefly determined by the resistance of the grid leak, and that when the grid-filament capacity of the succeeding valve is large, the capacity of the coupling condenser must be *reduced* to keep the general tone of the music at normal level.

Calculating Capacity of Coupling Condenser for a Given Grid Leak.

In effect, as can be seen from Fig. 2, which is a simplified version of the relevant part of Fig. 1, the coupling condenser and grid leak are connected in series between a point of high A.C. potential (the plate of V_1), and earth. An alternating current then flows through the circuit, and we have to choose such a value for C that the voltage-drop E_1 across R shall be nearly equal to E, the output voltage, *for all frequencies*.

A simple calculation, given in the appendix, shows that the ratio n between E_1 and E for various frequencies is given by the formula :

$$\frac{E_1}{E} = n = \frac{R}{\sqrt{R^2 + \frac{1}{\omega^2 C^2}}} \quad . \quad . \quad . \quad (1)$$

in which $\omega = 2\pi \times$ frequency, and the remainder of the symbols have the meanings implied by Fig. 2.

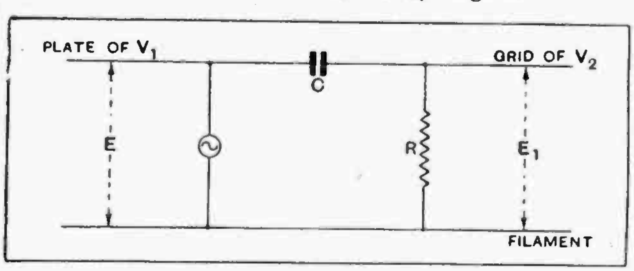


Fig. 2.—Equivalent current to Fig. 1.

Clearly, the higher the resistance of R, and the greater the capacity of C, the greater will be the voltage drop across R, and the smaller the drop across C, as can be seen from Fig. 2. without any calculation. Equation (1) shows the same thing; high values either of C or of R tend to make n equal to unity, when E_1 equals E. Since, however, both R and C must be very large indeed to make n actually equal to unity (the ideal case) we must set some arbitrary lower limit to n at some arbitrarily chosen frequency.

The writer has taken, as a basis for calculation, the condition that the voltage E_1 shall be not less than 90 per cent. of E at a frequency of 50 cycles per second. On this basis we shall lose in our amplifier not more than

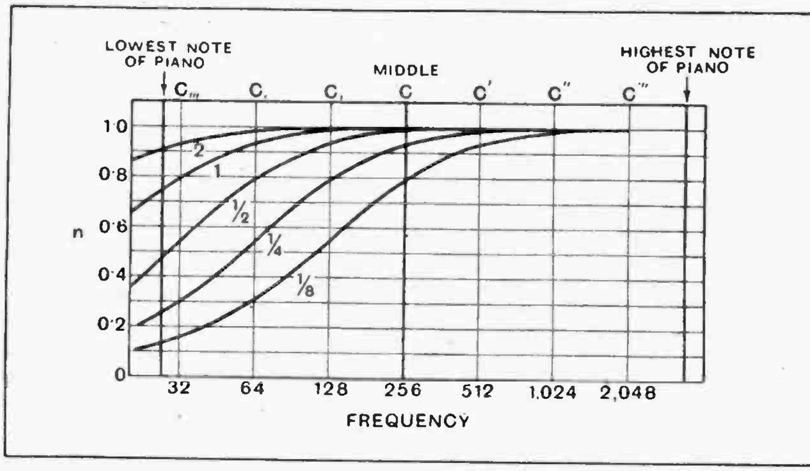


Fig. 3.—Curves showing effect on frequency characteristic of a single stage due to variations in the coupling capacity. Curve (1) is for any of the combinations in the table, the other fractions showing the ratio of the other condenser values to the capacity chosen, the grid leak remaining constant.

10 per cent. per stage of notes of this frequency, which is just less than an octave above the lowest note of the piano.

The value of capacity necessary to give any predetermined value of n at any desired frequency is given by the formula :

$$C = \frac{n}{\omega R \sqrt{1 - n^2}} \quad . \quad . \quad . \quad (2)$$

which is simply formula (1) rearranged.

Some Representative Values.

If we now put $n = 0.9$ in formula (2) we find that if R = 5 megohms (which is the most generally useful value, since 10-megohm leaks are not easy to obtain), C must have a value of *not less than* 0.0013 mfd. to satisfy this condition. Corresponding capacities are given in the Table for all usual values of grid leaks.

Grid leak. (Megohms)	Coupling condenser. (Microfarads)
0.25	0.026
0.5	0.013
1.0	0.0065
2.0	0.0033
3.0	0.0022
5.0	0.0013
10.0	0.00065

Those who read the appendix will observe that in this treatment of the subject the effect of valve and other stray capacities has been neglected. The plate-filament capacity of V_1, and the grid-filament capacity of V_2, together with stray capacities due to the resistances and

Coupling Condensers and Leaks.—their holders, the wiring, and any switches that may be used, are all shunted across the grid leak, so that the voltage developed across it will be less for high frequencies than for low. Since this results in a *lowering* of the tone of the music, while we are at the moment concerned with finding the capacity large enough to avoid undue *raising* of the tone by cutting off the low notes, our momentary neglect of this effect of stray capacities is justified.

The use of capacities *above* those given in the table will not noticeably alter the tone of the music; capacities *below* those given will *raise* the tone by cutting out the lower notes. In view of the fact that stray capacities lessen the amplification of the higher frequencies, the writer has found it advisable, in a resistance amplifier, to use condensers of little more than half the capacity given, in order to keep the general tone of the music at about the right level. In the final output, of course, both high and low tones are missing to quite a considerable extent, but the quality nevertheless appeals to the ear as being excellent.

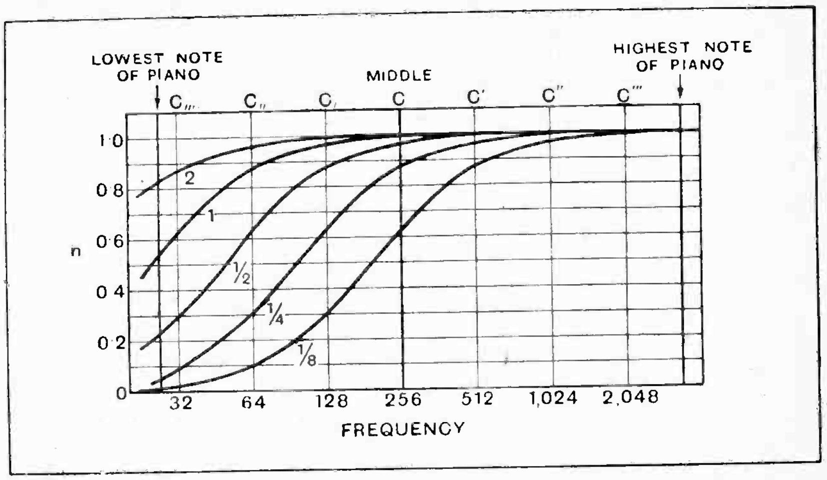


Fig. 4.—Frequency characteristics for various coupling capacities—two stages.

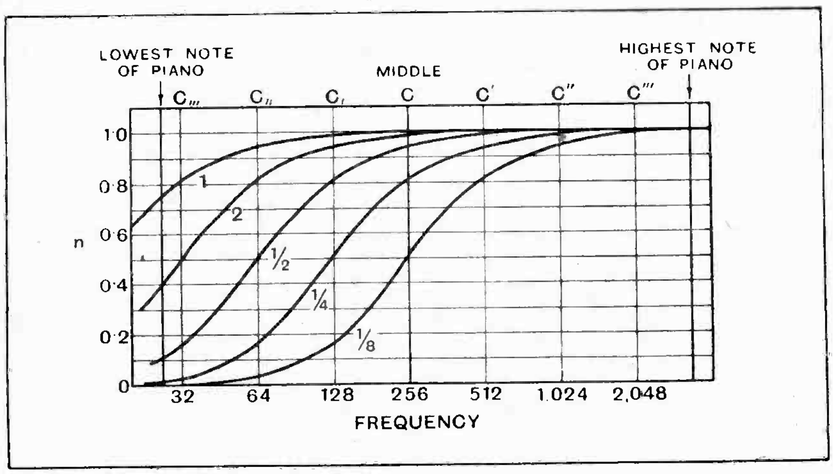


Fig. 5.—Curves equivalent to Figs. 3 and 4 for three stages.

In passing, it is amusing to recall the oft-repeated statement that "all notes are equally amplified in a resistance amplifier," and to compare this glib nonsense with the real facts.

Some idea of the effect on the tone of changing the coupling condenser is given by the curves of Fig. 3, which have been calculated from formula (1). The vertical scale represents n, or signal strength, while the horizontal scale represents frequency, plotted on the logarithmic or "musical" scale. Each "C" of the piano is marked.

The curve 1 represents the capacity prescribed in the table for any given grid-leak value; 2, ½, etc., represent capacities of double, half, etc., this value. It will be seen that the lower frequencies fall off rapidly as the capacity is reduced.

More interesting, perhaps, are Figs. 4 and 5, which represent in a similar manner the tone of music after 2 and 3 such stages. The ordinates in these figures are the square and the cube respectively of the corresponding ordinates of Fig. 3.

In conclusion, the writer would like to point out that there is only one difficulty likely to be met with in using condensers and leaks of the values herein suggested. That is, that perfect insulation in the coupling condenser is even more essential than in amplifiers of standard pattern, owing to the high resistance of the leak.

APPENDIX.

In the circuit of Fig. 2, if

I = current flowing

then, taking the circuit as a whole,

$$I = \frac{E}{\sqrt{R^2 + \frac{1}{\omega^2 C^2}}}.$$

Also, for the resistance only,

$$I = \frac{E_1}{R}.$$

Equating these two values for I, we get

$$\frac{E_1}{R} = \frac{E}{\sqrt{R^2 + \frac{1}{\omega^2 C^2}}}.$$

Now putting $\frac{E_1}{E} = n$, the equation becomes

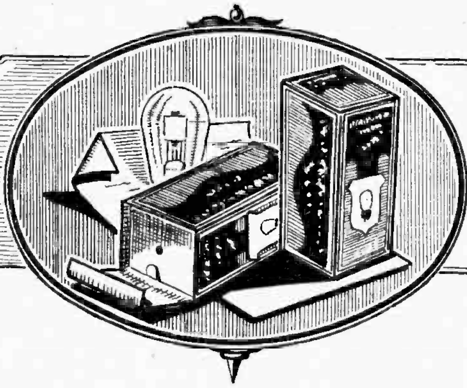
$$\frac{n}{R} = \frac{1}{\sqrt{R^2 + \frac{1}{\omega^2 C^2}}}$$

or

$$n = \frac{R}{\sqrt{R^2 + \frac{1}{\omega^2 C^2}}} \quad \ldots\ldots \quad (1)$$

From this, by a little rearrangement, we can get

$$C = \frac{n}{\omega R \sqrt{1 - n^2}} \quad \ldots\ldots \quad (2)$$



NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

VALVE CONTACT.

Faulty contacts between valve legs and sockets is a frequent cause of failure in receiving sets, and can be a source of great annoyance when trying out a new set for the first time.

To make quite certain that all valve contacts are perfect, a small piece of coil spring may be inserted in each socket. Three or four turns cut from a spring taken from a petrol lighter will be found quite satisfactory.—T. H. W.

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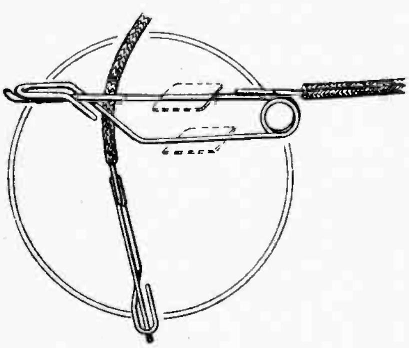
CLI ' CONNECTIONS.

The spring clips illustrated in the sketch are constructed from safety pins by removing the metal cap and bending to the shape shown. The point should also be cut off and the end of the wire bent upwards to prevent the connector from being accidentally pulled off.

If difficulty is experienced in opening the connector with the fingers, *i.e.*, if the connector twists sideways when pressure is applied, thin metal plates may be soldered to each wire, as indicated by dotted lines, to afford a better grip.—A. B.

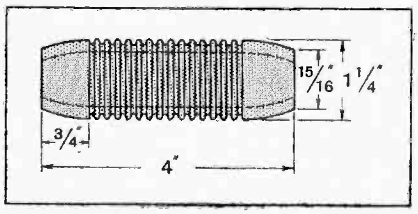


Spring connectors constructed from safety pins.

H.F. CHOKE.

A rubber grip such as is used for cycle handle-bars, and procurable for a few pence, makes an excellent former for an air-cored choke. The best type has a length of about 4in. with a maximum diameter of $1\frac{1}{4}$in. There are about 20 grooves in the centre, $\frac{1}{16}$in. wide, and if the grooves are fitted with fine wire such as No. 47 D.S.C. an efficient choke will result.

It takes up but little room, and, the wire being well spaced, has a low self-capacity. J. F. F.



Rubber handle-bar grip used as H.F. choke former.

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REPAIRING MOULDINGS.

It sometimes happens that bakelite or ebonite mouldings, such as knobs or dials, get chipped and are thereby spoilt for use on a panel. Such clips may easily be filled in with black sealing-wax. Plenty of wax should be used, the excess being removed with a fine-cut file. The repair may be finished by polishing with some fine abrasive, such as french chalk, on a wash-leather pad.—F. P.

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A SCREW-DRIVER HINT.

Screws in awkward and obscure corners of receiving sets require long screw-drivers for tightening up. Often there is difficulty in engaging the end of the screw-driver in the screw slot, particularly when the screw-driver is inclined to the axis of the screw. The direction of the screw slot can be seen, but it is difficult to tell which way the grinding on the screw-driver is pointing if the lighting in the interior of the set is poor.

To overcome this difficulty, a slot should be cut in the head of the handle coinciding with the direction of grinding, as shown in the sketch.—A. G. E.

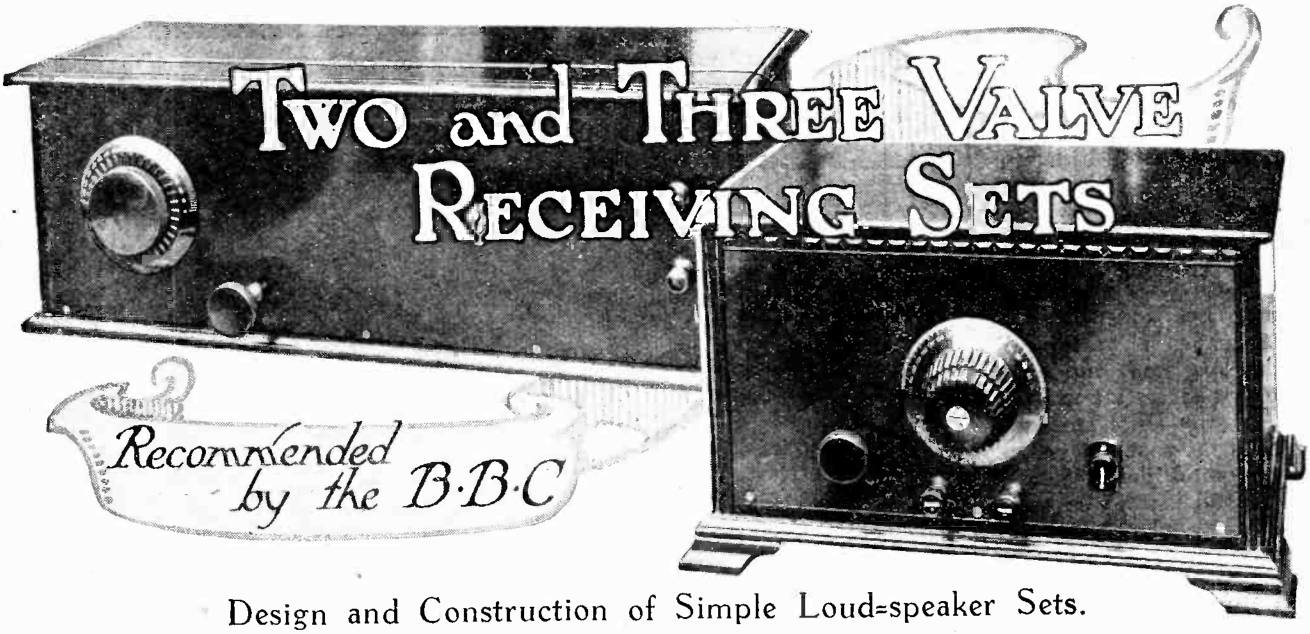
Indicating mark to show direction of grinding on the end of a screw-driver.

VALVES FOR IDEAS.

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

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

Two and Three Valve Receiving Sets



Design and Construction of Simple Loud-speaker Sets.

CONSIDERABLE interest has been created by B.B.C. demonstrations at the recent "Ideal Homes" Exhibition, which showed types of sets recommended for home reception. As a result of the B.B.C. having entered into the field of set designing, it is not surprising that many listeners are diligently conforming to the designs put forward. The circuit systems of the three sets which were exhibited are entirely orthodox, and rather take one back to the type of receiver used in the early days of broadcasting. Novel features have been avoided, but the principal merit of the sets is the interpretation of the circuit arrangement by the use of modern components and new types of valves correctly operated. Certain considerations lie behind the designs, for although each of the three sets shown were intended to be used as local station receivers, one of the aims has been to provide a high degree of selectivity without complicating tuning. An aim at selectivity is evidenced by the introduction of the small fixed condensers in the lead between aerial and aerial inductance, the use of a parallel tuning condenser of large maximum capacity, as well as by the provision of reaction.

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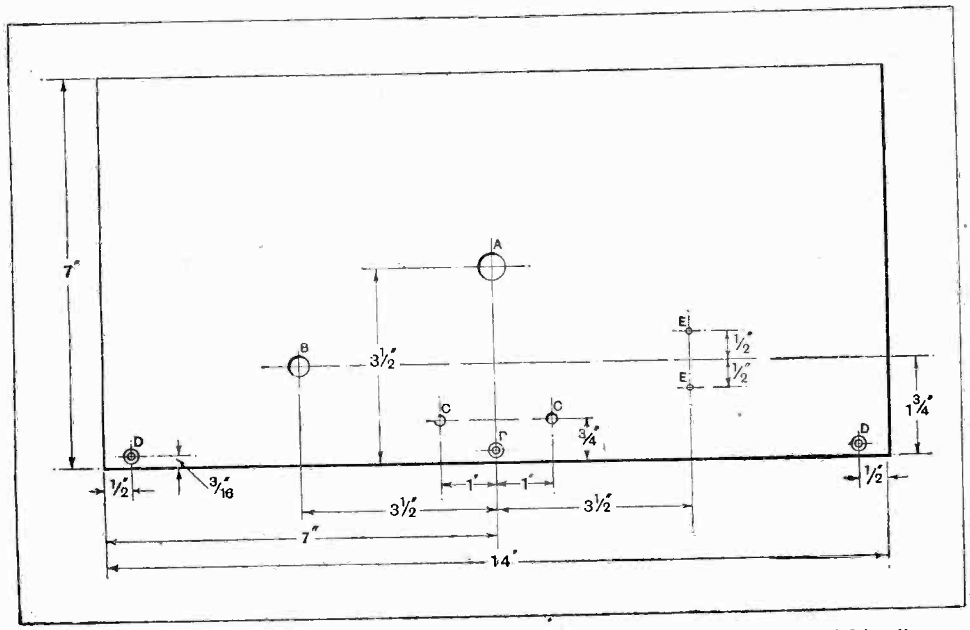
TWO-VALVE B.B.C. RECEIVER.

For loud-speaker reception up to, perhaps, ten miles from a main broadcasting station and assuming the use of reaction, this receiver can scarcely be improved upon. As it is usually a question of cost that limits one to the use of two valves, extravagance has been carefully avoided in making up this set, though where the merit of a particular component has a bearing on the results which will be obtained the quality of that component has been the first consideration.

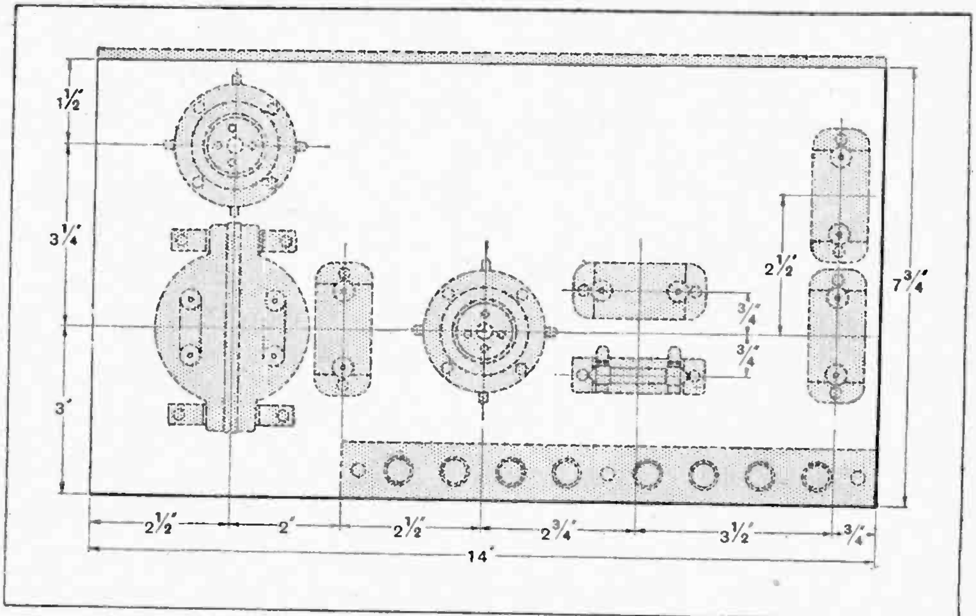
Material Required.

The fixed aerial condensers are of the small mica dielectric type. For aerial tuning it is immaterial whether the variable condenser follows the S.L.F. law, as shown, and almost any type of aerial tuning condenser will be suitable,



Details for drilling the front panel (two-valve set). Sizes of holes: A, 1/2 in. dia.; B, 3/8 in. dia; C, 3/16 in. dia.; D, 1/8 in. dia., countersunk for No. 4 wood screws; E, 3/32 in. dia.

2 and 3 Valve Receiving Sets.—though in allowing space for the sweep of the moving plates of the condenser actually fitted in this instance, sufficient room has been provided so that other condensers can be fitted without modification of the panel layout. A geared dial is employed which is convenient, though not essential, for aerial tuning. The two-coil holder is geared, and of a type that causes the reaction coil to drop away from the front of the panel. The circuit requires the grid condenser and leak to be separately mounted. As a high tension battery of 120 volts has to be used a 15-volt grid bias battery must be fitted, and it should be provided with tappings at every 1½ volts. No bridging condenser is provided across the H.T. terminals—a permissible economy. A cabinet of high quality has been selected, as this adds much to the value of the receiver. The cost of the necessary parts and materials given on page 489 is £4 15s.



Positions for securing the components to the baseboard (2-valve set).

Layout.

It is essential with only a single tuning dial to locate it in the centre of the comparatively small panel. The coil holder, also associated with the aerial circuit, is therefore on the left, which rather lengthens the wiring and prevents the layout of the parts following the positions shown in the theoretical diagram. The operating dial is balanced on either side by the "on and off" switch and the coil-holder knob, while the output terminals are conveniently arranged for connecting to telephone or loud-speaker leads at the centre or lower edge of the panel. On the baseboard practically all the components fall on two lines, which is preferable to merely distributing them uniformly over the area, and actually facilitates wiring. For ease of construction the terminal strip is mounted horizontally, the connecting wires being passed through holes in the back of the cabinet. The panel is not supported by brackets, and is secured to the fillets provided at the ends of the cabinet.

Interior view of the finished two-valve set.

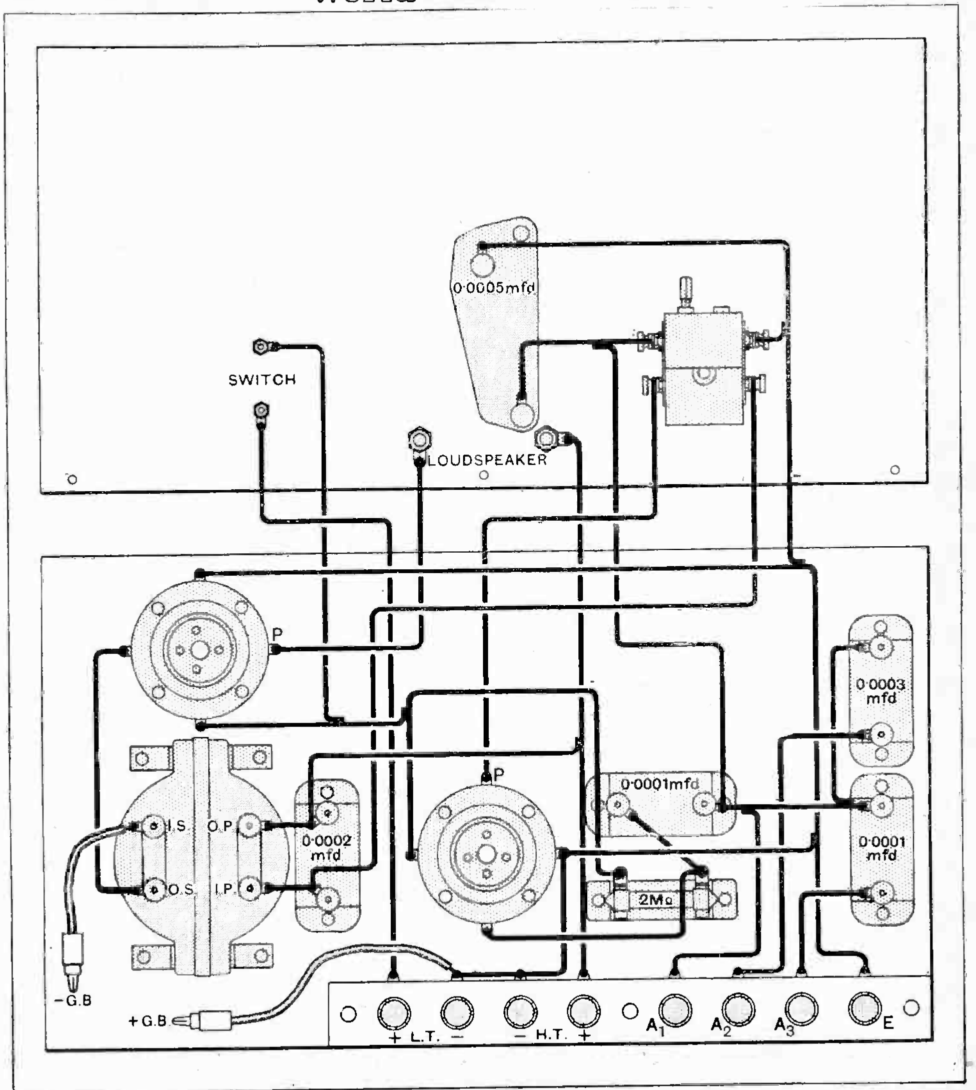
Working Instructions.

All components should be to hand before the construction is commenced, so that should any minor differences from those specified above exist, the necessary changes can be made before drilling is commenced. A great deal of trouble is saved by purchasing the cabinet fitted with panel and baseboard, and these should be carefully fitted together with three No. 4 × ⅜in. brass screws. The reader is reminded that nickel-plated screws are available and look well.

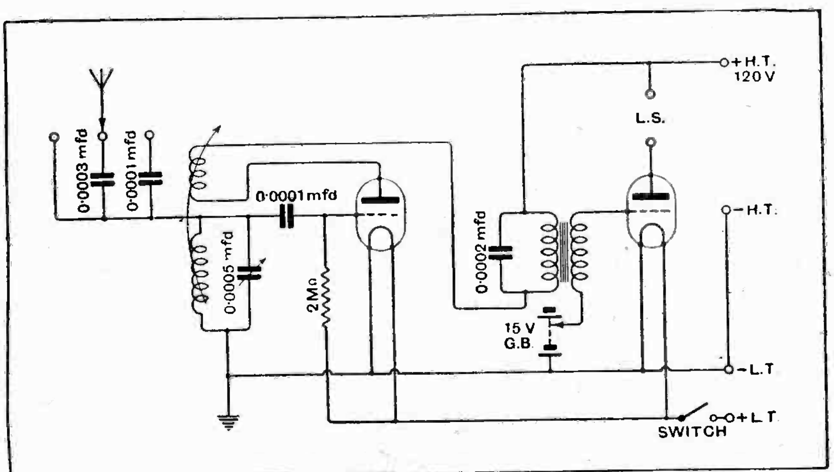
After locating the positions

2 and 3 Valve Receiving Sets.—for the holes on the panel small $\frac{1}{16}$in. holes should be drilled through, taking care that the point of the drill does not wander, and subsequently enlarged to the size specified in the drawing. Many small hand braces will not accommodate the large twist drills required for clearing the bushes of the one-hole fixing components, and the holes can either be enlarged with a small rat-tail file, working to a line, or with a large twist drill held in a pair of grips and following a guide hole. A polished panel finish is probably more durable than a matt surface, while a line finish, such as is obtained by rubbing from end to end of the panel with fine carborundum cloth, looks well.

Before screwing the components down to the baseboard all tags should be scraped and tinned. To facilitate making connections with the aerial and battery terminals a row of suitably spaced holes should be made in a piece of thin tin plate and then cut to form a series of tags with ends about $\frac{3}{4}$in. in length, so that when mounted on the under side of the strip the ends project along the edge of the ebonite, as shown in the practical wiring diagram. Tinned copper wire, No. 18 S.W.G., straightened by stretching, is used for wiring up.



Practical wiring diagram. It may be necessary to reverse the leads connecting to the reaction coil.

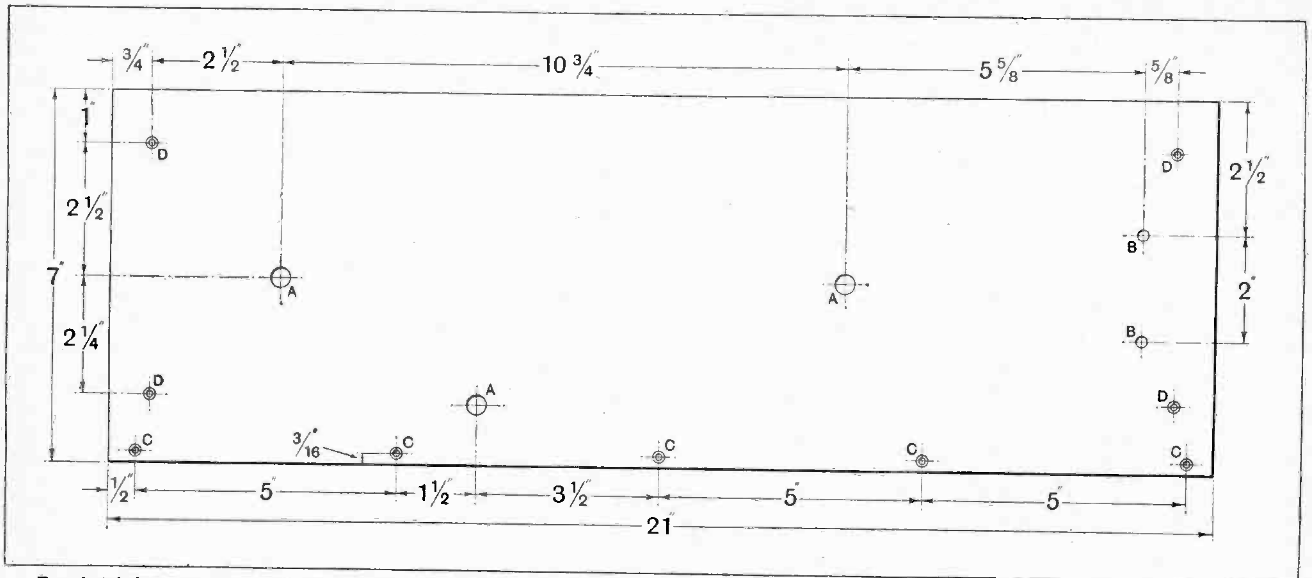


Circuit diagram of the B.B.C. two-valve receiver making use of grid rectification with reaction, series connected aerial condensers and transformer L.F. coupling.

Operation and Results.

A No. 50 coil or its equivalent inserted in the aerial circuit gives a tuning range of about 245 to 535 metres. A 150 coil should be used for tuning to Daventry, and it may be mentioned that, to provide critical reaction control, the reaction coil should have fewer turns than the grid coil. The effect of reversing the leads to the reaction coil holder should be tested before completing the wiring.

If the aerial consists of less than 50ft. of wire, the aerial should not connect to the tuning coil through either of the condensers. It is only when better selectivity is required, or when the aerial is a full 100ft. in length, that the series



Panel drilling details of the three-valve set. Sizes of holes: A, 3/8 in. dia.; B, 7/32 in. dia.; C, 1/8 in. dia. countersunk for No. 4 wood screws; D, 1/8 in. dia. countersunk for No. 6B.A. screws.

condensers are brought into circuit. At 11 miles from 2LO, using a short loft aerial, this set gave signals of good strength in a normal sized room with a sensitive loud-speaker of the horn type. Using telephone receivers and by critically adjusting reaction other B.B.C. and Continental stations were easily tuned in. Daventry at about 70 miles was appreciably weaker than 2LO at 11 miles, though its signals could be easily followed from a loud-speaker without concentration. On a good outdoor aerial Daventry not only came in at ample strength, but Radio-Paris could be tuned in on a loud-speaker.

Any good general purpose valves may be used in the two stages, and in the P.M., B.T.H., Osram, or Marconi series may be selected valves giving an amplification of from 5 to 7. For good local station reception an L.F. valve such as a D.E.5, B.4, P.M.6, or S.T.62 may be used in the detector stage, followed by a D.E.5A, B.11, P.M.256, or S.T.63, using 120 volts H.T. and a grid bias of perhaps somewhere between 7.5 and 15 volts.

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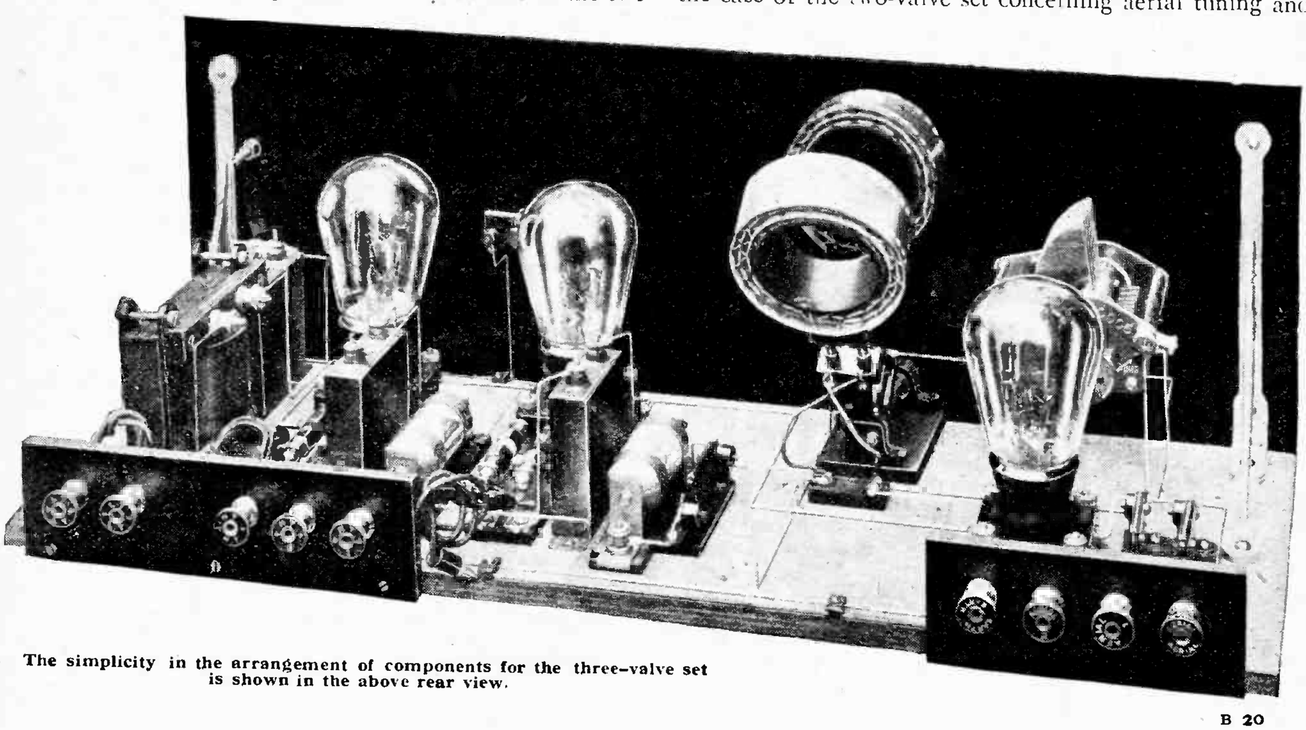
THREE-VALVE B.B.C. SET.

Local station reception is again the intention with the three-valve receiver put forward. What has been said in the case of the two-valve set concerning aerial tuning and



The simplicity in the arrangement of components for the three-valve set is shown in the above rear view.

B.B.C. TWO-VALVE SET.

1 S.L.F. condenser, 0·0005 mfd., with friction control, 4in. dial (Ormond).
2 Fixed condensers, 0·0003, No. 610 type (Dubilier).
2 Fixed condensers, 0·0001, No. 610 type (Dubilier).
1 Grid leak, 2 meg., Dumetohm and holder (Dubilier).
1 Two-coil holder.
1 "Ideal" transformer, 2·7 to 1 (Marconi).
2 "W.B." valve holders (Whiteley, Boneham & Co.)
8 Nickel-plated terminals A, E, A1, A2, H.T. +, –, L.T. +, – (Belling & Lee).
2 Ebonite sh ouded terminals, P +, P – (Belling & Lee).
1 "Wearite" "on and off" switch (Wright & Weaire).
1-16 volt G.B. battery "Ever-ready" (Portable Elec. Light Co.).
1 Cabinet, mahogany, 14 × 7 × 8in. deep (W. and T. Lock).
1 Ebonite panel, 14 × 7in.
1 Baseboard.
Wander plugs, sistoflex, screws, wire, etc.

B.B.C. THREE-VALVE SET.

1 Condenser, slow motion, 0·0005 mfd. (Brandes).
1 2-coil holder, "Newey" (Pettigrew & Merriman).
1 Fixed condenser, 0·0003 and base (Igranic Elec. Co., Ltd.).
2 Fixed condensers, 0·0001 and bases (Igranic Elec. Co., Ltd.).
2 Fixed condensers, 0·1 mica, (T.C.C.).
1 Fixed condenser, 1 mfd. (T.C.C.).
3 Valve holders (Benjamin).
1 "On-and-off" switch, "Trix" (E. J. Lever).
1 Anode resistance, 150,000 ohms (Varley).
1 Anode resistance, 250,000 ohms (Varley).
1 25-henry choke (R.I.).
2 Grid leaks, 1 meg. (Igranic).
1 Grid leak, 0·1 meg. (Igranic).
1-16 volt G.B. battery, "Ever-ready" (Portable Elec. Light Co.).
9 Terminals, A, A1, A2, E, H.T. + 1, + 2, H.T. –, L.T. +, L.T. –, "Eelex" (J. J. Eastick).
2 Terminals, L.S. +, – (Igranic).
1 "Camco" cabinet, mahogany, 21 × 7 × 7½in. deep (Carrington Man. Co.).
1 "Camco" panel, 21 × 7in.
1 pair "Camco" brackets.
1 Baseboard.
Wander plugs, flex, screws, wire, sistoflex, etc.

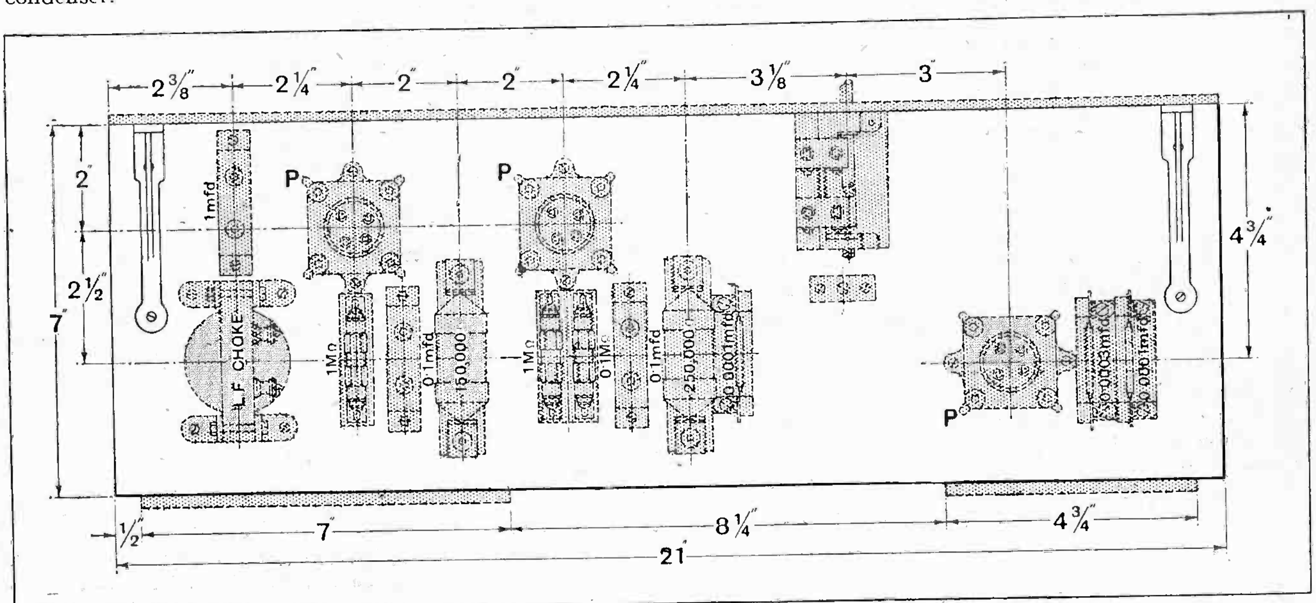
the use of reaction equally applies in this case. Anode bend rectification has been substituted in place of the leaky grid condenser, probably bringing about an improvement in quality and giving a very smooth control of self-oscillation by means of the reaction coil. It is doubtful if recourse to the use of reaction will be necessary at a distance of, say, 15 miles from a main station, which should probably not be exceeded if the really first-class quality of reproduction which this receiver is capable of giving is to be maintained.

The two L.F. stages are resistance-coupled, using wire-wound anode resistances and mica coupling condensers. To prevent the circulating of parasitic currents and the setting up of oscillation in the L.F. amplifier a resistance is inserted in the lead to the grid of the second valve. The loud-speaker is operated through the usual choke and condenser.

The components are situated on panel and baseboard almost in the same relative positions as they appear in the theoretical circuit diagram, the apparatus associated with each valve being assembled in a unit alongside of it, producing simple wiring with short leads. The detector valve, tuning equipment, and associated aerial terminals occupy the left-hand end, the components being liberally spaced to accommodate the swinging reaction coil. Most of the L.F. equipment is assembled in line and packed into small space, the arrangement giving a clean, workmanlike appearance. Like the two-valve set, the telephone terminals are in the front, all other terminals being supported on ebonite strips attached to the edge of the baseboard. All necessary parts can be purchased for £6 5s.

Constructional Details.

Panel, baseboard and brackets are supplied with the cabinet, although it is necessary to finish the edges of the

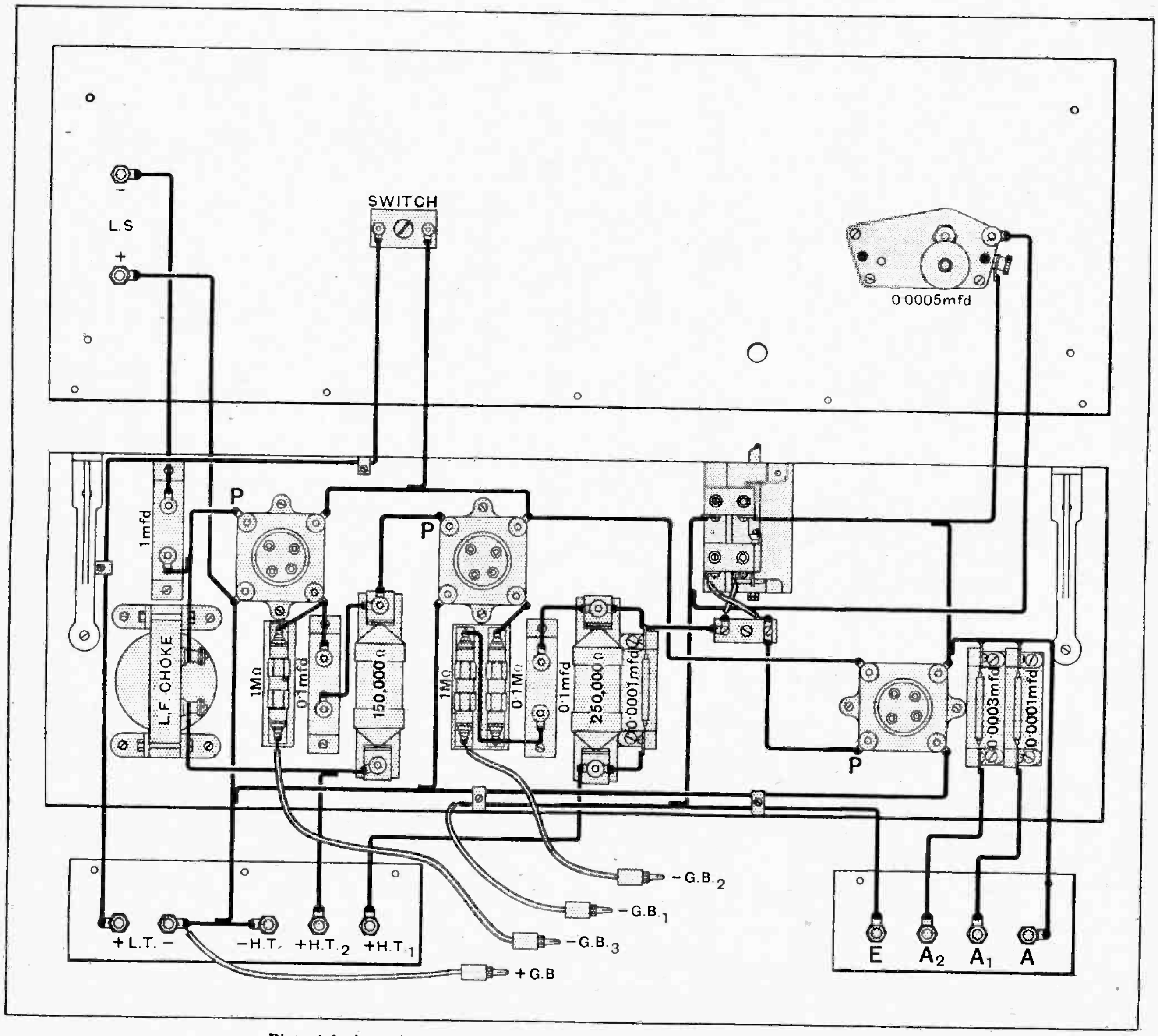


The setting out of the centre lines on which the components are assembled (3-valve set).

2 and 3 Valve Receiving Sets.—

baseboard, which in this case is 7-ply and, if desired, varnish or polish. The brackets also will need to be secured, and for fixing the panel with a view to avoiding the appearance of screw heads on the front, 6B.A. screws should be used, drilling slightly smaller holes nearly through the panel and forcing the screws home without need for tapping.

Brackets are obtained for supporting the small fixed condensers, while insulating pieces will need to be made up to support the grid resistance and leaks; $\frac{3}{16}$in. ebonite is used for this, and the clips attached together with connecting tags with $\frac{1}{4}$in. 6B.A. screws and nuts, the heads being recessed to avoid contact with the baseboard. No. 18 wire is used for connecting up, and all battery leads are run on the face of the board. Small ebonite cleats, with



Pictorial view of the wiring showing the actual route taken by the leads.

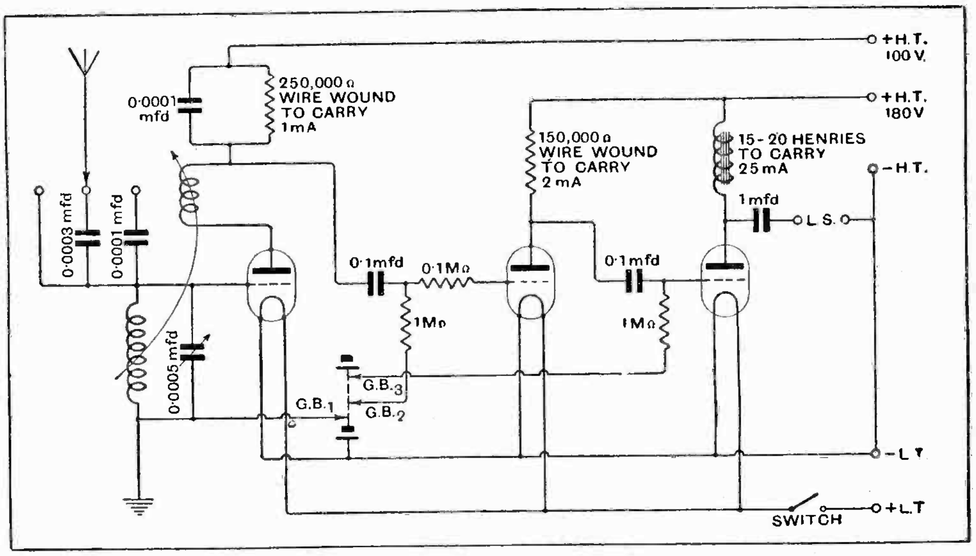
It is advisable to slightly elevate the coil holder, and a piece of $\frac{1}{4}$in. ebonite should be slipped underneath it before screwing down. A screw should only pass through one of the holes, as the holder is primarily held in position by its one-hole fixing. To facilitate making connection to the flexible leads of the holder a small piece of $\frac{1}{4}$in. ebonite carrying two pairs of tags is secured to the baseboard immediately behind the coil holder.

grooves to engage on the wire, are made up from $\frac{3}{16}$in. ebonite sheet, and attached at the points shown in the wiring diagram. Construction will be found quite straightforward, without any trouble as to fitting the components, all being simply screwed down to baseboard or panel. The one difficulty that may arise is the fitting of the terminal strips at the back of the cabinet. If one so desires the cabinet may be ordered with the apertures already made

2 and 3 Valve Receiving Sets.—for the strips, so that, having carefully filed the ebonite to fit the holes, the width of the baseboard is adjusted so that the ebonite strips come flush at the back.

Valves and Operation.

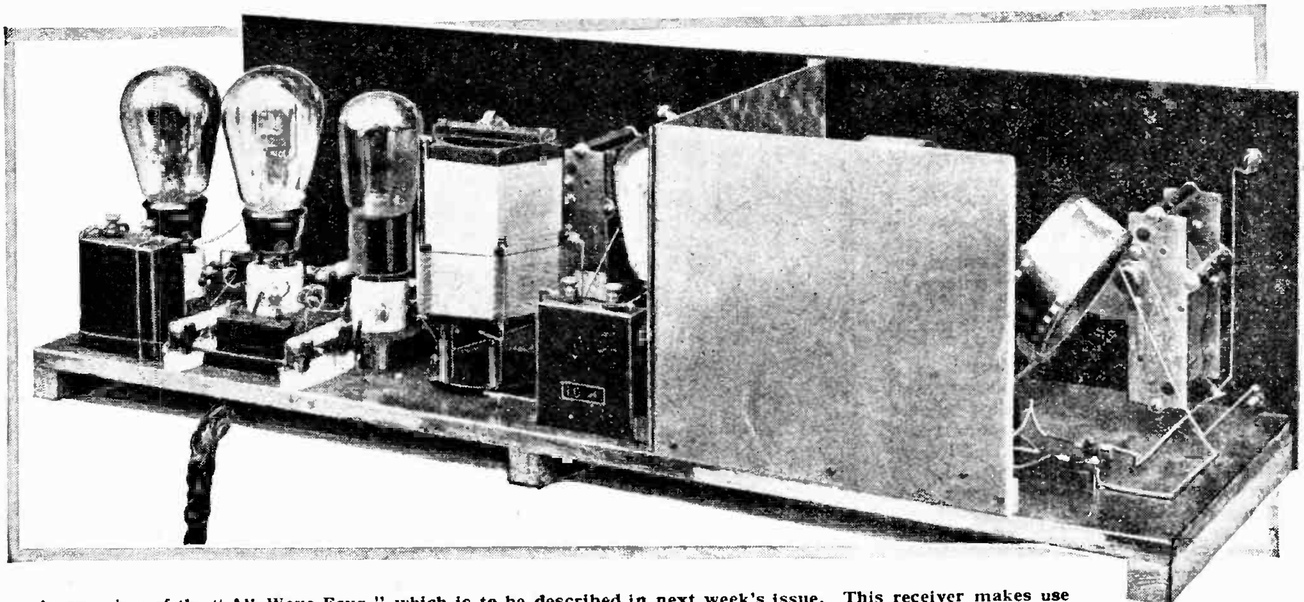
As the valves used in the receiver demonstrated were of the Osram type, D.E.5B, D.E.5, and D.E.5A could be recommended for use in the three stages. It might be found possible, without impairing quality, to employ a D.E.5B as the second valve, with a critical adjustment of grid bias, though the D.E.5 will, of course, be entirely satisfactory. A valve of the L.S.5 or even L.S.5A type may replace the valve in the last stage for operating a large loud-speaker, and in this case the grid bias battery should be increased to two 15-volt sections. In the P.M. series the first valve may be a P.M.5B, with a critical adjustment of H.T. voltage and 1½ or 3 volts negative on the grid, the second valve a P.M.5X, and the output valve a P.M.256. It would be useful to have a P.M.6 available so that the P.M.5X could be moved into the detector stage, using the P.M.6 as the first L.F. Alternatively the P.M.6 could be tested in the place of the P.M.256.



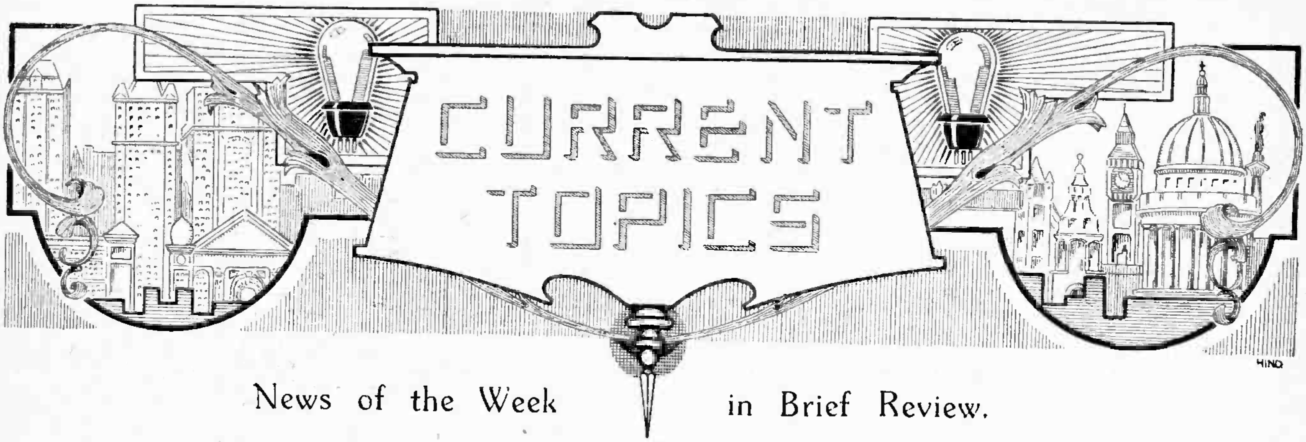
The three-valve receiver, though similar in tuning arrangements to the two-valve set, employs anode rectification, is resistance coupled, and is provided with a choke loud-speaker feed.

As to tuning range, the performance of the set corresponds with the two-valve receiver, and as to actual range of reception, as indicated by its ability to bring in distant stations, it is perhaps not quite so effective, but for really good quality from the local station little can better it. For the listener situated within fifteen miles from the local station, or perhaps up to 25 miles if he erects a good aerial and who needs a set to give the best possible reproduction with a good grade loud-speaker, and without a great outlay, this set can be thoroughly recommended. At a conservative estimate good reception of Daventry can be obtained at a radius of 100 miles.

EFFICIENT H.F. AMPLIFICATION ON THE NORMAL AND LONG WAVEBANDS.



A rear view of the "All-Wave Four," which is to be described in next week's issue. This receiver makes use of interchangeable H.F. transformers of modern design.



News of the Week in Brief Review.

A BRIGHT IDEA.

The newly appointed Federal Radio Commission in America has received a letter from an enthusiastic listener demanding that immediate steps be taken to eliminate atmospherics.

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PARIS WIRELESS EXHIBITION.

Paris will hold its Fourth Wireless Exhibition from October 28th to November 13th at the Grand Palais, under the auspices of the Syndicat Professionnel des Industries Radioelectriques.

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CONFUSION WORSE CONFOUNDED.

The clarification of the American ether, now choked up with more stations than it can carry, remains a dream of the future, despite the machinery recently set up by the American Congress to deal with the problem. According to our Washington correspondent, these arrangements have been rendered practically useless through the failure of the Senate to approve the allocation of funds for their operation and the pay of the Commissioners.

It is considered probable that, pending a settlement of the monetary question, the three commissioners may be willing to serve without pay for eight or nine months.

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BY BEAM TO AUSTRALIA.

At 6 o'clock on the morning of April 8th the official beam wireless service was opened between this country and Australia.

On the previous day a preliminary demonstration was given in the Central Wireless Office of the G.P.O., and complimentary messages were exchanged between Mr. L. S. Amery, Secretary of State for the Dominions, and Lord Stonehaven, Governor-General of Australia, Mr. Bruce, the Australian Prime Minister, Mr. Hughes, and others.

The messages from London are despatched *via* land line to Grimsby, whence they travel 10,000 miles to the Australian receiving station at Rockbank, and from there *via* land line to Melbourne. In the reverse direction signals travel from Melbourne, *via* land line to Ballan, whence they are transmitted to Skegness and conveyed by land line to London.

It is expected that the Indian and South African beam stations will be ready for testing within a few weeks.

THE IRISH IMPORT TAX.

An Anti-Tax Campaign has been initiated by the joint efforts of the leading wireless interests in Ireland with the object of securing the removal of the present import duty on wireless goods. Parliamentary deputies are being reminded that the tax is having a ruinous effect on the development of broadcasting in the Irish Free State.

It is pointed out that under existing conditions the retail prices of wireless apparatus are beyond the purse of the average citizen, and, owing to the consequent restricted market, there is no possibility of establishing a wireless manufacturing industry in the country, so that a protective tax is not needed.

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FOUND.

The owner of a copy of the 1927 edition of *The Wireless Amateur's Diary and Notebook* which has been found in a train is invited to make application for it at the offices of this Journal, giving evidence to prove ownership.

"HUSH HUSH" STATION IN PARIS.

Excitement has been aroused in Paris over the discovery by the police of a secret wireless transmitting station of high power, believed to be operated for the purpose of communicating Bourse prices to foreign countries.

But, whatever the purpose of the transmissions, nefarious or otherwise, the authorities are agreed that the station infringes the Government telegraphic monopoly. The two operators, together with four foreign bankers, are accordingly being charged with committing this offence.

Apparently the existence of the station was first suspected on account of a number of mysterious advertisements asking for wireless operators.

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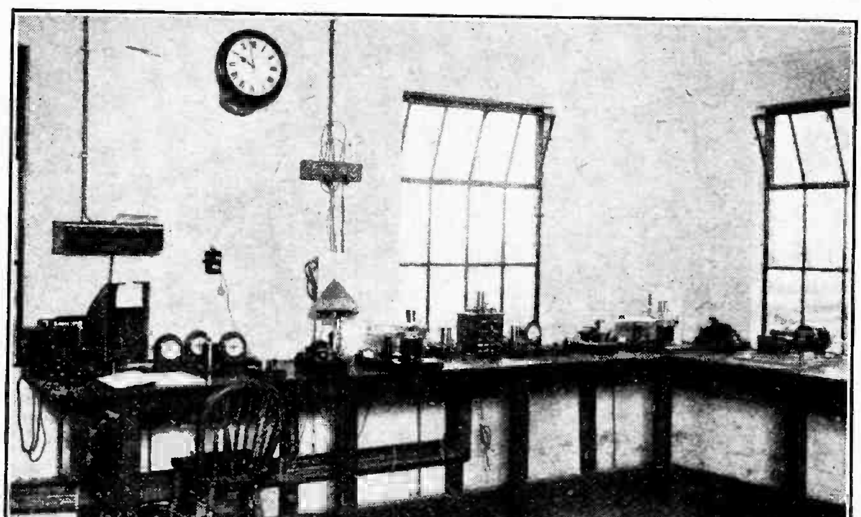
THE RANGE OF ATMOSPHERICS.

Members of the Incorporated Radio Society of Great Britain have received an invitation to attend a meeting of the Royal Meteorological Society, 49, Cromwell Road, South Kensington, S.W.7, at



AUSTRALIAN BEAM SERVICE. The Marconi receiver at Skegness, an important link in the new chain linking London and Melbourne. The photograph shows a corner of the receiving room with the land line connections and high speed recording instruments.

5 o'clock this evening (Wednesday), when an interesting report on "The Range of Atmospherics" will be brought forward and discussed. The opener of the discussion will be Mr. R. A. Watson Watt, B.Sc., of the Radio Research Board. A limited number of tickets of admission will be available for members on application at the offices of the Radio Society, 53, Victoria Street, Westminster, S.W.1.

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WORLD-WIDE AMATEUR TESTS.

An international test to be held in May for the purpose of ascertaining the most dependable amateur transmitting stations in each country, and to be participated in by amateurs all over the world, has just been announced by the Communications Department of the American Radio Relay League. The test will start on May 9th, to last for two weeks, and will be open to anyone in any country of the world possessing an amateur transmitting and receiving station.

Messages will be filed for delivery in all countries, and the amateur station in each locality showing the quickest, most accurate, and most consistent performance in connection with the forwarding of these messages to their destinations will receive a suitable certificate designating it as an official foreign contact station.

Readers interested in the test should make immediate application for further particulars to the Secretary of the American Radio Relay League, Hartford, Connecticut, U.S.A.

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"SOME THIN NEW."

Amateur transmitters occasionally get more than they expect in the direction of reports, etc. The following string of questions has been received by a Glasgow transmitter from an enthusiast in Rockdale, Texas.

"Dear Mr. ——,

I saw in the Dallas News where you heard one of our stations over in U.S.A. that is some thin new to us. . . . I hate to put you to so much truble by asking so maney questions but we are proude that you can get our stations in U.S.A. I wish we could get your stations on what meter do youall broadcast and what is some of station call letters and what power is your station how maney watt please tell me all aboute your radios I have been in the radio buisness for aboute four years but we cant learn to much we have to maney stations in U.S.A. we have some thing over sixteen hundreds stations I guess that is the reason we cant do much on distens so I guess my letter is tire some but I hope you will ans it and tell me all aboute stations so I hope to here from you.

Yours Truley"

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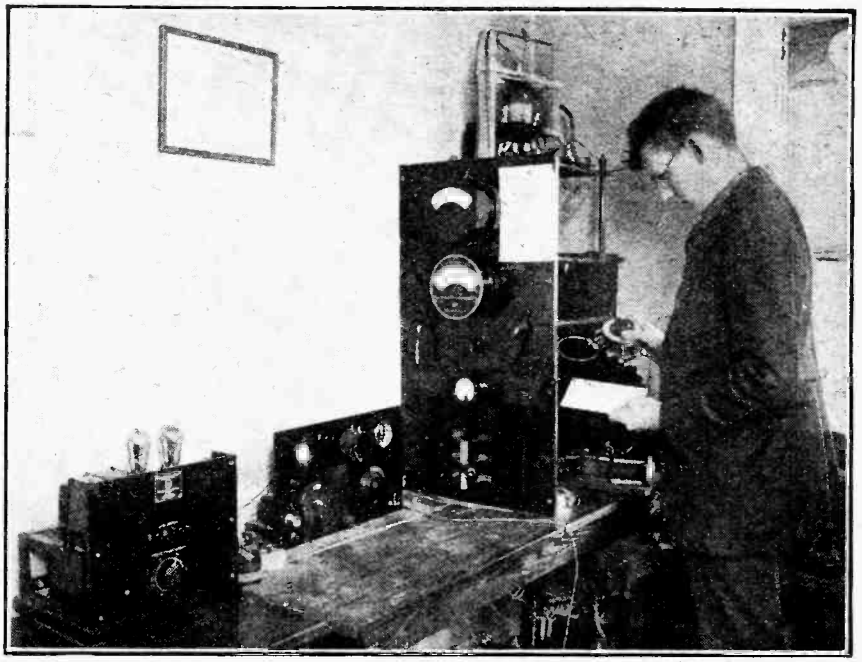
TELEVISION DEMONSTRATION IN NEW YORK

In a square of glass 2in. across, a group of Press representatives at the Bell laboratories in New York saw the figure of Mr. Hoover, the U.S. Secretary of Commerce in Washington, speaking on the telephone 200 miles away.

This successful demonstration of television was carried out on April 7th and was organised by the American Telephone and Telegraph Company. The experiment was first performed on the telephone line, but subsequently the party witnessed a number of vaudeville "turns" transmitted by wireless from the Whippany broadcasting station, New Jersey. For the benefit of a large audience, the pictures on the small glass square were projected on to a screen, and although the definition on the screen was not so clear it was generally agreed that the demonstration was a remarkable success.

The person whose picture was transmitted (says the *Times* New York correspondent) sat in front of a cabinet containing three large photo-electric cells, each 15in. long. Across the subject's features ran a beam of light directed to successive points by a rotating reel, with 2,500 points pierced in the edge, in such a manner as to direct the beam to every part of the feature. The changing currents set up in the photo-electric cell were amplified 5,000,000,000 times before transmission. So clear was the "picture" on the receiving screen that it was possible to distinguish the person's teeth and the ash on the end of a cigarette.



TRANSMITTER WHO RECEIVES HIS OWN SIGNALS. Mr. Boyd Phelps (2EB) of Jamaica, New York, with his short-wave transmitter specially designed for work on 5 metres. In his hand is a 5-metre wavemeter. As he cannot discover an amateur who will receive on such a low wavelength, Mr. Phelps has installed an automatic transmitting key; he is thus able to tour the country in a car and pick up signals from his own station!

WIRELESS AT WESTMINSTER.

BY OUR PARLIAMENTARY CORRESPONDENT.

Interference by Experimenters?

Sir Frederick Hall asked the Postmaster-General in the House of Commons last week whether his attention had been called to the annoyance caused to listeners-in on three nights a week when dance music was being broadcast from Daventry; and whether, seeing that this annoyance was due to the fact that holders of experimental licences availed themselves of their privileges on these occasions, he would take steps either to forbid any testing to begin until Daventry had closed down, or, alternatively, to terminate the programme from Daventry at 11 p.m. on Mondays, Wednesdays, and Fridays?

Sir W. Mitchell-Thomson said that his attention had not previously been called to this matter. He was surprised to learn that there was any appreciable interference by experimenters with the reception of Daventry programmes, as the wavelengths which experimenters were authorised to use were far removed from the 1,600 metres wavelength of the Daventry station. If Sir F. Hall would bring any particular case of which he might have knowledge to the attention of the B.B.C. they would no doubt immediately investigate it.

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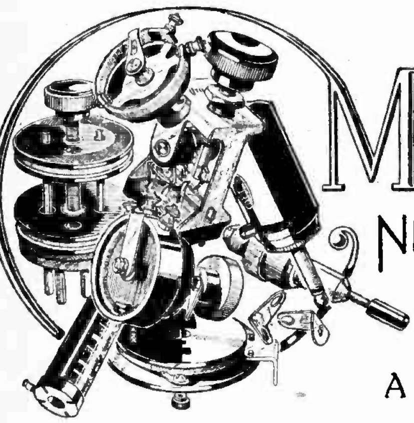
A Cenotaph Broadcast.

In reply to Major Cohen, who asked why he had refused the request of the British Legion to broadcast their annual Cenotaph service on Whit Sunday, in view of the value of the service to thousands of ex-Service men and widows and dependants of ex-Service men who were unable to be in London on that date, Lord Wolmer said that no such request had been made to the Postmaster-General. The matter fell within the province of the First Commissioner of Works.



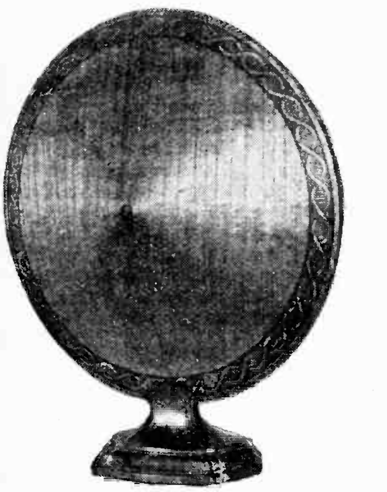
MANUFACTURERS' NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

THE FARRAND LOUD-SPEAKER.

A loud-speaker of the cone type which has attained considerable popularity in the United States is the Farrand, a product of the Farrand Manufacturing Co., Inc., and handled in this country by Larsen de Brey & Co., 14, Brownlow Street, Holborn, London.

It is a beautifully finished instrument consisting of a double 14in. cone which, instead of being constructed of shaped cardboard, is of exceedingly thin wood, and, judging from the stiffness, the wood used is probably in the form of ply. A critical adjustment of the reed is not required, and it is merely necessary to tighten up the adjusting screw in the centre, which suggests that the movement is a differential one. The loud-speaker does not work on small input, but when a second L.F. stage is employed excellent reproduction is obtained. Although giving a good response in the base, there is no tendency for the louder notes to produce a booming sound, an effect which is



The Farrand cone loud-speaker. On the reverse side the cone is open at the centre.

sometimes met with in loud-speakers of this general type. Both speech and music are reproduced with a clean crisp sound, and even on heavy input, such as is obtained from two L.S.5A. valves in parallel working on 300 volts, with signals from a local station, there is no tendency to rattle.

The general finish is good, and the apearance attractive both as regards the decoration of the cone and the antique bronze base.

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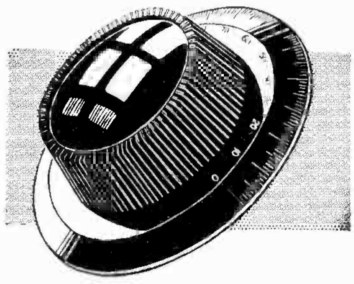
MANDEM DIALS.

As there are on the market many variable condensers fitted with small and in some cases unattractive dials, the supply of a separate dial by McLeod & McLeod,



The new Mandem dial. It is of good design and cleanly finished.

329, High Holborn, London, W.C.1, will be appreciated by many amateurs who wish to improve the appearance of their sets.

The dial which is 4in. in diameter is a really attractive job. It is cleanly moulded in ebonite and carries a 180° scale. The operating ring is liberal in diameter, and the milling is deep and sharp. Examined for trueness the underside was found to be perfectly flat. Fixing is provided by means of a recessed grub screw.

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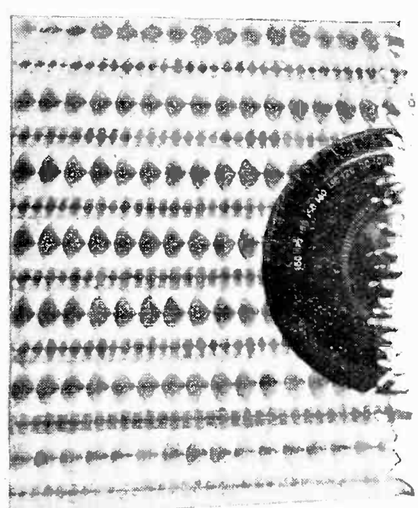
FIGURED ALUMINIUM PANELS.

Several attempts have been made by amateurs to replace the usual ebonite panel by one of aluminium. The difficulty usually encountered is to provide a good finish for the aluminium surface and the amateur sometimes finds that the grade of aluminium he is working will not take a bright polish.

Attempts have been made to produce a figured surface and here again a good deal of skill and experience are required to produce a really attractive finish.

The demand for aluminium panels is now being met by White Bros. & Jacobs, Ltd., 46, Chalk Farm Road, London, N.W.1, bearing an engine turned finish and covered with a hard transparent lacquer.

The accompanying photograph does not show the panel to its best advantage, and the small circles, resembling an engine turned finish, which are marked with regularity over the surface look well when reflecting light, particularly when in combination with the ebonite tuning dials. Aluminium panels will not be found difficult to drill, though when the condensers of several tuning circuits are assembled on the conducting panel somewhat large holes must be drilled to accommodate small insulating bushes to prevent short-circuiting the grid biassing cells. Being covered with a hard transparent varnish, the surface can be cleaned down without injury to the marking, and will remain bright without oxidising or corroding.



A substitute for ebonite panels. An aluminium panel with an engine turned surface protected with a hard transparent lacquer.

The panel supplied for examination was $\frac{1}{16}$in. in thickness, and was quite stiff. Aluminium panels of this type are likely to become exceedingly popular in the near future.

PRACTICAL HINTS AND TIPS.

A Section Mainly for the New Reader.

VOLUME CONTROL.

It is now recognised that one of the most effective controls of signal intensity is obtained by varying the filament current of the H.F. amplifying valve. The full benefit of this device is, however, felt only when the rheostat operates smoothly and when its value is suitably chosen with regard to the valve. It would clearly be a mistake to use a 30-ohm instrument to control a 2-volt valve consuming 0.3 amp., as a movement of the brush through a few degrees would make a very large difference in emission. For this valve a maximum value of 5 or 10 ohms would be better.

A 6-volt valve, consuming 0.1 amp., on the other hand, will continue to emit when a very considerable resistance is inserted in series with its filament; a maximum value of 50 ohms is not too great.

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ANODE RECTIFICATION.

In spite of the fact that a valve acting as a "bottom bend" rectifier is less sensitive than when functioning with the more generally used leaky grid condenser, the former arrangement is becoming increasingly popular, not only because it is likely

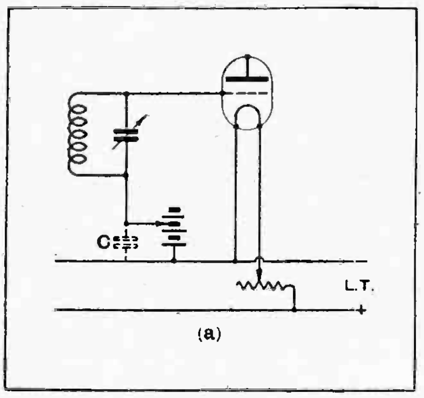


Fig. 1(a).—The simplest method of adjusting grid bias.

to introduce less distortion, but because it does not damp the circuit across which it is connected. This feature may not be of much advantage with many simple circuits (and some complex ones which are now obsolescent) in which coils having a high H.F. resistance are used, but it is a matter of considerable importance when the detector valve follows a modern H.F. transformer. In fact, the increased amplification ob-

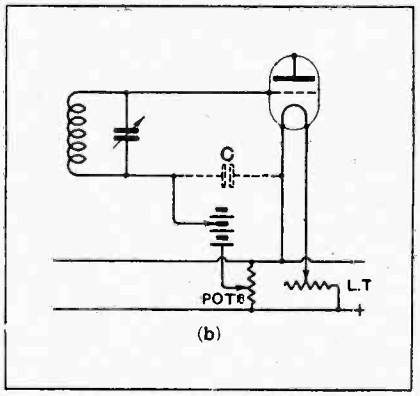


Fig. 1(b).—Fine adjustment of grid voltage by potentiometer control.

tainable tends to offset the reduced detector efficiency, and, except perhaps when dealing with a very feeble input, signals may actually be louder than when grid detection is used.

Generally speaking, a valve with an amplification factor of 20 or even much more is to be recommended as an anode rectifier. Many of the modern high-magnification valves are particularly suitable, and some of them have an exceptionally sharp bend on the lower part of their characteristic curves.

To obtain the best results on weak signals, it is essential that the steady voltage applied to the grid should be of such a value that it is normally maintained at this point of curvature. When dealing with very large applied H.F. voltages as received from a near-by station, the adjustment of bias is not critical, although it is desirable that the grid should be sufficiently negative to prevent the flow of grid currents. Under such conditions the simple arrangement shown in Fig. 1(a) is adequate. It will be seen that the lower end of the tuned circuit is taken to the negative side of the filament through a tapped bias battery.

It should be realised that there are two distinct methods of adjustment whereby the valve may be made to operate on the lower bend; either the grid or anode voltage may be altered, and thus a correct operating point may be found with the arrangement referred to above, even if the valve has a sharp bend. In practice, however, two variables are always inconvenient, and it will be found better to keep the plate voltage fixed and to make finer adjustments of grid bias than are possible by varying the battery tappings with the aid of a potentiometer connected as in Fig. 1(b).

Still another method of obtaining fine control of grid bias is shown in Fig. 1(c); this, however, is only applicable when a 2-volt detector is used in conjunction with 4- or 6-volt valves. One end of a rheostat is connected to the filament, and a lead from the *negative* side of the L.T. battery is soldered to a suitable point on the winding. By joining the lower potential end of the tuned circuit to the contact brush, the correct proportion of the total voltage "dropped" across the resistance is applied to the grid.

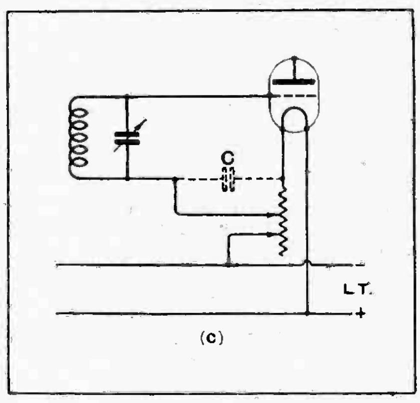


Fig. 1(c).—Another method, only applicable when there is sufficient voltage drop in the resistance.

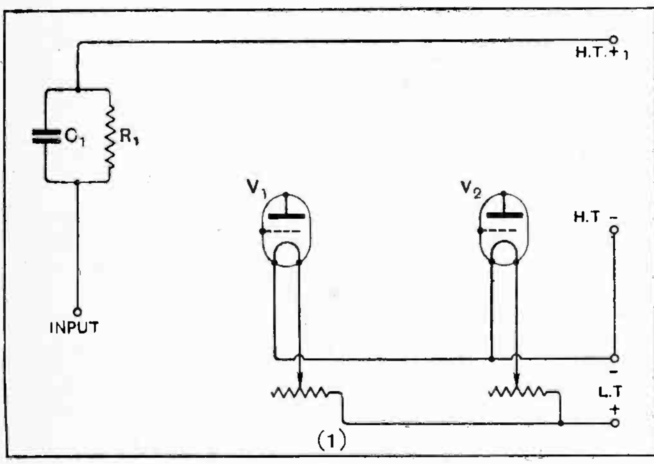
In each of the diagrams a by-pass condenser C is shown. While not absolutely essential, its inclusion is recommended. Any capacity of from 0.01 mfd. upwards may be used for the by-pass condenser.

DISSECTED DIAGRAMS.

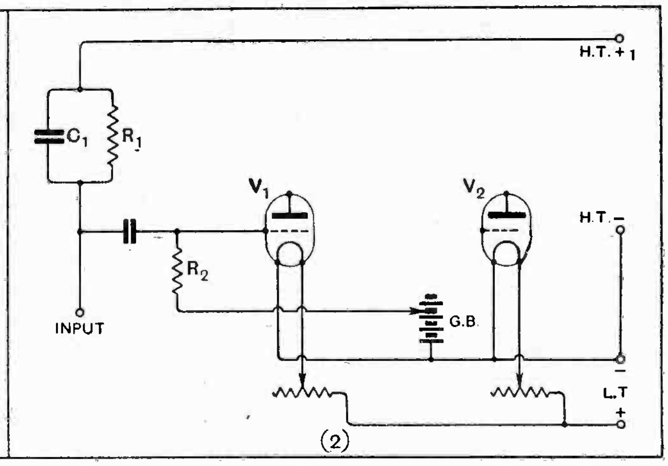
Practical Points in Design and Construction.

No. 68.—A Resistance-Transformer L.F. Amplifier.

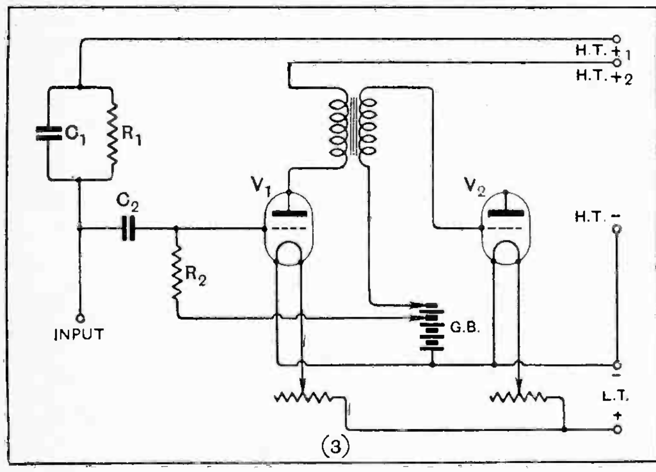
The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless instruments, and at the same time to assist readers in mastering circuit diagrams. The "mixed" L.F. amplifier circuit shown below is becoming increasingly popular, and is particularly suited for adding to the H.F. amplifier-detector set shown in last week's issue. This combination gives, in essentials, the circuit of the "Everyman Four" receiver.



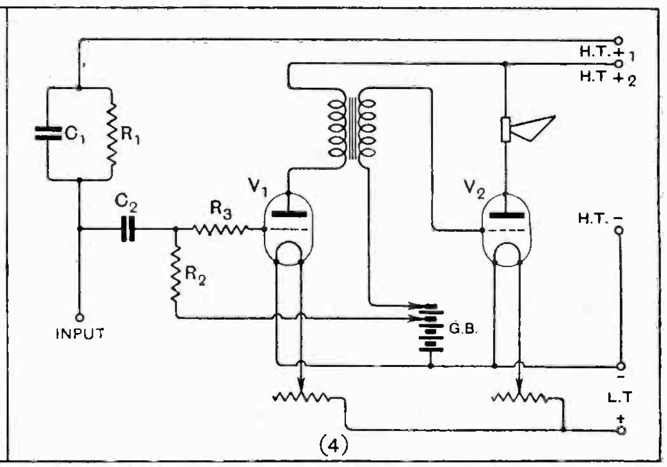
The anode circuit of the preceding valve (connected to the input terminal), is completed through a resistance with shunting condenser and H.T. battery. Filaments of the L.F. valves are connected in the usual manner.



L.F. voltage variations developed across the anode resistance are applied to the grid of the first L.F. valve (V_1) through a condenser fitted with a leak, through which a negative bias is applied.



The plate circuit is completed through the L.F. transformer primary and H.T. battery. The secondary is joined across grid and filament of V_2, with bias battery interposed.



The anode circuit of the second valve is completed through a loud-speaker. A resistance (R_3) of about 0.5 megohm is inserted in the grid circuit of V_1 to isolate it from H.F. impulses.

IT is intended that this amplifier and the detector (with or without H.F.) preceding it should be fed from common batteries. Thus a separate set of parallel battery terminals are generally mounted on the "input" side.

No attempt will be made to deal with the values of the anode resistance R_1, the by-pass condenser (C_1), or the coupling condenser (C_2), as this matter has been dealt with elsewhere on several occasions. The grid leak (R_2) will be chosen with regard to the capacity of C_2. The insulation of all these components must be of the highest order.

The present tendency is to use as V_1 a valve of about 20,000 ohms impedance. With the usual 120 volts H.T. supply a negative bias of 3 volts may be applied to its grid.

With the valve mentioned above, a low-ratio transformer, with a large primary, is suitable. Alternatively, a valve of lower impedance may be used with the same transformer and suitably increased bias, with a still better response on the lower frequencies. This will give less amplification and will automatically reduce the tendency towards overloading.

The question of cost enters largely into the choice of an output valve (V_2), as it should be emphasised that large power outputs are only obtained by expending a considerable amount of battery power. This valve should accordingly be of the lowest possible impedance consistent with the H.T. current (and voltage) which can conveniently be fed to it.

THE CONSTANCY OF B.B.C. TRANSMISSIONS.

Factors Governing the Strength of Received Signals.

By W. H. F. GRIFFITHS.

Quite erroneous ideas of the constancy of signal strength obtained from a local broadcast transmission are sometimes formed through neglecting to take account of many variable factors present at the receiving end.

IN the smoking compartment of one's City-bound morning train one often hears some such statement as "2LO was frightfully weak last night."

It is, of course, necessarily a statement of the "man-in-the-street" whose only instrument for the comparison of signal strength is the human ear. Wireless men know how utterly impossible it is to employ the ear as an instrument for the comparison of sound intensities even when the interval between the sounds to be compared is brief. For any statement of relative signal strengths to be made on two receptions separated by an interval of twenty-four hours, and, in all probability, with the ears in an entirely different physical condition brought about by a variety of causes, among which is the strain of a noisy city, is well known to be absurd, especially when the statement has quantitative pretentions, such as a definite small percentage difference.

To judge the relative signal strengths of a local broadcast station on successive nights to be, say, 20 per cent. different is therefore an impossibility unless meters are employed, and yet one would certainly not expect greater variations than this when situated within, say, 10 miles of the station, assuming the ratio of modulation amplitude to carrier-wave amplitude maintained constant by the station engineers; *i.e.*, great variations of *radio*-frequency energy are not expected.

Short-period fading and great signal strength variations due to *radio*-frequency transmission causes are only experienced in the reception of transmissions from stations (operating on the 300-500 metre waveband) at least 70 to 100 miles distant.

Audibility Dependent upon Modulation Ratio.

In the reception of radio-telephony, however, the actual signal strength, as experienced by the ear, is not only dependent upon the *radio*-frequency energy, but also upon the extent to which this energy is modulated. In fact, variations of "modulation ratio" (or *audio*-frequency variations) of the transmitter may produce much greater variations of actual signal strength than those caused by radio-frequency variations.

It is possible, however, to control this modulation ratio during transmissions, and, normally, one may assume that it is kept fairly constant for any given class of musical item. That is to say, the amplification control is so arranged that, for instance, all contralto soloists, however powerful their actual voices, are made to effect roughly the same mean modulation ratio throughout their performances, further brief adjustments having, of course, to be made to suit an increase of power occurring on certain of the soloist's notes (characteristic of the particular singer), in order to prevent brief period over-modulation.

If it is assumed that the modulation ratio throughout a given class of musical item is maintained (by control), always, at the same constant *mean* value, then the actual signal strength or audibility will be dependent only upon the amplitude of the radio-frequency carrier-wave, and this can be measured at the receiving station without reference to modulation ratio except for sudden fluctuations, of very brief duration, due to over-modulation which can easily be detected and ignored.

Local Variable Factors.

Even by the use of meters, however, small carrier-wave variations are not easy to determine unless one has a complete knowledge of all the possible variable factors at the receiving end. If an aerial is simply tuned to resonance with an incoming transmission by means of an inductance L (Fig. 1) the "resonance volts" across the latter may be measured by means of a high-impedance thermionic detector voltmeter V. The aerial current is proportional to this voltage, and, if the aerial is exactly in resonance with the incoming signal wave, the E.M.F. induced in the aerial by the potential gradient of the advancing wave-front is also proportional to the voltmeter reading.

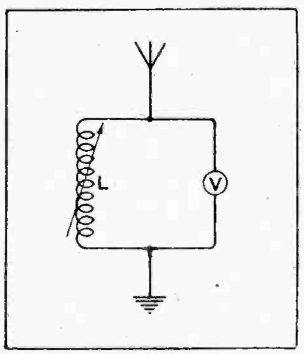


Fig. 1.—Circuit for measuring the radio-frequency E.M.F. induced across the ends of the aerial tuning inductance by the transmission from the broadcasting station.

Quite apart from variations of field strength of the transmission being received it is possible to experience variations of voltmeter readings due to a variety of causes, among which may be enumerated the following:—

1. A slight detuning of the aerial circuit by a mechanical "drift" of the inductance L, by change in disposition of leads or by swinging aerial. Tuning will be fairly sharp, because the only load on the circuit, that of the voltmeter, is inappreciable. This error is eliminated by careful retuning between readings.

2. Variations of aerial circuit effective resistance due to series resistance changes, such as earth resistance, plugs, or switches, or other contact surfaces.

3. Variations of aerial circuit effective resistance due to dielectric losses in aerial insulators, in the insulation

The Constancy of B.B.C. Transmissions.—of the tuning coil or in any solid dielectric material between the aerial and earth lead-in wires.

4. Variations of aerial circuit effective resistance due to changes of impedance of another aerial in close proximity to the one in use.

5. Variations of aerial circuit effective resistance due to changes of load, if any, taken from it. This possibility should always be eliminated by making sure that the thermionic voltmeter is the only load imposed, and this is usually negligible and certainly constant.

Misleading Signal Strength Curves.

In order to show how important these local variations may become, the reader is referred to the curve of Fig. 2, curve A, showing the signal strength variations of 2LO at 10 miles between 6 p.m. and 10.45 p.m. on a particular evening, as they would have appeared if the voltmeter readings had been accepted as an unquestionably true criterion. It will be observed that this curve shows a steady increase of signal strength as the night progressed, just as one would expect in the reception of a long-distance station, due to the Heaviside layer and the well-known night effect—the total change is seen to be nearly ± 20 per cent. from a mean value of 1.21 volts.

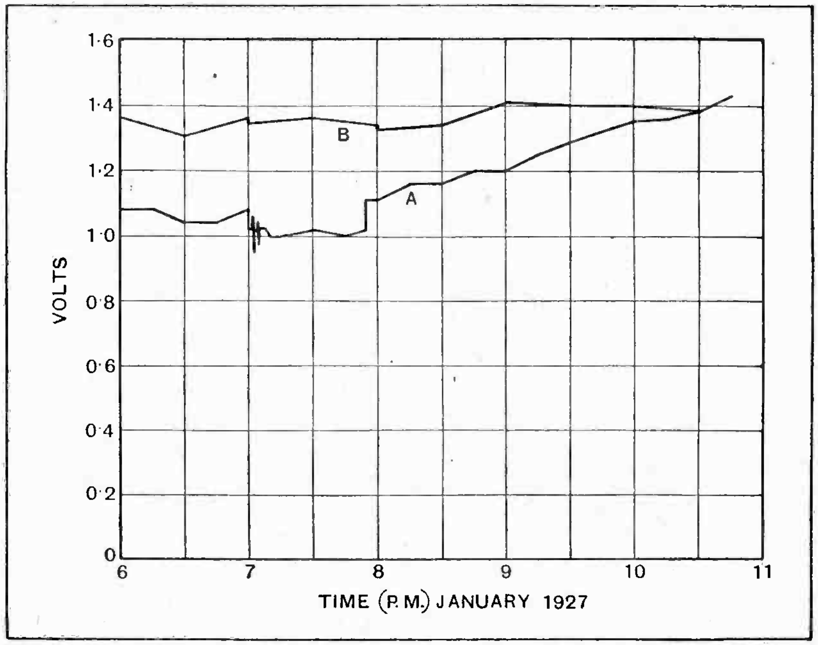


Fig. 2.—Curves showing (A) the apparent variation in signal strength during the course of an evening of 2LO at 10 miles, and (B) after correcting for variations in the effective resistance of the aerial circuit.

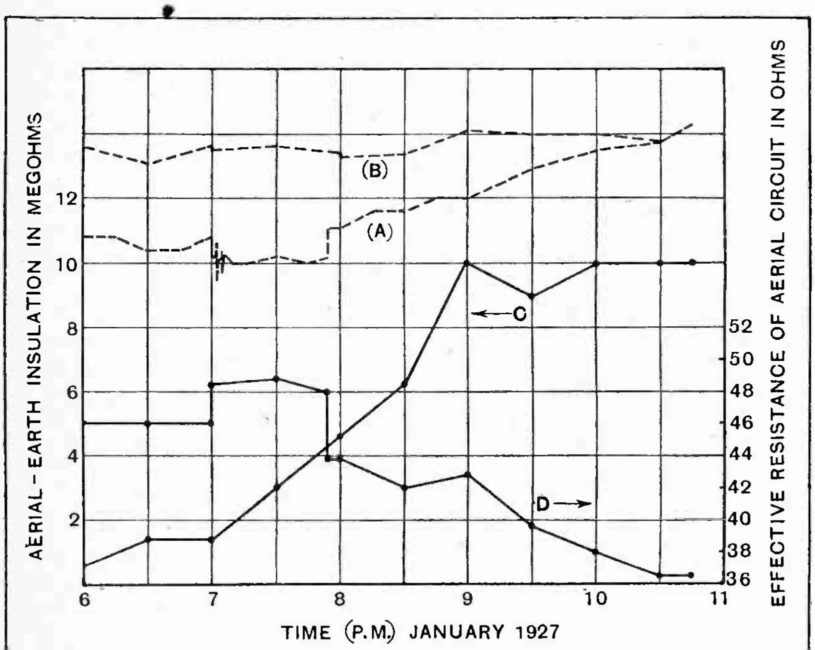


Fig. 3.—Curves (A) and (B) reproduced from Fig. 2. Curve C shows the improvement of aerial-to-earth insulation throughout the evening, and curve D the effective aerial circuit resistance.

This was known to be far too great a variation, and corrections were applied to the curve—corrections made possible by a knowledge of the effective resistance changes of the aerial circuit from readings taken at half-hourly intervals during the test. After these corrections had been made the curve was completely altered, and is shown in Fig. 2, curve B. Many of its irregularities were entirely smoothed out and the total change, it will be seen, was reduced to ± 4.5 per cent. from a mean value of 1.37 volts—a variation which is quite negligible, and which is, in fact, outside the limits of accurate measurement unless the utmost precaution is exercised.

The explanation for the large changes in the pseudo-voltage curve A is fairly simple.

In the first place, the day, during the hours prior to the commencement of the test, had been very wet, and the D.C. insulation resistance of the aerial (from earth) at six o'clock was found to be only 0.5 megohm. At half-hourly intervals throughout the evening the D.C. insulation of the aerial was tested and showed a steady improvement, until at nine o'clock it reached the value 10 megohms, which, from experience, was known to be a good normal value. The curve C of Fig. 3 shows this improvement of insulation, which was undoubtedly due to the dry, bright evening. These values of insulation resistance were not in themselves the direct cause of any appreciable increase of effective resistance of the aerial circuit. The reactance of L at 361.4 metres (the wave-

The Constancy of B.B.C. Transmissions.—

length of 2LO) was about 880 ohms, and a resistance of 1.0 megohm shunted across this would only have increased the effective resistance of the aerial circuit by about 0.75 ohm. The normal (lowest experienced) aerial circuit resistance was known to be 36.5 ohms, and the value (from curve D, Fig. 3), corresponding to a D.C. insulation of 1.0 megohm (on curve C), is seen to be 46 ohms.

It is, however, reasonable to suppose that the improvement of D.C. insulation resistance could be taken as a rough indication of a reduction of dielectric losses of the unclean aerial and lead-in insulators, although the two quantities are not in any way numerically related. Measurements of effective resistance (also made at half-hourly intervals during the test) proved this to be the case, the curve D giving the general steady decrease in effective resistance from 46 ohms at six o'clock to 36.5 ohms at 10.30 p.m. It will be noticed that the decrease of A.C. leakage lagged somewhat behind the decrease of D.C. conductance by a period of about an hour—this also is, perhaps, conceivably natural.

This gradual aerial improvement therefore explains the apparent gradual increase in signal strength of curve A (drawn also on Fig. 3 for comparison with the curve of aerial resistance), but the well-defined drop of voltage from seven o'clock precisely until 7.53 p.m. was due to energy absorption by a neighbouring aerial. The tuning of a near-by aerial lower and smaller than the one in use has been shown by the present author[1] to effect a considerable reduction of signal strength, and, in the present case, a sudden drop of 5 per cent. occurred at the moment of opening the earthing switch of an already tuned and adjusted crystal receiver. The sudden fluctuations between seven o'clock and 7.5 p.m. indicated a catwhisker adjustment of the interfering receiver—rises due to insensitive low-resistance crystal contact and falls due to complete catwhisker release from the crystal. The effect of this absorption is shown as an increase of effective resistance in curve D (Fig. 3), and at 7.53 p.m., when the interfering aerial was earthed (and its impedance therefore tremendously increased), the signal strength was suddenly increased corresponding with a sharp decrease in aerial resistance.

[1] *The Wireless World*, June 3rd and 10th, 1925.

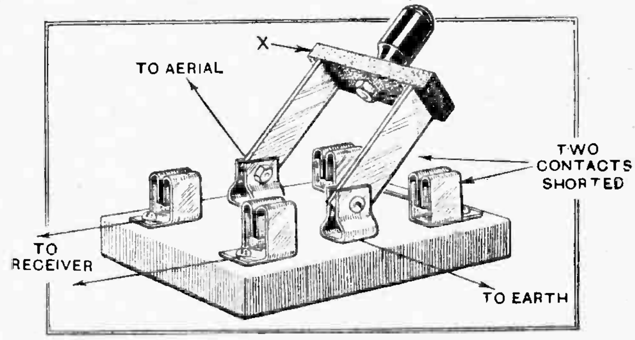


Fig. 5.—The effective aerial circuit resistance is frequently increased by poor insulation at X due to accumulation of dirt or moisture in the fibre when the switch is exposed to the weather.

The Correction of the Signal Strength Curve.

Having ascertained to what causes the local variations were due, and having plotted the curve of effective aerial resistance variations, corrections were applied to curve A of *apparent* signal strength by multiplying the voltmeter reading at any instant by the ratio of augmented effective resistance at that instant to the normal (lowest experienced) value of aerial resistance. This gave the voltage that would have been obtained across the aerial tuning inductance had the effective resistance of the complete aerial circuit not been augmented by any means, but remained constant throughout the test at its normal value of 36.5 ohms, and the resulting curve is therefore a true criterion of field strength fluctuation in the neighbourhood of the receiving station.

It is, perhaps, interesting to note that in dry weather, when the insulation remained constant throughout the day of the test, and when local interference was known to be absent, curve E, Fig. 4, of actual resonance volts was obtained. This curve is typical of many obtained under perfect conditions, and has a mean value only 1 per cent. different from that of the corrected curve of Fig. 2.

Curve F of Fig. 4 is typical of signal strength curves obtained from 5XX, 75 miles distant, the maximum variation being ± 3 per cent. The constancy of field strength from a transmission at this distance is largely due, of course, to the much longer wavelength employed.

Short-period variations of signal voltage, of course, occur, due to excessive

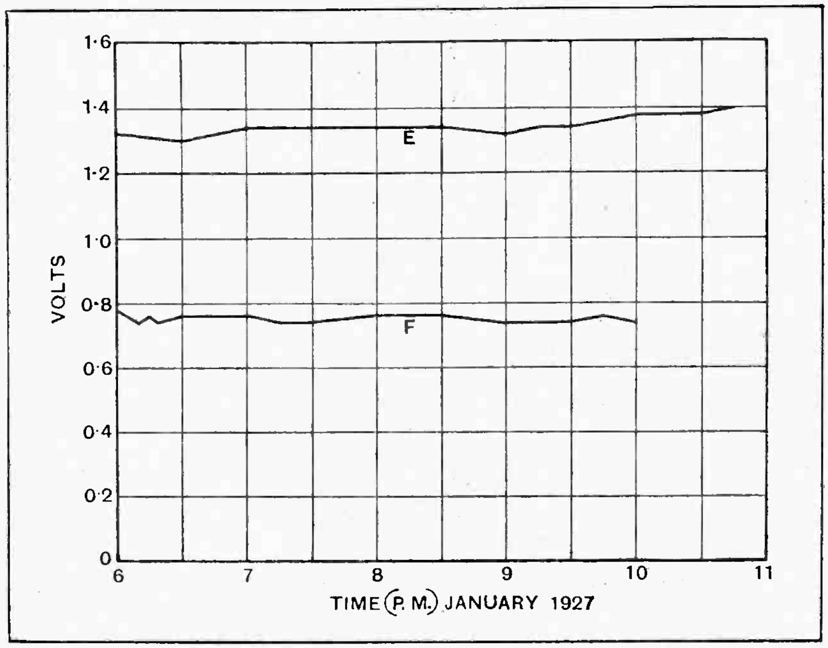


Fig. 4.—Curve E: Variations of signal strength from 2LO in dry weather without interference from adjacent aerial. Curve F: Signal strength curve for 5XX at 75 miles.

The Constancy of B.B.C. Transmissions.—
modulation, and these should not be taken into account. For this reason the modulation should be observed during tests of this kind by coupling a rectifying circuit with telephone receiver sufficiently loosely to the aerial inductance so that no change of voltage is detected due to its proximity—this is best accomplished by using a semi-aperiodic coil, of very high inductance, far removed from L.

If the moving coil instrument of the thermionic voltmeter is sufficiently (excessively) damped it will not indicate these sharp over-modulation variations, and if, on the other hand, the moving system is inclined to excessive "over-swing" they will be much exaggerated.

Conclusion.

In conclusion the author would emphasise the importance of using the D.C. insulation resistance variation of the aerial as an indication of the changes of total dielectric loss at radio-frequencies. There is one fault common to many aerials that may be traced in this way—the losses which occur in *outside* earthing switches of the double-pole change-over type usually mounted on porcelain bases, as sketched in Fig. 5. The porcelain base is glazed, and so causes very little trouble, even in wet weather, but the insulating piece, X, which bridges the two switch blades is usually of fibre, and when this becomes damp when dirty it is a source of loss by no means inconsiderable.

In one case of the writer's experience, although the D.C. insulation of the aerial system was only increased from 5 megohms to 13 megohms by the removal of this bridge piece, the effective resistance of the aerial was decreased by 3.5 ohms, which was equivalent to a pure shunt resistance of only 2.2×10^5 ohms across a reactance of 880 ohms, the wavelength being that of 2LO.

TRANSMITTERS' NOTES AND QUERIES.

Reception in India.
Mr. R. J. Drudge-Coates (AI DCR), Rawalpindi, gives his experiences on reception of European signals. He states that on 45 metres they are just audible at about 1830 G.M.T., and are best from about 2000 to 2400 G.M.T., fading out with daylight at 0030. On 32 metres signals are good from 1430 to 0030 G.M.T., and their strength is better than on 45 metres. U.S.A. signals come in well after 2300 G.M.T.

Mr. Drudge-Coates also tells us of an interesting low-power test with the American yacht *Warrior* (KFSX), then at Colombo, a distance of 1,700 miles from Rawalpindi. The H.T. of his receiver was keyed, and a transmission made on 39.8 metres. Signals were reported by KFSX as R2. steady. The receiver was an 0-v-1 Reinartz using 75 volts to V24 valves.

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Short-wave Transmissions.
The American station 2XAF, operated by the General Electric Co. at Schenectady, New York, will transmit regularly on Thursdays from 6.0 p.m. to midnight E.S.T. (23.00-05.00 G.M.T.) in addition to its present transmissions on Tuesdays at 6.0 p.m. and on Saturdays at 6.30 p.m. E.S.T. The wavelength is 32.77 metres, and the station transmits the same programme as WGY.

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2XG is also transmitting telephony tests on 15 metres at about 2.0 p.m. on most days.

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Another experimental short-wave station of interest to amateurs is PCJJ, owned by the Phillips Lamp Works in Holland, which is working on 30.2 metres. We understand that this station has recently been heard in Sydney. This is claimed as a record distance for short-wave broadcasting.

The station was also clearly heard in the Dutch East Indies, Dutch West Indies, and South Africa.

A regular broadcasting programme is now being transmitted on Mondays from 1800 to 2300, Tuesdays from 2000 to 2400, Wednesdays and Thursdays from 1500 to 2300, and on Fridays from 1800 to 2300, G.M.T.

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Mr. Gerald Marcuse (G 2NM), Queen's Park, Caterham, will be conducting telephony tests on 90 metres every Sunday at 14.30 and 18.30 G.M.T., commencing with 1.5 watts input to aerial and gradually increasing the power. He will welcome and acknowledge all reports.

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Mr. T. Woodhouse (G 6IO), 31, Tresco Road, S.E.15, will welcome the co-operation of any provincial experimenter who may still be working on the 150-200 metre waveband. He and Mr. E. T. Pethers (G 6QC), 3, Conley Street, East Greenwich, S.E.10, are transmitting on this waveband on Mondays, Wednesdays, and Fridays, after 2300 G.M.T., and will be glad of any reports from listeners.

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QSL Cards for Belgian Amateurs.
We are asked by the Reseau Belge to state that QSL cards for amateur transmitters in Belgium should be addressed to their headquarters at 11, Rue du Congrès, Brussels, and not to 88, Bould, Lambermont, as stated in our issue of April 6th.

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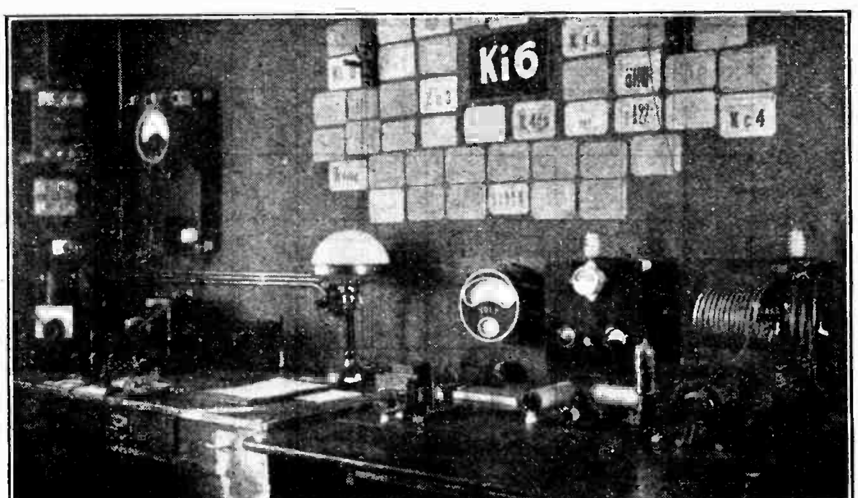
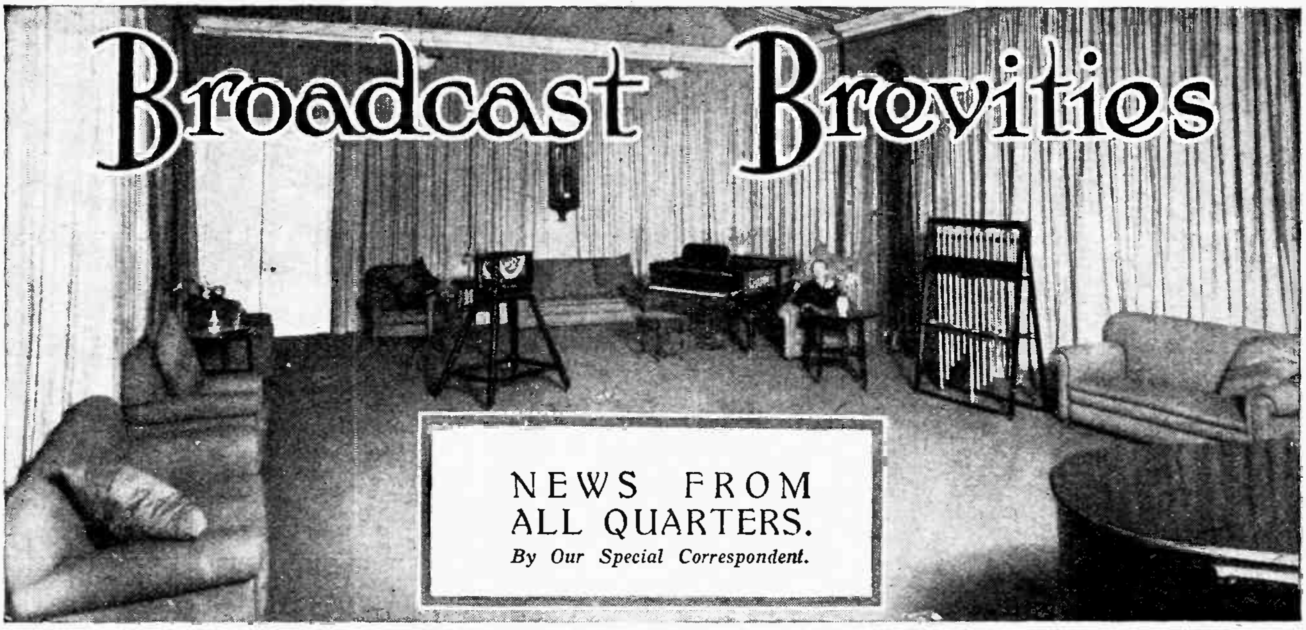
New Call Signs Allotted and Stations Identified.

G 5KH	R. H. P. Collings, 144, West Hill, Putney, S.W.
2BAS	K. C. Wilkinson, Jnr., 133, Half Moon Lane, Herne Hill, S.E.24. (This call-sign was given incorrectly in our issue of March 16th, as 2BHS).
AI 2KW	L. E. W. Jones, "A" Corps Signals, Karachi, India.



A GERMAN TRANSMITTER. The amateur station EK 4AEO, formally operated under the call-sign K 16, which is owned by Herr Karl Kerger, in Hamburg, and situated on the roof of an eight-story building. The transmitter has an input of 50 watts to a Hartley circuit giving .6 amp. in the aerial and the wavelength used is 39 metres.

Broadcast Brevities



NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Wavelength and Power Tests.—New Long-wave Stations.—Future of the Queen's Hall.—Noise from Trams.—German Broadcasting Handbook.—Coming Events.

The King at Cardiff.

The King's Speech at the formal opening of the National Museum of Wales on April 21 will be broadcast from Cardiff and relayed to Daventry. Other stations of the B.B.C. will pick up the Daventry transmission by wireless link for re-broadcasting.

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Daventry and Son.

The interest shown in "Daventry Junior" has misled many listeners into supposing that the new station is now conducting its preliminary tests. This is not the case; it is Daventry Senior that has been busy with tests after the regular broadcast programmes have closed down. The tests are being conducted with various Continental stations, using the longer wavelengths, in pursuance of the mandate given to Capt. Eckersley by the International Broadcasting Bureau in Geneva last February to investigate the problem of the allocation of long wavelengths among European stations.

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5XX Testing.

The tests have been, and are still being, conducted between Daventry, Radio-Paris, Königswusterhausen, Rome, and Karlsborg, and the first series consisted of experiments with varying wavelengths keeping a constant separation of 10 kilocycles between each station and keeping the power constant. A second series of tests followed, in which the wavelengths were kept constant and the power varied.

The value of these experiments may be realised when it is recognised that there are already upwards of thirty broadcasting stations in Europe using wavelengths between 1,000 and 4,000 metres, which waveband can only accommodate comfortably about a dozen stations.

The problem is not, of course, so acute as in the case of the ordinary broadcasting waveband of 300 to 500 metres, but it is nevertheless one of considerable difficulty. Capt. Eckersley is not a man to be beaten in matters of this kind, and he is confident that a formula will be evolved which will enable mutual interference between long-wave stations to be avoided.

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New Station for Sweden.

Apropos these tests, I understand that the number of prospective long-wave stations continues to increase. Italy's new 1,600-2,000 metre Telefunken station is now testing on 5 kW.; Holland is talking of a 1,850-metre station near Amsterdam, and Motala, near Stockholm, has begun testing on 1,320 metres, although this is 16 metres longer than the official wavelength allotted by Geneva. This new Swedish station will relay the programmes from Karlsborg and, it is stated, will be the most powerful in Europe, with an input of 120 kW. in the generators and 40 kW. to the anodes of the oscillating valves.

The comparative strength of many European stations is often somewhat difficult to estimate, as in some cases the published figures give the output of the main generators, and in others the power absorbed by the valves. In the case of Daventry the power is, I believe, reckoned by the output of the transmitter.

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Queen's Hall Concerts.

The question of the future of the Queen's Hall is still under discussion, and I understand that Messrs. Chappell and

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FUTURE FEATURES.

Sunday, April 24th.

LONDON.—Military Band Concert.
CARDIFF.—"Emmaus," an Oratorio, by Sir Herbert Brewer.

Monday, April 25th.

LONDON.—Symphony Concert.
GLASGOW.—"The Lesson," a one act Radio Play founded on fact, by Morland Graham.
ABERDEEN.—Tchaikovsky Concert.

Tuesday, April 26th.

LONDON.—Military Band Concert.
BOURNEMOUTH.—Old Favourites.
ABERDEEN. — "Heart's Desire," Comic Opera in two acts, by Mabel Constanduros.
BELFAST. — "Madame Favart," Comic Opera (Offenbach).

Wednesday, April 27th.

LONDON.—Chamber Music.
MANCHESTER.—Choral Songs and Instrumental Interludes.

Thursday, April 28th.

LONDON.—Light Orchestral Concert.
GLASGOW.—Orchestral Concert.
BELFAST.—Symphony Concert.

Friday, April 29th.

LONDON.—"Romeo and Juliet."
MANCHESTER. — "The Burglar," Comedy in one act, by Margaret Cameron.

Saturday, April 30th.

BIRMINGHAM.—Popular Favourites.
MANCHESTER.—Concert by Prizewinners of Lytham-St. Anne's Musical Festival.

Co. and the B.B.C. have not yet come to terms over the suggestion that the latter should in future carry on the good work which Messrs. Chappell feel reluctantly compelled to relinquish, and continue those much appreciated concerts which have become almost a necessity to music-loving Londoners.

In a recently published letter in the daily Press Messrs. Chappell assure us of their intention of continuing the Queen's Hall concerts, but leave us in doubt as to whether these intentions refer only to the symphony concerts or if the "proms" are also included.

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"The Wandering Jew."

A full-sized broadcast programme of "The Wandering Jew" is to be given during the Whitsuntide week with Mr. Matheson Lang in his original part as "Matathias," which many of us will recollect when so ably played by him at the New Theatre in 1920. I understand that he will be supported by an exceptionally strong cast, and we may look forward to an entertainment which will enthral alike those who have seen the play and those to whom it is new.

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Tramway Interference.

I referred a week or two ago to the system adopted in Vienna to cope with the interference caused to listeners through noises caused by leakages or other defects—from their point of view—in the electric tramway system. This interference does not appear to be confined to Austria, as I hear that a petition has been signed by listeners in Reading asking if the town council can do anything to abate similar interference from the tramway system in that town.

I also hear of complaints from Bath, Bristol, Norwich, Ipswich, Leeds, Burnley, Bradford, Rotherham, Purley, and many other places. The B.B.C. is always ready and willing to follow up such matters immediately, and in many cases the mere replacing of a defective insulator has been sufficient to overcome the trouble. It is feared, however, that all municipal and other electric traction corporations do not always take the interest in the listeners' comfort that they might reasonably do without very much trouble and expense.

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Another Royal Broadcast.

The speeches following the annual dinner of the Royal Academy should prove of exceptional interest when broadcast on the evening of April 30th.

The president, Sir Frank Dicksee, will on that occasion propose the health of the Academicians' guest, H.R.H. Prince Henry, and I feel sure that few listeners will willingly miss either this speech or the Royal reply.

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A Curious Contretemps.

Many of those who were enjoying Miss Alice Moxon's singing, relayed from the Grand Hotel, Eastbourne, on Sunday, April 10th, were surprised when the melodious strains faded out and were replaced by a masculine voice calling "Say when." The explanation of this unexpected interlude was due, I understand, to a slight defect in the transmission line which necessitated a rapid change over. These minor mishaps are not unknown to the B.B.C. engineers, but as a general rule the actual changing over can be staved off until the interval between two items. On this occasion the engineer whose voice broke in upon the flowing melodies was not aware that the microphone was still in action on that particular circuit. Misunderstandings will occasionally happen even in the best regulated undertakings, and, anyhow, the interruption was not long enough to cause any serious inconvenience except, perhaps, to the telephone staff of the B.B.C., who were kept busy for a time in satisfying frenzied enquiries, "What they were after."

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A Useful Handbook.

I have received from Germany a useful little guide to the broadcasting stations of the world, printed in English, French and German. The contents include the names, call-signs, wavelengths and power of every public broadcasting station, with an additional table giving fuller particulars of those in Europe, and a map showing their geographical positions.

A brief note gives the times and code used in the transmission of time signals from Nauen and the difference of standard times in various European zones compared with G.M.T. Another useful adjunct is the International Morse code of letters, figures, and punctuation marks. The booklet may be obtained from Messrs. Stern-Druckerei, of Magdeburg, and the price is 1 mark.

A Treat Postponed.

Owing to indisposition, Miss Fay Marbé, whose broadcast was announced last week would take place on April 18th, has been obliged to postpone her first appearance before the microphone until April 30th.

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Travelling with a Xylophone.

The Musical Avalos, the novelty xylophone trio, will broadcast from Birmingham on April 21st, from Manchester on April 22nd, and from Cardiff on April 23rd. They are reputed to possess the largest xylophone in the world.

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A Quarrel Scene from Shakespeare.

Two duologues from Shakespeare are to be broadcast from Birmingham on April 25th. One is the quarrel scene from "Julius Cæsar," with Wortley Allen as Brutus and Stuart Vinden as Cassius, and the other is the wooing of Lady Anne from "Richard III.," with Stuart Vinden as Richard, Duke of Gloucester, and Molly Hall as Lady Anne. Stuart Vinden began his theatrical career at His Majesty's, London.

IN A RUSSIAN VILLAGE. Peasants at a village club near Taganrog listening to a broadcast concert. Towns and villages all over Russia are being rapidly equipped with receivers in order that the powerful stations now under erection may be heard in all parts of the country.

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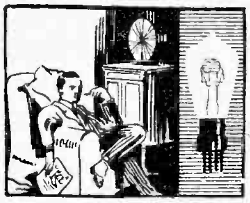
Pot Pourri.

"Scraps," a new radio revue, which is to be broadcast from 2LO on April 30th, will include the following sketch items:—"The Reformers," by A. P. Herbert; "Three Ways of Saying It," by Mabel Constanduros; "Cross Words," by R. Guy-Reeve; "Making the Pudding," by J. Melluish; "Wedding Quartette," by Herbert C. Sargent. The cast includes Harold Clemence, Alma Vane, Harold Kimberley, Florence Bayfield, Philip Wade and Mabel Constanduros.



NEWS FROM THE CLUBS.

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

Uncanny Electro-Mechanical Intelligence.

Major Raymond Phillips recently gave a lecture to the Croydon Wireless and Physical Society on "Wireless Control and Its Future," at which the Mayor of Croydon presided, and was supported by Mr. W. Thompson, B.A., B.Sc., president of the society.

An essential piece of apparatus used by Major Phillips was a special form of coherer which was unaffected by the explosions from a pistol which valves could not possibly have survived. Such a coherer had in fact been used without damage in connection with the firing of a six-inch gun.

Carrying a small transmitter, controlled by a Morse key, the lecturer walked about the auditorium and rang—singly or in chords—a row of bells on the stage.

With the same transmitter, from similar distances, the Major controlled perfectly two toy trains on circular rails laid on the stage. He started and stopped them at will, moved them backwards or forwards together, or in opposite directions. More surprising still was the control exercised by speaking through a special microphone. When the Mayor and Mr. W. Hussey, one of the members of the audience, simply said "Stop," the trains obeyed. "Back" saw them immediately begin to run backwards, and "Ahead" invariably produced forward movement. These three commands were instantly responded to. To control pure mechanism by only talking to it created a weird impression.

With the same portable transmitter a motor horn was sounded on the stage. The lecturer, by means of the transmitter, fired a revolver when fifteen yards or so away, and then readjusted the receiver so that, from the same distance, the revolver went off four times in rapid succession.

Visitors will be gladly welcomed to the meetings of the society, which are held at 128, George Street, Croydon. Particulars can be obtained from the Hon. Sec., Mr. H. T. P. Gee, of Staple House, 51, and 52, Chancery Lane, London, W.C.2.

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A Remote Control Demonstration.

The South Woodford and District Radio Society met on Monday, March 28th, at the Experimental Station, 5AR, worked by Mr. Ostermeyer, of South Woodford. The object of the meeting was to witness a demonstration of the distant control unit recently put on the market by the Lissen Co. The demonstration showed that when worked on a filter circuit it was really the high tension current which ensured response from the relay. This relay switched on the filament of the valves in a room upstairs immediately the loud-speaker on the ground floor was connected to the circuit.

Mr. Ostermeyer, who is a short-wave enthusiast, owns a very neat transmitting station, and is the fortunate possessor of an American Synchrophase receiver, which was also demonstrated to the club upon this occasion. This instrument confirmed the fact that several Continental transmissions are still suffering from heterodyne, including Langenberg (Cologne).

After the demonstration there was discussion on mast erection, the switching on and off of current, and aerial screening.

Hon. Secretary: Mr. E. J. Turbyfield, F.L.A.A., 42, Alexandra Road, South Woodford, Essex. Meetings at 8 p.m. weekly

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 20th.

Edinburgh and District Radio Society.—117, *George Street, Edinburgh. "Some Methods of Measuring Signal Strength at Application," by J. B. Davidson. At 8 p.m.*

THURSDAY, APRIL 21st.

Institution of Electrical Engineers.—Savoy Place, Victoria Embankment, London, W.C.2. Kelvin Lecture, "High-Frequency Currents," by Prof. G. W. Marchant, D.Sc. At 6 p.m.

Golders Green and Hendon Radio Society.—Willifield Way, Golders Green, N.W.11. "Principles and Prospects of Television" (with experiments), by Prof. J. Denton, A.M.I.E.E. At 8 p.m.

FRIDAY, APRIL 22nd.

Radio Society of Great Britain.—Informal Meeting. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place. W.C.2. Discussion on the coming Solar Eclipse.

MONDAY, APRIL 25th.

Northampton and District Radio Society.—At the Cosmo Café. "The Tropakronkë," by Dr. D. D. S. Stewart. At 8 p.m.

WEDNESDAY, APRIL 27th.

Radio Society of Great Britain.—At 6 p.m. (tea at 5.30.). At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture and Demonstration: "The Internal Action of the Thermionic Valve," by Mr. A. C. Bartlett.

An Energetic Society.

Another well-attended meeting of the Lancaster Storey Institute Students' Association Wireless Club took place on Wednesday, March 30th. After the minutes had been read the Secretary gave his report, and commented on the wireless debate held on March 12th, which was attended by over forty students.

The report was followed by a few remarks by the Morse instructor (Mr. R. Shenton), who spoke highly on the progress made by the few but very keen Morse students.

The Secretary then gave a short lecture on the simple principles of wireless transmission and reception; this was illustrated by blackboard diagrams. The lecture, which was followed by an earnest discussion amongst the members, eventually went back to the discovery of lodestone and the interesting laws of magnetism.

The various activities of the club now include:—Lectures, debates, demonstrations, Morse tuition, exchange mart, "radio" bulletin, construction classes.

Anyone interested in the above club should communicate with the Hon. Secretary, Mr. W. Salt, L.S.I.S.A., Lancaster Storey Institute Technical College, Lancaster (Wireless Section).

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Television Experiments.

The members of the Hounslow Wireless Society are deeply interested in television. At a meeting held on March 29th it was decided that those members interested and prepared to take part should act in collaboration and under the direction of Mr. Huntingford, who had kindly consented to superintend the experimental work; that the members should be provided each month with a report, and when possible a demonstration showing the progress made; that the apparatus possessed by the society should be available for experimental purposes as required.

The latter part of the evening was devoted to an examination of the specification of a television system as patented by Mr. Charles Baxter. Although members were impressed by the ingenuity of the invention, some doubt was felt as to the definition obtained by the system used when transmitting objects illuminated by ordinary light.

Hon. Secretary: Mr. W. R. Collis, 7, Algar Road, Isleworth.

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Wire Telephony.

The lecture given by Mr. E. Cross before the members of the Sheffield and District Wireless Society at the meeting on the 1st inst. was somewhat off the beaten track and dealt with the closely allied subject of wire telephony. The lecturer first described the use of repeaters for amplifying speech currents over long transmission lines, and showed how the use of the thermionic valve had provided a solution of this problem. The latter portion of the lecture was devoted to a description of the Sheffield automatic telephone installation, which has recently been successfully put into commission.

At the close of his lecture Mr. Cross announced that members would be enabled to see the plant in operation as he was arranging for a visit to one of the exchanges at an early date.

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

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Comfort in Coventry.

The Coventry Transmitters' Association are again active, after a lapse, owing to their loss of previous headquarters. They are now comfortably situated in the Ragged Schools, New Buildings, and would welcome any amateur transmitter visiting the city, on any alternate Tuesday upon which the meetings are held, to these headquarters, where they will find both lively discussions and Morse practice in progress.

Hon. Secretary: Mr. L. W. Gardner, 10, Ludlow Road, Coventry.

A Regular Field Day.

Material enough for half a dozen lectures was used by Mr. H. Saville (6HS) at his demonstration before the Stretford and District Radio Society on Thursday, March 24th. He began by using the Loewe triple valve, which contains most of the elements for making a complete three-valve resistance-coupled set; in fact, the only other components used were a condenser and coil. Yet excellent loud-speaker reproduction was given from both Manchester and Daventry without the use of any reaction.

Next Mr. Saville demonstrated the new Marconi Osram K.L.1 valve, and as the club room is fitted with direct current, he converted the supply into alternating and successfully showed how simple it was to run a set from the mains direct.

The third item in his repertoire was an illustration of the direct broadcasting of gramophone records by means of electrical methods. The ordinary sound-box was discarded, and a headphone used in its place, the method being similar to that used by the B.B.C. for the transmission of gramophone records.

Among other pieces of apparatus explained to the members were an improved H.T. eliminator and a Trickle charger for accumulators, the latter being one of the Tantalum type, which was also used by Mr. Saville to show that a chemical rectifier would only pass current one way.

Finally, the lecturer took about a score of the party to his house for supper and to hear a demonstration of a coil-driven loud-speaker, the tone of which was very fine, especially on the bass notes, the only drawback, from the ordinary person's standpoint, being that considerable power was required to operate it.

Hon. Secretary: Mr. J. Chapman, 99, Cyprus Street, Stretford, Manchester.

Calls Heard.

Extracts from Readers' Logs.

Rawalpindi, India.

January-February, 1927.

England:—G 2DX, 2VR, 2KZ, 2CC, 2GY, 2RG, 2OD, 2LZ, 2XP, 2JY, 2QM, 5BY, 5HX, 5WQ, 5UW, 5DH, 5MA, 5FQ, 5UP, 5XY, 5VL, 5YV, 5LF, 5AD, 5GQ, 5TZ ('phone), 6UZ, 6TA, 6BR, 6BD, 6ZM, 6YD. Scotland:—GC 2SR, 2WL, NW, 6KO, 6NW. Ireland:—GI, 5WD, 6MU ('phone), 6QD. Free State:—GW 11Z, 18B. Australia: A 2YJ, 2RT, 2MS, 2NO, 2YI, 2IJ, 2TM, 3HL, 3AT, 3DC, 3MY, 3OT, 3NB, 3VP, 3AL, 3BQ, 3PX, 4AN, 5KN, 5BG, 5HG, 5JA 5LF, 5AR, 6AG ('phone), 6SA, 6MU, 7DX, 7CW, 7LA, 7CS, 7BQ, 7IG. Belgium:—B 4RS, 4AR, K44, V33, B1. Denmark:—D 7MT, 7FJ, 7ZM, 7BX, 7BD, DNSC, DOXZ. France:—F 8EI, 8GI, 8UT, 8ZB, 8JJ, 8BP, 8GER, 8YOR, 8UDI. Germany:—K 4ADB, 4ADI, 4YAE, 4YAB, 4ACA, 4SAR. Holland:—N OPM, OQQ, OAF, PB7A, OAZ. Italy:—I 1CE, 1BW, 1NA, 1BD. Japan:—J 1PP, 1SR, KZB. Java:—EI PK1, PK9. Phillippines:—PI 1HR, 1BD, 3AC, 3AB, 7OU, WUCC, WUAJ. Russia:—R 1NN, 2WD, RCRL. Sweden:—SM, TN, UK, UV, VJ, RP, XR, YG, SKTR, SIC. South Africa:—O A3Z, A3A, A4L, A4Z, A5X, 1SR, K[illegible]. U.S.A.:—U 1AAO, 2ATH, 2CVJ, 6CKV, 8CAU, 9CPU, WIZ. Miscellaneous European:—BR 5AA, O HK, O HL, O KE, O TH, S 2NM, S 2ND, S 7ND, La 1E, La 4X, TPAI, IC SN1, CS 2YD, CS 2UN, GF3. Asia:—1DH, SS 2SE, JM 3AB, KFSX, KDGL, AE 1BK, FC 8EM, FI 8FOK, FI 1B, BN SK1, BN SK2, WUAT, ORA.

R. J. Drudge-Coates (AI-DCR).

(0-v-1) Reinartz.

Tunbridge Wells.

Feb. 20th to March 13th.

Australia:—A 2NO, 5KN. Belgium:—B B2, O5, V4, 4AU, K4. Brazil:—BZ 1AW, 1AC, 1AK, 1AR, 1AA, 1BW, 2AX, 1IB, SQ1, SPW, PTR. China:—BXY. Denmark:—D 7CY, 7WW, 7ZG, 7MK, 7DD, 7SS, 7EP, 7GN, 7CZ. Dutch Colonies:—PKP, PTS. Egypt:—SUC. France:—F 8OEO, 8EF, 8JN, 8DDH, 8JNC, 8DX, 8FIZ, 8AY, 8BRN, 8XIX, 8SM, 8YY, 8YA, 8KP, 8FF, 8PJN, 8CN, 8FP, 8FK, FW, OCLY, OCDJ, OCRU, FUT. Finland:—S 2CO, 1DO, 2NM. Great Britain:—G 2AY, 2WJ, 2LZ, 2RG, 2WN, 5OY, 5PM, 5HZ, 5DH, 5MA, 5ZA, 5JW, 5IV, 5UW, 5TR, 5LB, 5KH, 6WG, 6LR, 6UT, 6FD, 6ZG, 6VC, 6WV, 6XG, 6RV, 6KO, 6QH, 6MS, GBM, GBK. Germany:—K 44, 4ABR, 4AEU, 4RL, 4ABF, 4YT, 4DBA, 4KBL, 4XR, 4SA, 4DKA, AGB, AGC. Holland:—N 0UC, 0NF, PCA, PCMM. India:—AI DCR. Indo-China:—AF HVA, 1B, HNN. Italy:—I 1DR, 1CY, 1DO, 1SL, 1DO, 1DM. Irish Free State:—GW 3XC, 3ZZ. Japan:—JES. Java:—ANE, AND, ANF. Luxemburg:—L 1SE. Morocco:—FM 8AFA, 8RIT, 8JO, 8ST, 8PMR. Northern Ireland:—GI 5MO, 5NJ, 6MU, 6MV. Norway:—LA 1X, LA1, 1AD, 1A, 1SE. Portugal:—P 1AE, 1AF. Sweden:—SMUK, SMRV, SMZN, SMYU, SMVR, SMUA. South Africa:—O A4X, A3X, A4Z, A3Z. Spain:—EARI. Tunis:—OCTU. United States:—U 2TP, 8DF, 8EX, 1IC, 1AJM, 1ALR, 8AJ, 1KP, 2XAF, 8DON, 1CDP, 3CKL, 2PZ, 1VB, 1ID, 1CMF, 1AUR, 2CVR, 3BSH, 1AGR, WIK, WIZ. Miscellaneous:—PK9, VZDO, 1XR, BIH, LP1, 9XE, BG 2XT, SJM, 9SJ, AP4, GBH.

W. H. Allen.

(0-v-1 Schnell) on 20 to 50 metres.

Wakefield, Mass., U.S.A.

Great Britain:—G 2CC, 2IT, 2KG, 2JP, 2NH, 2NM, 2RG, 2ASW, 2XY, 5AD, 5BA, 5BY, 5DH, 5HX, 5KU, 5NW, 5OA, 5RH, 5UW, 5YA, 5YX, 6BP, 6FA, 6HZ, 6LR, 6RY, 6WV, 6YO, 6YP, 6YQ.

U 1AGS, per H. D. Prince (G 6HP), 12, Hillcrest Road, Sydenham.

Hampton, Middlesex.

February.

Great Britain:—G 2AO, 2AY, 2CC, 2RK, 2UN, 2VG, 2VS, 2WJ, 2XO, 5FQ, 5GQ, 5HK, 5HX, 5JG, 5KH, 6FD, 6FT, 6FZ, 6IA, 6IZ, 6KK. Northern Ireland:—GI 2IT, 5MO, 5WD, 6MU, 6QD, 6WG, 6YW. Irish Free State:—GW 11B, 11Y, 13C, 14B, 3AG, 3XC. Belgium:—B BE9, K44, K3, 4AR, P7, 4RS, K6, 4UU, B1, 3XX, Z1, 7EC, O5, H5, S5, D2, O8, 4QQ, 4XS. Canada:—C 1AD, 1AR, 1DM, 2FO. Denmark:—D 7NI, 7JO, 7FJ, 7ZM, 7CH. Spain:—EAR 6, 18, 28, 44, 52. France:—F 8TRV, 8UDI, 8GZ, 8SSW, 8KZ, 8CP, 8ARO, 8LZ, 8HIP, 8SST, 8OLO, 8VVD, 8ABC, 4BM, 8IU, 8BRI, 8YA, 8SIT, 8LB, 8FLM. Italy:—I 1AY, 1CE, 1DI, 1UU. Germany:—K 4XU, 4SA, 4AFK, 4AAP, 4ABF, 4GD, 4AEY, 4RM, 4UAO, 4DBA, 4DKA, 4SMR, 4QJ, 4XB, 4WM, 4KA. Norway:—LA 1R. Holland:—N 0NM, 0PM, 2PZ, 0CX, 0ST, 0WJ, 0WF, 0LY, 0WM. Austria:—O JZ, HK. Portugal:—P 1AW, 3FZ. Sweden:—SM UV, UK, WR. Finland:—S 7NB, 1ND. Yugo-Slavia:—YS 7DD, 7WW. U.S.A.:—U 1YB, 1AHU, 1ASU, 1AGA, 1FN, 1LX, 1AJF, 1BBM, 1AKR, 1AYX, 1ACU, 1VW, 1AUR, 1ASA, 1AAP, 1ATG, 1NV, 1QC, 1BDB, 2AHE, 2DH, 2AUL, 2SZ, 2CDR, 2HS, 2PV, 3AHL, 3LAR, 3BQJ, 4DD, 4KR, 5JF, 8YOR, 8DCM, 8RP, 8ABG, 8AF, 8AMU, 9DR. Various:—FN 8PMR, 8RIT, 8SSR, 8VX, 8AY, 0HA, WIZ, WIR, WIK, PCMM, PX1, ET 2XA, ICU, TMU, ER 5AA, SGT, SUC.

(0-v-1). On 40 to 200 metres.

A. F. Elton Bott.

The Editor's Mail

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.

SHORT-WAVE TRANSMISSION ROUND THE EARTH.

Sir,—In your issue of March 23rd, on page 356, there is a brief note referring to the experiments recently made in Berlin to determine the time taken for a signal to travel round the world. From this time the length of path is calculated, and thus the height at which the wave has travelled, is deduced. The results obtained give a height which your Berlin correspondent gives as 350 kilometres, but which Herr Quäck, of the Telefunken Company, states to be 182 kilometres. Now these results are based on the assumption that the waves travel with the velocity of light *in vacuo,* but since the waves travel in an ionised medium they have a phase velocity higher and a group velocity lower than the velocity of light. Since the waves travel around the earth their phase velocity can be estimated, and from it the group velocity. Making this very necessary correction, the German observations are consistent with a height of about 90 kilometres, which agrees very well with the height deduced from other experiments. I had already written an article discussing this point in detail, which article will appear in the May number of *Experimental Wireless*—when the note in *The Wireless World* suggested the advisability of pointing out at once that the height of several hundred kilometres for the ionised layer was the result of a false assumption.

G. W. O. HOWE.

Glasgow, March 26th, 1927.

STAND-BY TRANSMITTER TESTS.

Sir,—Your leading article in the issue of March 23rd, which summarised the opinions expressed in your correspondence columns has, I observe, elicited an explanation of the Broadcasting Corporation's policy from the chief engineer.

As the writer of a letter dealing more with the high power question than the other matter, may I say that not only is Captain Eckersley's letter a justly deserved compliment to the activities of *The Wireless World,* but it also illustrates both the efficiency of his department and the genuine interest in listeners' welfare displayed by the gallant Captain. Rather than maintain the official aloofness which only too often characterises the work of a Government Department, this branch of the Corporation evidently is alive to the value of the technical Press in forming a definite future policy. Such co-operation augurs well for the development of the British broadcasting system.

While sharing the fears of your Journal as to the overwhelming local power of these contemplated stations, it would, perhaps, be as well to withhold our criticisms until they may be wanted.

I may say that in the course of correspondence with the B.B.C. on the question of Morse interference and other matters I have found, especially with the chief engineer, an intelligent desire to help the listener, and genuine complaints have always brought very courteous acknowledgments.

In view of this friendly attitude, may I ask Captain Eckersley to enlighten us on a further important matter which concerns the late listener very much. Of late there has been greatly increased activity in testing from the London station and its auxiliary at Marconi House. On Mondays, Wednesdays, and Fridays, now, when 2LO is supposed to close down at 11 p.m., the programme is often extended until 11.15 p.m. or after. The responsibility for this naturally does not devolve on the engineer. For a half hour after this we are treated to piano solos, etc., as part of tests from 2LO, and this is closely followed by a shrill whistle, indicating the start of further tests by the stand-by transmitter. Twelve o'clock is quite a usual time for all this to finish, when I am enabled to listen without interference to the tail-end of a programme from Madrid or Barcelona. Both these transmissions are well worth hearing, but to go for them earlier necessitates the use of reaction to the detriment of quality. By reason of limited pockets there must be many readers who are in similar circumstances to mine, and who share my complaint.

It should here be emphasised that regular listening at very late hours never reveals a high-powered foreign station or its stand-by transmitter testing.

Precluding the discount, if any, of the value of daylight test, it would seem that the authorities abroad are not active in this direction. Although just praise must be given to the British stations for their small percentage breakdown periods, I am sure we should all appreciate some official assurance on this matter, which is important. In spite of Captain Eckersley's remarks, I think you will agree that first-class selectivity to be independent of any interference is still an expensive proposition.

A. F. CADDICK.

Croydon, March 30th, 1927.

DISTORTION IN RESISTANCE AMPLIFIERS.

Sir,—I have read with much interest the article by Baron Manfred von Ardenne on "Sources of Distortion in Resistance Amplifiers." The report shows theoretically and practically that the high-impedance, high voltage-factor valve introduces distortion due to :—

(a) Valve capacity shunting the anode resistance.

(b) Too small a coupling condenser at the low frequencies.

In order to reduce these forms of distortion to inappreciable values it is obvious that the valve impedance must be kept small while retaining the voltage factor, the anode resistances can then be kept small so that the shunting due to valve capacity is considerably reduced, and finally larger coupling condensers and lower grid leaks can thus be used, thereby correcting considerably these causes of distortion at the lower frequencies.

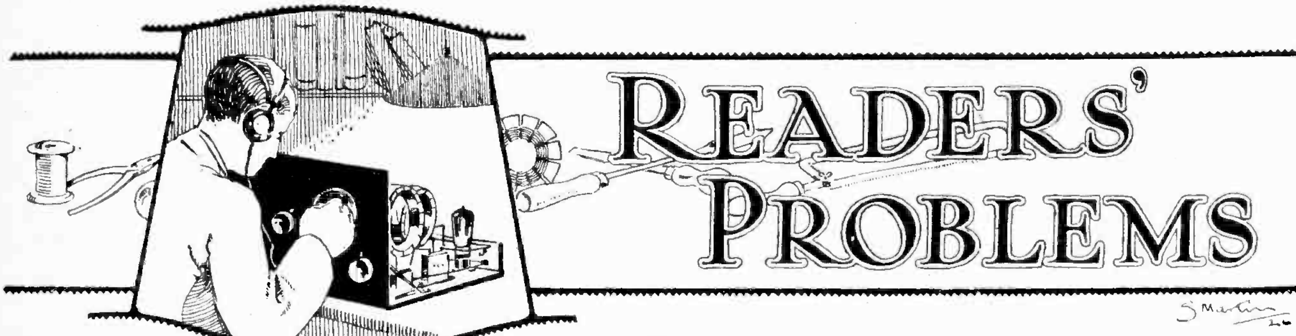
The Cosmos blue type valves with low impedances of 55,000-70,000 ohms are, therefore, a most decided advance in reducing the causes of distortion when used with the Cosmos resistance coupling unit having a low anode resistance and high coupling condenser value together with a normal value of grid leak of 5 megohms.

It is unfortunate that this article considered only the high-impedance valve, as the use of such a valve will tend to introduce these causes of distortion to a much greater degree. The advantages of lower impedance valves are only lightly referred to in Fig. 5 (3), where the frequency amplification curve is superior, but the particular valve used was of low voltage factor.

In conclusion the low-impedance high voltage-factor valve is the correcting factor in resistance amplifiers.

METROPOLITAN-VICKERS ELECTRICAL CO., LTD.,
Manchester. N. P. Hinton.

April 7th, 1927



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

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

The "Universal Three" Again.

I have had a "Universal Three" receiver in operation for a considerable time now with great success. I should like, however, to alter it so as to experiment with the Hartley circuit, as I understand that the Schnell circuit which this receiver uses can be readily converted to the Hartley circuit with the minimum of trouble. T. B. D.

This receiver, which was published in our issues of August 18th, 25th, and September 1st, 1926, was, of course, designed to tune from 20 to 20,000 metres, and, therefore, to cover practically all wavelengths and thus to be a really universal instrument. It can fortunately be converted to the Hartley circuit without in any way interfering with these great advantages. Referring to the diagram in Fig. 1, which we publish below, it is only necessary to remove the variable 0.0005 mfd. condenser marked reaction, and also to substitute in place of the 0.00005 fixed feed back condenser shown at the bottom of the diagram a variable condenser of somewhat similar capacity. Thus, the Gambrell "Neutrovernia," which has a minimum of 2 and a maximum of 40 micro-microfarads, would be entirely suitable, or, of course, any other neutralising condenser. Reaction is then controlled by this condenser.

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Resistance Capacity Values.

I propose to use a Cossor 2-volt R.C. valve as an anode bend detector, which is to be coupled to the L.F. amplifier by the resistance method. Please give me your opinion as to the best values of components. H. A. N.

From the point of view of high amplification combined with good quality, we doubt if you could better an anode resistance of 0.5 meghom, a coupling condenser of 0.005 mfd., and a leak of 3 meghoms. The capacity of the coupling condenser in conjunction with the leak resistance as specified will give an excellent pass-on of the lower audible frequencies, but the effects of occasional overload, if you allow them to take place, will be serious, and you could reduce the value of the coupling condenser to 0.002 mfd. without any noticeable falling off in the reproduction of the lower tones.

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Selectivity.

I should be greatly obliged if you would give me your advice with regard to the following problem. I am situated about one mile from the Glasgow station, and wish to build a receiving set which will cut it out and bring in as many of the Continental stations as possible. I am prepared to use up to five valves (two H.F. stages), but would much prefer to make up a four-valve set if this could be guaranteed to give the desired results. Taking the "Everyman Four," and the "Wireless World Five" sets, which do you recommend? A. P. N.

Without an intimate knowledge of local receiving conditions, it is always difficult to give a definite opinion on these matters. We do think, however, at the very short distance you mention, one could hardly expect a receiver with only two tuned circuits to give sufficient selectivity; and to be on the safe side we recommend the "Wireless World Five."

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H.T. Accumulator Troubles.

I have just tested my accumulator high tension battery, which is an old one, and find that several of the cells are "dead." As it seems to run down very quickly, I am wondering if it is the presence of high resistance in these cells which causes a quick discharge. Would it be advisable to have them replaced? H. H. C.

We think it is highly improbable that your "dead" cells have a high resistance, and even if they had, the presence of this resistance would tend rather to restrict the discharge of the other cells than to accelerate it. We do consider, however, that it would be highly desirable to have the faulty cells replaced.

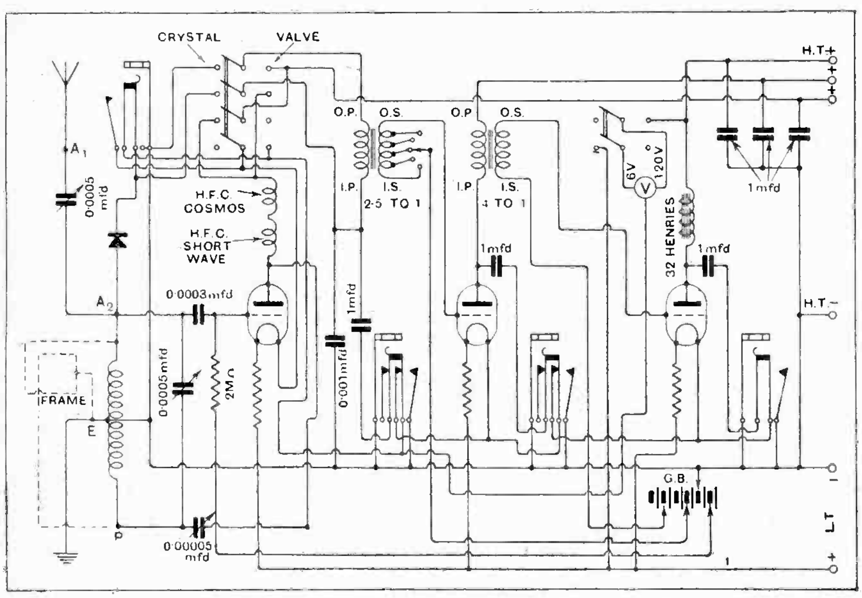

Fig. 1.—A universal Hartley receiver for all wavelengths.

A Correction.

I have obtained a copy of your "Everyman-Four" booklet, and am constructing the receiver described therein. There appears, however, to be a discrepancy between the instructions given on pages 8 and 9 for making the aerial-grid transformer and the illustration on page 10. In the former case, it would appear that the primary winding of this transformer is wound in the same direction as the secondary, namely, in a clockwise direction looking at the transformer from its bottom end, a tapping being made at the eighth turn. In the illustration, however, it would appear that the winding is commenced at the terminal marked A1, and wound on the same direction as the secondary as far as the tapping in the eighth turn marked A2, but at this tapping it would appear that the winding is reversed and finishes up by being wound in the opposite direction. It would appear to me that the illustration is wrong, and I should be glad if you would confirm this. J. O. H.

You are perfectly correct in your assumption that the illustration is wrong, and is unfortunately due to a draughtsman's error. A moment's thought will make it clear to you that with the primary winding reversed in this manner at its half-way point, the E.M.F. induced by signals coming down the aerial in the top half of the coil would be counteracted by the reversed E.M.F. set up across the lower half of the winding. In brief, the primary winding would possess negligible inductance, and there would scarcely be any coupling at all between primary and secondary, and in theory no signals should be heard, although doubtless due to stray couplings between the aerial lead-in, etc., a certain amount of signals would be heard due to the great sensitivity of this receiver. The winding then should be wound on from A1 to E in the same direction as the secondary winding.

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Canned Music.

I wish to build an amplifier suitable for amplifying gramophone music, and shall be glad if you will give me a simple and inexpensive circuit diagram. T. F. L.

We give in Fig. 2 the circuit diagram which you require. With regard to the pick-up device from your gramophone, you do not state exactly what method you propose to adopt for this. In many cases as you know, complete gramophone tone arms can be purchased with an ordinary type of microphone incorporated in the tone arm, except, of course, that the microphone is specially adapted to the needs of the gramophone. In other cases, readers have mounted the microphone directly in front of the loud-speaker horn, whilst still another section of experimenters have made use of one of the many microphone buttons which are upon the market for this purpose. The first of these methods can be recommended as being perfectly satisfactory for ordinary purposes. The second method also is quite good, but the third method is scarcely to be recommended owing to excessive microphonic noises. In any case, however, the input from your amplifier to the microphone must be made via a proper microphone transformer. Usually, it is best to purchase the transformer from the same firm as the microphone, or a complete tone arm should be obtained. Of course, in cases of emergency an intervalve transformer would give results in this position, but you should choose an instrument like the Marconiphone 8 to 1 rather than the Marconiphone 2.7 to 1.

The complete instrument can be used as an ordinary speech amplifier, or, of course, with the substitution of an intervalve transformer in place of the microphone transformer, the instrument can be used after a wireless receiver. We gave full details together with a circuit showing the necessary switching arrangement to throw over from wireless to local speech reproduction, the whole apparatus being very simple and inexpensive to make, on page 827 of our issue dated June 16th, 1926. Of course, where absolutely faithful reproduction of gramophone music is required, an electromagnetic pick-up device should be used, together with an amplifier such as was described in the special article published in our issue of January 26th, 1927.

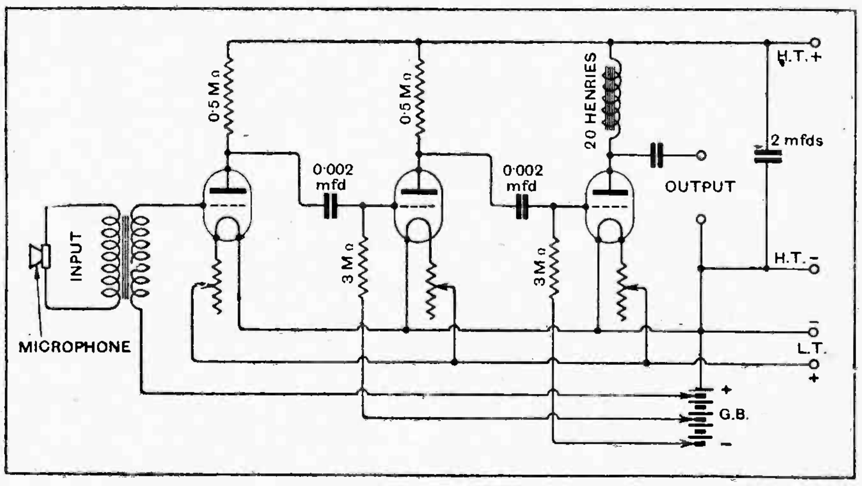

Fig. 2.—Connections of a speech amplifier.

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At the Back of Beyond.

I am at present in London, but shall shortly be returning to the Tierra del Fuego region, and am desirous of taking a wireless set with me. I do not wish to construct an instrument myself, but wish to take a commercial receiver, and should like your advice on this matter. R. C.

The nearest broadcasting stations to this desolate spot will probably be Valparaiso and Buenos Aires, and, since both these places will naturally be well outside the thousand-mile limit from your locality, it will be necessary for you to take the most sensitive receiver you can get. You will therefore need to take either a multi-valve straight H.F. set, such as the Marconi "Straight Eight," or a good super heterodyne, such as the Igranic "Neutrosonic Seven." We mention these two sets as being fairly representative of the two main classes of wireless receivers in this country, and there are, of course, a large number of sets in this country of equal merit. We think it would be as well for you to write round to the various big wireless firms, placing your requirements clearly before them, and arranging to have a demonstration of the particular receiver they recommend, and afterwards to make up your mind upon the matter. We presume that you will have facilities for charging accumulators. It will, of course, not be possible for you to receive the stations of the British Broadcasting Co., nor stations on the North American continent, except under very exceptional conditions, and then only by a very exceptional freak.

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An Obsolete Circuit.

In the early days of broadcasting I had a five-valve receiver with two neutralised tuned anode H.F. valves stabilised by means of a potentiometer, with a detector valve and two L.F. amplifiers. I have been abroad for the last two years, and before my departure disposed of this set. Before constructing a new one, your opinion as to whether the same circuit (which gave excellent results) is still to be recommended would be greatly appreciated. W. B. D.

It can be definitely stated that the circuit of your receiver is now quite obsolete, and we have no hesitation in saying that much greater amplification and better selectivity would be obtained from a single stage of modern H.F. amplification. If you care to write to us again, indicating your requirements more fully, we will recommend the most suitable of our recent designs.

A Phantom Fault.

I have recently built a loud-speaker very carefully in accordance with the instructions given in an article published by you in your issue of August 4th, 1926. I notice that this instrument appears very sensitive to distortion in the amplifier, a fault which is not found in two other horn type loud-speakers made by reputable firms which I possess. I do not claim by any means that my amplifier is of the best type for distortionless reproduction, and, in fact, am intending to reconstruct it, but my horn type loud-speakers appear to give less distortion than my home-made diaphram type. Yet curiously enough, on testing them on a friend's amplifier which is built according to the very latest ideas for distortionless reproduction my home-made loud-speaker sounds extremely pleasing, and my horn type ones give distinctly inferior results. On deliberately introducing distortion into my friend's amplifier, however, the falling off in quality in my home-made loud-speaker appears to be far greater than in the case of the horn type, and that is why I say my home-made instrument appears distinctly sensitive to distortion in the amplifier. I shall be extremely obliged if you will show me how to correct this trouble. K. O. F.

This symptom far from showing that your loud-speaker possesses any great fault, shows that you have built it better than you knew, and that you have constructed a very good instrument indeed. Naturally, of course, a really good loud-speaker should be sensitive to faults however slight in other parts of the receiver. Probably, indeed, the overall reproduction of your other two loud-speakers is so bad that any fault in the amplifier from the point of view of faithful reproduction is swallowed up in the vast sea of distortion produced by the loud-speakers, and, therefore, these loud-speakers sound no better if moved from a bad amplifier to an almost perfect one, but at the same time they show little or no diminution in quality if moved from an almost perfect amplifier to a thoroughly bad one without grid bias or power valves. You are advised, therefore, to leave your home-made instrument alone, and to rebuild your amplifier.

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A Periodicity Puzzle.

I am about to purchase an H.T. battery eliminator to work off my mains which are 240 volts 25 cycles, but most of the advertised instruments seem to be built for 40 to 60 cycles. I shall be glad if you can advise me in this matter. K. N. R.

Undoubtedly the greater number of A.C. electrical supplies systems in this country operate with 40 to 60 cycles periodicity, and this accounts for practically all the eliminators being made for this periodicity band. There are, however, some sources of supply having a much lower periodicity such as 25 as in your case, and some on the contrary, supply at a much higher periodicity, namely, 90 cycles. We understand that many of the larger manufacturers are prepared to quote special prices for battery eliminators of unusual frequencies or voltages, and we should advise you to make enquiry among them. Of course, the difficulty in a low periodicity supply is adequate smoothing, and at the same time readers have reported to us excellent results on 25 cycles even with standard eliminators designed mainly for 40 to 60 cycles. Eventually, of course, as you know, it is intended to abandon the use of D.C. in this country for domestic use, and to standardise all sources of supply at 220 volts A.C. 50 cycles periodicity, just as in America a standard of 110 volts 60 cycles is used. This naturally makes for much cheaper mass production of battery eliminators, and, indeed, of all electrical devices such as electric cookers, etc.

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Pitfalls of Anode Bend Rectification.

I am intending to build a four-valve set consisting of an H.F. valve and anode bend detector, and two stages of L.F. I wish to use two Marconiphone transformers in the L.F. amplifier which I have on hand, and I presume that this would be in order, and that I should use the 2.7 to 1 ratio instrument in the first stage, and the 4 to 1 instrument in the second stage, as you so frequently advise in transformer-coupled amplifiers. L. D. T.

In reality, of course, for best results using anode bend rectification, it is preferable to use one of the new type valves specially produced for this purpose followed by a very high anode resistance, say, 1 megohm in value. If you follow your anode bend rectifier with a 2.7 to 1 transformer which has an inductance, we understand, of 50 henries, you will not get very good reproduction, especially on the lower notes, because you must remember that the valve impedance, normally high, will be much higher still when used as an anode bend rectifier. You want, in fact, a much bigger inductance here, and we should advise that you connected the primary and secondary of your 4 to 1 transformer in series and use it as a choke in a choke coupled stage following the detector, and that you followed your first L.F. valve by the 2.7 to 1 instrument, using it as a normal transformer.

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When Bushes are Superfluous.

I am constructing the "Everyman Four" receiver, following the instructions given in your book on this receiver. I wish to know whether it would be possible for me to dispense with the ebonite panel and make use of a panel of three-ply wood. I also propose to use 2-volt valves throughout, and am contemplating actually the Mullard P.M.1 H.F. valve as H.F., detector, and first L.F., with a Mullard P.M.2 in the output stage. Will you state whether these valves would be in order? May I also use a stud switch to change the aerial from A_1 to A_2 or A_3 in the receiver, instead of providing separate terminals? R. H. F.

You can very well use the wooden panel in place of the ebonite one, and you need put no bushes on to insulate variable condensers, etc., since all parts which are in electrical contact with this panel are at earth potential with respect to oscillatory currents, and therefore no loss of efficiency will take place. With respect to D.C. currents of course, the low potential end of the variable condensers which are in electrical contact with the wooden panel are actually slightly above earth potential owing to the $1\frac{1}{2}$ volts grid battery in the case of C_1 and the fixed resister in the case of C_2, but, of course, this will not matter with respect to H.F. energy, and no leakage is likely to take place, and bushing would be superfluous. Were you using a metal panel, however, it must be remembered that in that case bushes would have to be fitted to both variable condensers in order to avoid directly short-circuiting the H.F. valve grid battery, and the resistance R_2, but these bushes, even in this case, need not be very large, as they only have to withstand a very small voltage. In the case of wood, therefore, you would be perfectly in order in using it without any extra bushes.

With regard to valves of the type you mention, we would suggest Mullard P.M.1H.F. in the H.F. position, a Mullard P.M.1A. as detector, a Mullard P.M.1L.F. in the first L.F. position, and a P.M.2 in the output position.

With regard to the latter part of your query, it is possible to use this stud switch without serious losses being introduced, as, of course, aerial losses are always fairly high in any case, and the slight additional loss which is bound to be caused in this manner will probably pass unnoticed. Still, if not done carefully, noticeable extra losses would be introduced, and on the whole we think you would find it better to avoid this.

The Wireless World

AND RADIO REVIEW
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Editor: HUGH S. POCOCK. Assistant Editor: F. H. HAYNES.

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EMPIRE BROADCASTING.

FOR the second time in the short history of broadcasting it has been left to Holland to steal a march on this country and, in fact, on Europe generally. It will be remembered that some long while before broadcasting here was introduced British amateurs were accustomed to listen to the Dutch broadcasting station at The Hague which, with the call-sign PCGG, sent out regular Sunday afternoon concerts, mainly for the benefit of listeners here. Now again Holland sets the example by leading the way in short-wave broadcasting. On the 15th of March the station PCJJ, established at the Philips Lamp Laboratories at Eindhoven, in Holland, communicated by wireless telephony with the Dutch station at Bandoeng, in the Dutch East Indies. The transmission was carried out on a wavelength of approximately 30 metres.

Heard in Australia.

Since that initial success fairly regular broadcasting has been conducted. Now, as we go to press, comes the announcement that the Sydney station, 2BL, has successfully rebroadcast one of the programmes. We congratulate Holland, and the Philips Company in particular, on the enterprise shown in establishing this broadcasting record, more especially so as the purpose is apparently to provide a means for long-distance broadcasting, and advantage has been taken of the peculiar suitability of the 30-metre wavelength.

Will Holland's Example be Followed?

It will be of interest to observe whether this example set by Holland will be followed by other countries in Europe. Personally, we should be sorry to see stations established in this country to work on wavelengths of that order unless ample notice were given, for the reason that comparatively few sets in the hands of the public would be capable of listening in to the transmissions. The only application which we can see at the moment for a short-wave broadcasting station in this country would be for the purpose of overseas communication, as we have previously suggested in these columns.

Not a B.B.C. Affair.

If such a station were erected it might quite possibly fall outside the scope of the British Broadcasting Corporation and come under the control of the Foreign Office and the Colonial Office.

An Opportunity Neglected.

It is a matter for regret that we should so far have neglected to take advantage of the wonderful opportunity which broadcasting provides for communication with the outlying sections of the Empire. When we know that wireless sets are being bought in places as far distant as India and Iraq, in the hope of being able to pick up the transmissions from Daventry once in a while for, perhaps, no more than a few minutes, we can form some idea of the enthusiasm which would be created if a short-wave British station were established in this country of sufficient power to be heard more or less consistently!

CONTENTS.

COMMERCIAL PICTURE TRANSMISSION

A Technical Description of the Methods and Apparatus Used in America.

By A. DINSDALE.

FROM time to time various systems of phototelegraphy have been described in this journal. Many of these have been purely experimental in character, but some of them have been practical and ready for commercial exploitation. Other countries are gradually taking up the commercialisation of picture transmission and making progress. In this country we have scientists who have developed entirely practical apparatus and methods, but no move is being made to exploit them commercially.

In America, where there is no Government monopoly of electrical communications, work on the commercialisation of picture transmission has been going on for some time, having been undertaken by the American Telephone and Telegraph Company and the Bell Telephone Laboratories, Inc. Complete success has attended these efforts, and seven "Telephotographic Stations," extending right across the United States, are now in regular daily commercial operation.

For the complete details of this extensive system, described in this article, we are indebted to the abovementioned companies.

The seven stations already in operation are Boston, New York, Cleveland, Chicago, Atlanta, San Francisco, and Los Angeles. An eighth station is under construction at St. Louis

Transmission Over Telephone Lines.

The system as at present established makes use of the wire transmission lines of the Bell telephone system, which cover the entire country. While the mechanism for the transmission of photographs over extensive distances has been primarily developed for use on these telephone lines, it has been demonstrated experimentally that it can be used to send pictures by wireless just as easily when atmospheric conditions are such that steadiness of transmission and freedom from interference prevail.

Fading and static are the greatest difficulties encountered when an attempt is made to transmit pictures over great distances by wireless, and these difficulties may easily cause interruptions in the service. The system to be described, therefore, was designed for wire transmission partly for this reason and partly for the reason that the principal business of the company which developed it is wire, and not wireless telephony, and it desired to put its wire system to a further use.

Another aspect of the problem is that although the broad principles of picture transmission have been well known for nearly fifty years, their reduction to successful practice required, among other things, the perfection of apparatus and methods for the faithful transmission of electrical signals over long distances, and these developments have become known to the communication art only within the last few years.

Prominent among these later developments which have facilitated picture transmission are the photoelectric cell, the thermionic valve amplifier, electrical filters, and the use of carrier currents.

Picture Transmission Apparatus.

Essentially, the process of transmitting a picture from one place to another electrically (*i.e.*, by wire or wireless) consists of three operations. First, there must be some means for translating the lights and shades of the picture into some characteristic form of electric current. Secondly, there must be a channel, wire or wireless, capable of transmitting the characteristic of the electric current faithfully (*i.e.*, without distortion) to the required distance. Finally, at the receiving end there must be some means for retranslating the received electrical signal into lights and shades, corresponding accurately in relative values and positions with those of the original picture.

Analysed for purposes of electrical transmission, a picture consists of a large number of tiny elements, and the transmission process necessitates some method of traversing or scanning these elements, which must be transmitted one at a time in a definite sequence.

The method used in the Bell system is to prepare the picture as a film transparency, which is bent round a glass cylinder. The cylinder is then mounted on a carriage, which is moved slowly along its axis at the same time that the film cylinder is rotated.

A tiny spot of light, focussed upon the film, is thus caused to traverse the entire picture area in a long spiral, like the needle of the old-fashioned phonograph. Within

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the cylinder is located a photoelectric cell, upon which the spot of light shines after passing through the film and the glass cylinder, and the degree of brilliancy which falls upon the cell at any given moment depends upon the density of the portion of the film through which the light is shining at that moment.

The arrangement of this apparatus is shown in Fig. 1. A photoelectric cell, as most readers probably know, is a device for transforming light impulses into electrical impulses. It is, unlike selenium, practically instantaneous in its response, but not so sensitive. It consists of a cathode of some alkali metal, such as potassium, sealed in a vacuum. When light shines upon the metal it emits electrons, *i.e.*, an electric current, just like the glowing filament of a receiving valve.

Assuming for the moment that the photoelectric current, which is a direct current of varying intensity, is of adequate strength for successful transmission, and that the transmission circuit is suitable for carrying direct current,

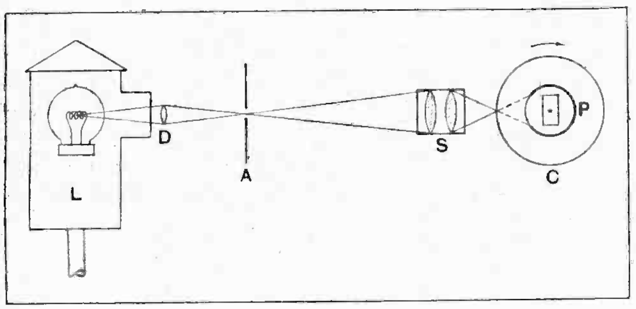

Fig. 1.—Sectional diagram of optical system at transmitting end. L, light source; D, condensing lens; A, diaphragm; S, projection lens; C, transparent picture film; P, photoelectric cell.

we will imagine that the output current from the photoelectric cell has traversed the transmission circuit and arrived at some distant point.

The "Light Valve."

At this distant point we require the third element mentioned above—means for translating the incoming electrical impulses into light and shade. This is accomplished in the system under discussion by means of apparatus illustrated diagrammatically in Fig. 2.

A source of light, L, is focussed on to a cylinder, C, which has wrapped round it a piece of unexposed photographic film, and which is rotated and moved axially exactly in step with the cylinder at the transmitting end.

Between the light source and the cylinder there is interposed a device known as a "light valve." This device, shown in detail in Fig. 3, is due in its general form to E. C. Wente. It consists essentially of a narrow ribbon-like conductor lying in a magnetic field in such a position as to cover entirely a small aperture.

The incoming current impulses pass through this ribbon, which is, in consequence, deflected to one side by the interaction between the polarising field and the field set up round the ribbon by the passage of the current through it, thus exposing the aperture beneath. Light passing through, or attempting to pass through, this aperture is thus varied in intensity in accordance with the extent of the displacement of the ribbon, which in turn

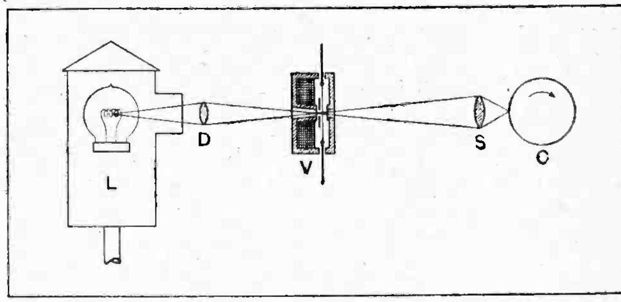

Fig. 2.—Optical system at receiving end. L, light source; D, condensing lens; V, light valve; S, projection lens; C, sensitive film.

depends upon the variations of the incoming electrical impulses, which represent values of light and shade in the original picture at the transmitter.

After passing through the aperture of the light valve, the beam of light falls upon the sensitive film bent round the cylinder, which rotates in exact synchronism with the one at the sending end, thus exposing the film to an extent which will vary in exact proportion to the lights and shades of the original picture.

Adapting the Scheme to Telephone Line Transmission.

In the simple outline of the scheme given above, nothing was said about the transmission ciruit, which in this case is the ordinary telephone line. Since this latter was developed primarily for a purpose other than picture transmission, the picture transmission apparatus must be adapted to suit existing line conditions.

As already stated, the output of the photoelectric cell at the sending station takes the form of a very weak

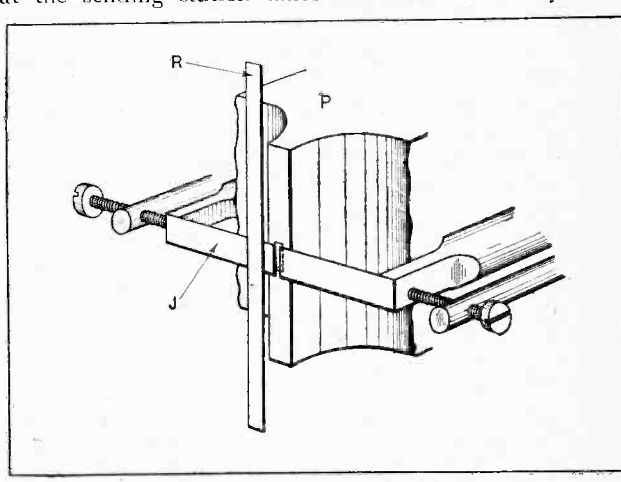

Fig. 3.—Details of light valve. R, ribbon carrying picture current; P, pole piece of magnet; J, jaws of aperture behind ribbon.

direct current of varying amplitude. The range of frequency components in this current varies from zero up to a few hundred cycles. Now, commercial long-distance telephone lines are not usually designed to transmit direct currents or very low-frequency currents, so the photoelectric currents cannot be directly transmitted.

In order to overcome these difficulties, therefore, the photoelectric currents are first amplified by means of low-frequency amplifiers, and then impressed upon a modu-

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lator valve jointly with a carrier wave having a frequency of about 1,300 cycles. What is actually transmitted over the telephone line, then, is the carrier wave modulated by the photoelectric current impulses, so that the line currents, in frequency range and amplitude, closely resemble the currents of ordinary speech, for which the circuit is designed.

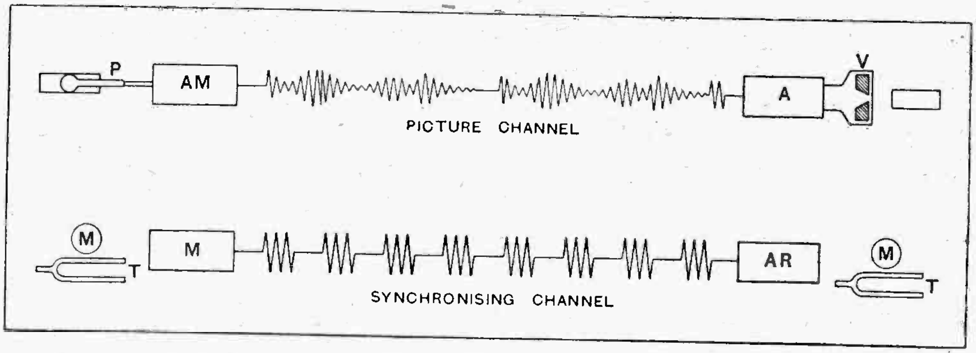

Fig. 4.—Diagrammatic representation of picture and synchronising currents. P, photoelectric cell; AM, amplifier-modulator; A, amplifier; V, light valve; M, phonic wheel motors; T, tuning forks; AR, amplifier-rectifier.

When the carrier current, modulated according to the lights and shades of the picture at the sending end, traverses the ribbon of the light valve at the receiving end, the aperture is opened and closed with each pulse of the alternating current. The envelope of these pulses follows the light and shade of the picture, but the actual course of the illumination with time shows a fine structure of the same periodicity as the carrier.

This effect is shown in the upper part of Fig. 4, marked "Picture Channel."

How Synchronism is Achieved.

It is fairly obvious that in order to ensure that the light and shade traced out on the receiving film shall reproduce an exact copy of the picture at the sending end of the circuit, it is essential that the cylinders at both ends rotate at exactly the same speed. Various methods of achieving this necessary synchronism of motion have been developed from time to time, but the method used in the Bell system consists of phonic wheel, or impulse motors, controlled by electrically operated tuning forks.

If it were possible for two forks at widely separated points to vibrate at exactly the same frequency, the problem of synchronisation would immediately be solved, but such an arrangement is not practical, for variations of speed occur with variations of temperature and other causes. If an attempt is made to control two cylinders by this method the received picture will, in general, be skewed with respect to the original.

In the present instance the difficulty was overcome by controlling the phonic wheel motors at each end by the same fork, and for this purpose it is necessary to transmit to the receiving end impulses controlled by the fork at the sending end. Thus two sets of impulses must be sent along the transmission line, viz., the picture impulses and the synchronisation impulses.

This could be achieved by using two separate transmission circuits, as shown in Fig. 4, but this is not economically practical, so the problem has been solved by impressing upon the transmission circuit a second carrier wave. This second wave has a frequency of about 400 cycles, and carries the synchronisation impulses.

Thus the line has two currents to carry, one of them (the picture carrier) having a frequency of 1,300 cycles, and the other (the synchronisation impulse carrier) having a frequency of 400 cycles. Both these frequencies are well within the frequency limits for which the long-distance telephone lines are designed, and they are far enough apart to be separated easily by means of electrical filters.

At the sending end a master fork controls the speed of the phonic wheel motor which drives the cylinder mechanism and at the same time impresses control impulses

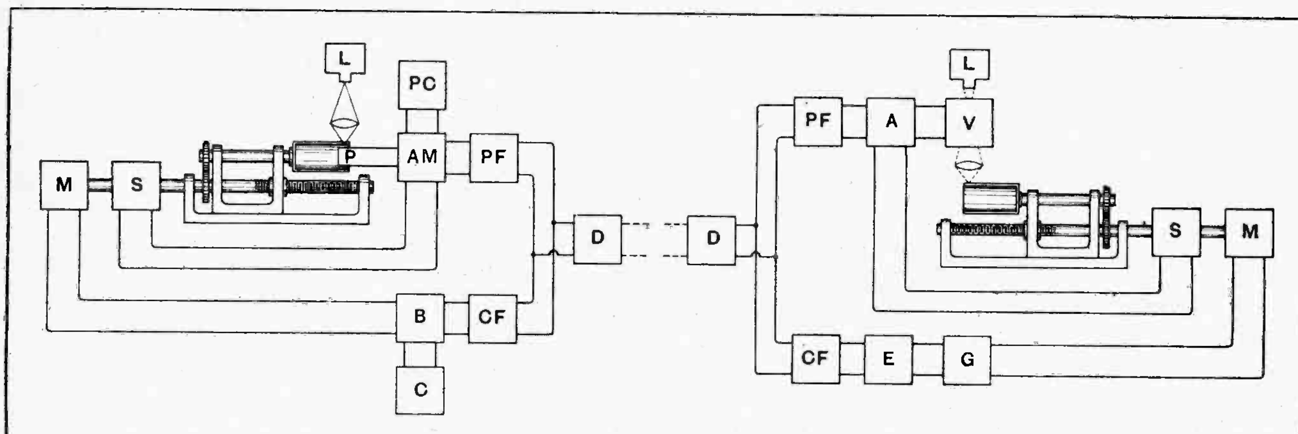

Fig. 5.—Layout of complete system. B, master fork; C, control carrier oscillator; CF, control channel filter; M, motor; S, starting mechanism; PC, picture carrier oscillator; PF, picture channel filter; AM, amplifier-modulator; L, lamp; P, photoelectric cell; V, light valve; A, amplifier; E, amplifier-rectifier; G, secondary fork; D, terminal amplifier.

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upon the control carrier wave. At the receiving end the control impulses, after being filtered and amplified, drive a secondary fork which controls the phonic wheel motor which drives the receiving cylinder.

The Electrical Circuits.

The mechanical and electrical arrangement of the whole system are shown diagrammatically in Fig. 5, in which the various elements previously described are shown in their proper relations to each other.

Certain portions of the electrical circuits are worthy of somewhat detailed description. One of these is the amplifier-modulator system for the picture channel, and

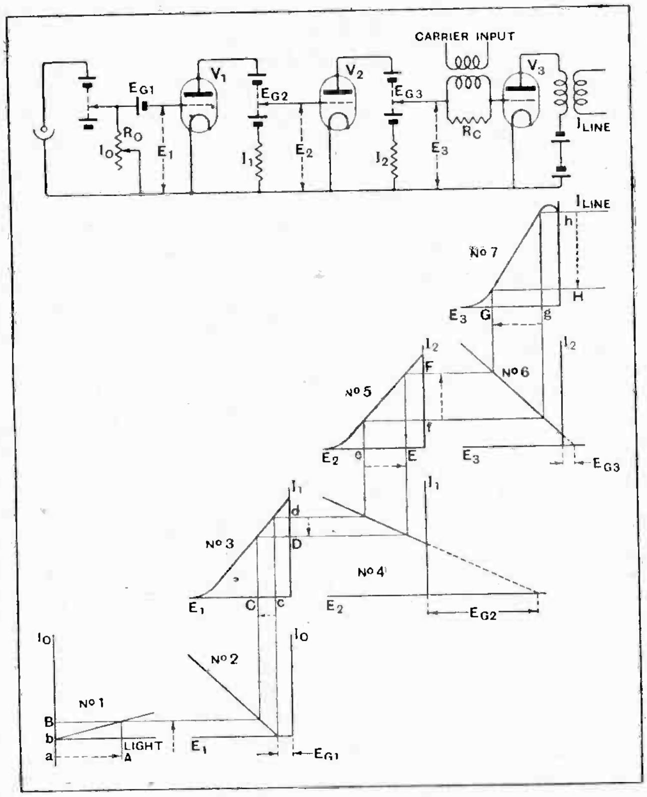

Fig. 6.—Schematic circuit diagram of amplifier–modulator with electrical characteristics of each element.

another is the filter system employed for separating the picture and synchronising channels.

In Fig. 6 (top) is shown a diagram of the D.C. amplifier and the modulator used for the picture channel, together with diagrams (bottom) showing the electrical characteristics of each element of the system.

At the extreme left is the photoelectric cell, the current from which passes through a high resistance. The potential tapped off this resistance, of the order of 30 or 40 millivolts, is applied to the grid of the first valve. The second valve is similarly coupled to the first, and the modulator valve follows in order.

The relationship between illumination and current in the photoelectric cell is shown in diagram No. 1, and is linear from the lowest to the highest values of illumination. The voltage-current (E versus I) characteristics of the amplifying valves and the modulating valve circuits are shown in the figure by the diagrams which lie immediately below these valves. They are not linear over the whole extent.

In order to preserve the linear characteristic, which is essential for faithful picture transmission, it becomes

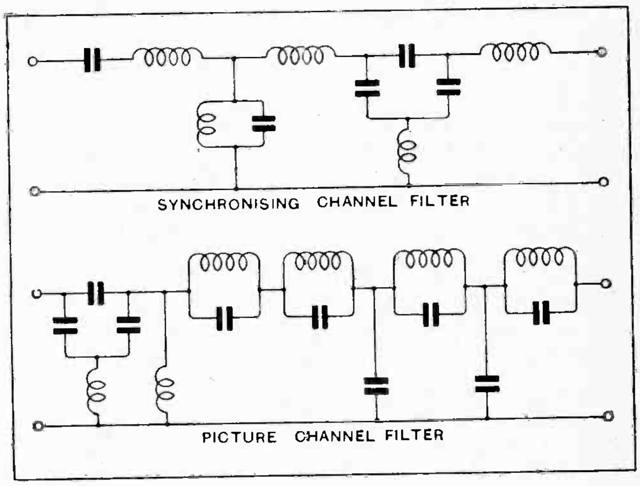

Fig. 7(a).—Schematic circuits of picture and synchronising channel filters.

necessary to locate the range of variation of current in each of the latter valves on a linear portion of their characteristic.

This is accomplished by appropriate biasing voltages (Eg), as shown. As a consequence of this method of utilising the straight portions of the valve characteristics, the current received at the distant end of the circuit does not vary between zero and a finite value, but between two finite values. This electrical bias is exactly matched in the light valve by a mechanical bias of the jaws of the valve opening—an ingenious arrangement.

In Fig. 7 (a) is shown diagrammatically the form of the band pass filters used for separating the picture and synchronising channels. The synchronising channel filter transmits a narrow band in the neighbourhood of 400 cycles, and the picture channel filter a band between 600 and 2,500 cycles.

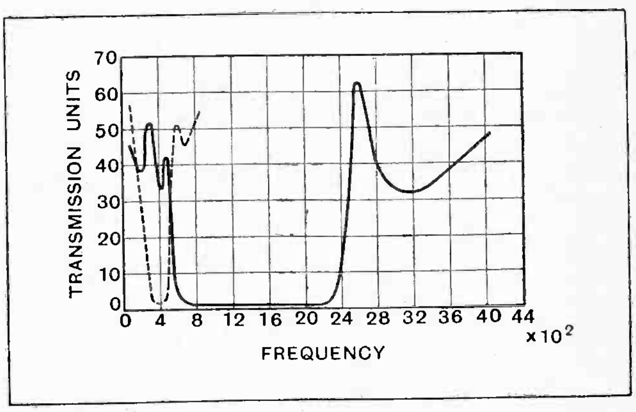

Fig. 7(b).—Attenuation characteristics of picture (full line) and synchronising (dotted line) channel filters.

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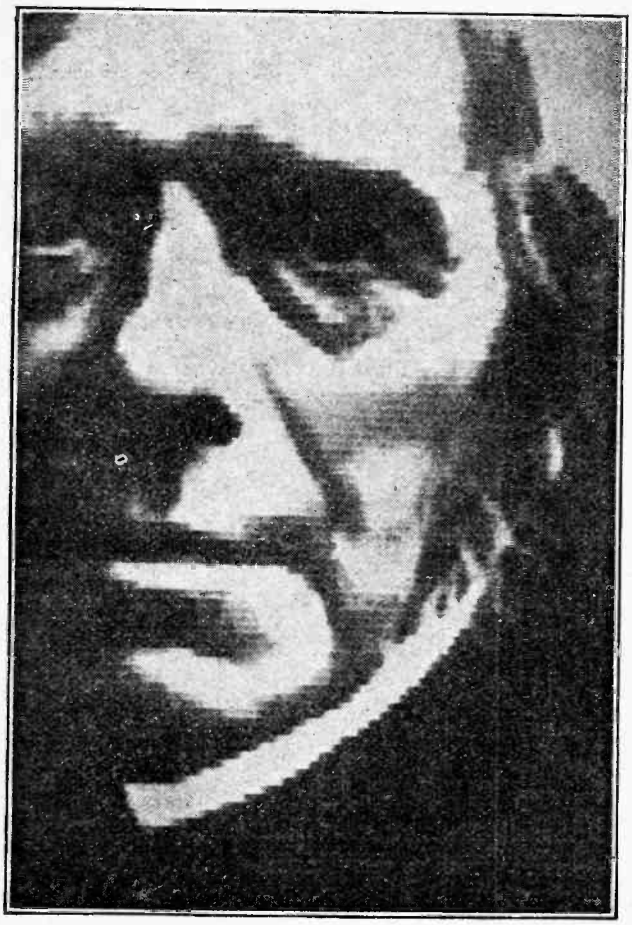
In addition to these main circuits arrangements are provided for starting the two ends of the circuit simultaneously and for the transmission of signals. These functions are performed by the interruption of the picture current working through appropriate relays and detectors. Testing circuits are also provided for adjusting the various parts of the circuit without the necessity for using the actual transmission line.

The Structure of Received Pictures.

All electrically transmitted pictures have a certain amount of structure, upon the degree of fineness of which depends the excellence or otherwise of the picture. This structure may be likened to the dots of which a newspaper reproduction is composed. In order to obtain the reproduction it is necessary to divide the picture up into these dots. The process is the same for reproductions on fine art paper, but the dots can be much smaller, so that they are practically invisible, which results in a picture of very much better quality.



Enlarged section of picture transmitted by the variable density line method.

In electrically transmitted pictures the structure consists, in most cases, of lines. These are caused by the process of scanning by the light beam at the transmitting end, as the picture rotates upon its cylinder, and each line in the received picture represents a track which has been followed by the light beam in its passage across the original picture.

Portion of transmitted picture of variable width line type, enlarged

When picture transmission is accomplished by the modulation method, as in the present case, there are, in general, two methods by which a transmitted picture may be received. One of these is to form an image of the light valve aperture on the sensitive photographic film.

When this is done the resultant picture is made up of lines of constant density but varying width. For a dark part of the picture the lines are all thick and heavy; white portions have very fine lines, and intermediate shades are represented by lines the width of which varies in accordance with the density of the picture at any given spot.

An advantage of this form of reception is that the picture (when received in negative form), if the structure is of suitable size (60 to 65 lines to the inch), can be used to print directly on zinc and thus make a typographic printing plate similar to the earlier forms of half-tone, whereby the loss of time usually incident to copying a picture for reproduction is eliminated. The disadvantages of this form of picture are that it does not lend itself readily to retouching or to change of size in reproduction, and the white portions are marred by fine parallel lines.

The other method of reception is to let the light from the light valve fall upon the film in a diffused manner through an aperture of fixed length, so that lines of

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constant width (exactly juxtaposed) but of varying density are produced.

Prints made from negatives received in this manner, provided the structure is fine enough (100 lines per inch or more), are very closely similar in appearance to original photographic prints and may be reproduced through the ordinary half-tone cross-line screen. The gradations of light and shade in the picture are very much smoother, white portions are unmarred by lines, and the picture may be retouched or subjected to any special photographic procedure which may be desired.

Practical Details of Procedure.

The photographs reproduced here have all been transmitted electrically by the system under review and received by the variable density line method. Readers may, therefore, judge for themselves as to the excellence of the results.

The picture to be transmitted is handed in to the telephoto station, usually in the form of a negative, which is apt to be of any one of a number of sizes. From this a positive film is made, measuring five inches by seven, which is then placed in the cylindrical film-holding frame of the transmitter. Simultaneously an unexposed film is placed on the receiving end.

Adjustments of current values for "light" and "dark" conditions are then made over the line, after which the two cylinders are started simultaneously by a signal from the transmitting end.

The time of transmission for a picture 5in. × 7in., having 100 lines per inch, is about seven minutes. This time is a relatively small part of the total time required from the taking of the picture until it is delivered in the form of a print. Most of this total time is taken up with purely photographic processes.

When these processes are reduced to a minimum by using the negative and the sending end positive while still wet, and making the prints in a projection camera without waiting for the received negative to dry, the overall time can be reduced to about three-quarters of an hour.

Practical Utility of the System.

The utility of the system under discussion was first demonstrated in America in 1924 during the Republican and Democratic Conventions (for the Presidential election) held in Cleveland and New York. During these conventions hundreds of photographs were transmitted to New York and Chicago, or to Cleveland and Chicago, and reproduced in those cities in the afternoon papers.

A demonstration of picture news service on a still larger scale was furnished on March 4th, 1925, when pictures of the inauguration of President Coolidge were transmitted from Washington simultaneously to New York, Chicago and San Francisco, appearing in the afternoon papers in all three cities. Some typical news illustrations are reproduced herewith.

The fields in which electrically transmitted pictures may be of greatest service are those in which it is desired to transmit information which can only be conveyed effectively, if at all, by an appeal to vision. Illustrations of cases where an adequate verbal description is almost impossible are portraits, such as, for instance, those of criminals or missing persons; finger prints; drawings, such as details of mechanical parts; weather maps, military maps, or other representations of transient conditions.

The fact that an electrically transmitted picture is a faithful copy of the original offers a field of usefulness in connection with the transmission of original messages or documents in which the exact form is of significance, such as autographed letters, cheques, legal papers, etc., and where it is of vital importance that these documents

[Courtesy: Bell Telephone Laboratories.

Autographed photograph transmitted by the variable density line method.

be sent from one place to another in the minimum space of time.

Whilst the application of the system of news photographs is perhaps the most obvious, whereby photographs of great events may be transmitted to points hundreds of miles distant and reproduced immediately in newspapers while the story is still "red hot," there are a thousand and one commercial applications, as the following examples (which have already occurred) will show.

One field of usefulness is suggested by the X-ray photograph reproduced here. Such pictures as this, or electrocardiographic tracings, can be transmitted to some specialist across a continent so that his diagnosis of the trouble may be flashed back with a minimum of delay.

Another use is suggested by the reproduction of a copy of an oil company's stock circular, illustrating the case of a New York firm which, being interested in

Commercial Picture Transmission.—

the floating of a new stock issue, was able to save eleven days and meet a favourable market by flashing telephotos of stock circulars and stock certificates back and forth across the country, thus getting in hours the approvals, revisions, etc., that would otherwise have consumed nearly a fortnight, and making certain that printing directions were given in unmistakable form.

A street railway company in California desired to show a new type of tramcar at a meeting of its directors in New York City. There had been an unavoidable delay in forwarding the picture, but it got there on time and very satisfactorily in the form of a telephoto.

An advertising manager in New York planned to be in Chicago on a certain day, but at the last minute could not make the journey. An important cover illustration for a booklet had to be in Chicago the next morning. The air mail had gone, but in the emergency the telephoto system supplied the picture in less than two hours. (From New York to Chicago is a 22-hour journey by express train.)

These are but a few of scores of different examples of the utility of the system which could be given.

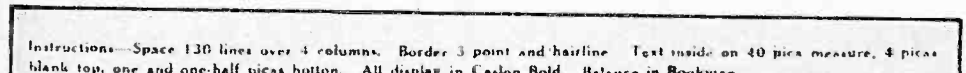
As regards charges, a picture can now be sent from Boston to New York for $15 (£3); to Chicago for $25 (£5); to San Francisco for $50 (£10); simultaneously to New York, Chicago, and San Francisco for $60 (£12); New York-Chicago, $20 (£4); New York-San Francisco, $45 (£9); Chicago-San Francisco, $35 (£7). There are also other reduced charges, and extra prints can be obtained within the area of reception for $1.50 (6s.) each.

During the Christmas season, by special arrangement, personal photographs, inscribed with Christmas and New Year greetings and autographed, could be sent by anyone over the telephone lines to five centres throughout the country. For this service a special price of $15 (£3) was charged, and it constituted an unusual means of greeting relatives and friends. Telephotos sent under the arrangement were printed on heavy art paper and were enclosed in an attractive folder.

For the purposes of regular commercial operation, connection with the nearest Bell telephoto station is made by train or air mail, and since the stations have been established in the centres of the most densely populated industrial sections of the country the entire continent may fairly be described as being well served by this new system of communication.

[Courtesy: Bell Telephone Laboratories.

Example of X-ray photograph electrically transmitted by the variable density line system.



Instructions—Space 130 lines over 4 columns. Border 3 point and hairline. Text inside on 40 pica measure, 4 picas blank top, one and one-half picas botton. All display in Caslon Bold. Balance in Bookman.

Pantepec Oil Company of Venezuela 24 pt. bold

Incorporated under the laws of Delaware 10 Pt. bold

Transfer Agent: National Bank of Commerce, New York

Registrar: Bankers Trust Company, New York 10 pt

ONE INCH DASHES

CAPITALIZATION

10 Pt Bold **Authorized 2,000,000 shares**

To be presently Issued and Outstanding 1,500,000 shares

No par value shares

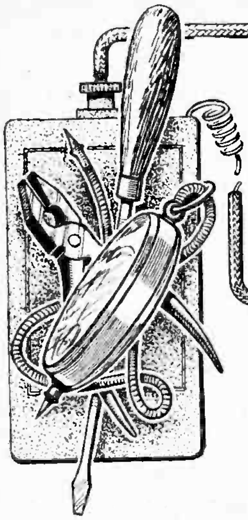
10 pt *We summarize from the letter of the President of the Company as follows:* 10 POINT

The development of approximately one-third of the properties of the Pantepec Oil Company will be carried on under a contract made with the Union Oil Co. of California, one of the largest of the independent companies, under the terms of which the Union Co. has agreed to expend $3,500,000, over a period of six years for development, drilling and other purposes and the Pantepec Company will share equally in the profits derived from oil produced. The proving up of any portion of the properties covered by this contract will also tend to prove up the remaining properties of the Pantepec Company which are contiguous and in which it has an undivided interest.

The Pantepec Company owns or has conditional contracts to acquire, or options on, oil concessions covering about 3,044,074 acres throughout Venezuela. Subsidiaries of the Dutch Shell, Standard Oil of New Jersey, Standard Oil of California, Atlantic Refining Co., Gulf, Sun and others are actively engaged in development in Venezuela, and large parts of the Pantepec properties lie close to fields which are now producing oil, or

[Courtesy: Bell Telephone Laboratories.

Corrected proof of an oil company's circular transmitted over telephone lines.



PRACTICAL HINTS AND TIPS

A Section Mainly for the New Reader.

LOOSE COUPLING.

One of the most certain ways of overcoming (or at any rate reducing) trouble caused by induction effects from near-by power circuits is to replace the popular "direct-coupled" aerial system, as shown in Fig. 1 (a) by loose coupling (Fig. 1 (b)). At the same time the selectivity of any receiver will be improved by the alteration.

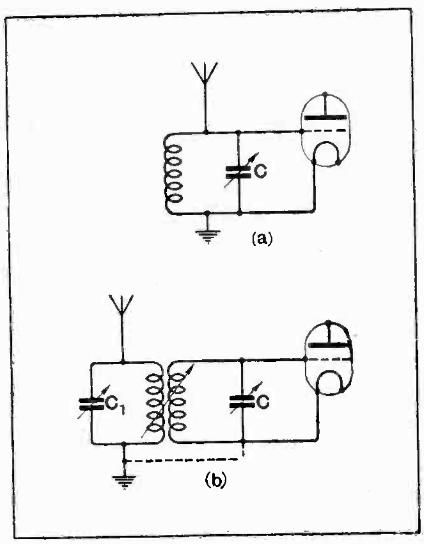


Fig. 1.—Direct- and loose-coupled aerial connections.

The necessary modifications are by no means difficult, although it will sometimes be impossible to find room for the extra tuning condenser in the receiver: in such cases it may conveniently be mounted in a separate wooden box, which will at the same time serve as a support for the coil-holder if required.

A word of warning should be added for the benefit of those who propose to add loose-coupling to a receiver which includes a stage of un-neutralised H.F. amplification. Sets of this kind are normally stabilised by the aerial load; when this is removed or decreased uncontrollable oscillation will be produced as the grid and plate circuits come into tune. Obviously, therefore, before adding the loose-coupled aerial arrangement, it will be necessary to neutralise the high-frequency valve.

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VALVES FOR PORTABLES.

Although accumulators provide the most satisfactory source of low-tension voltage, it cannot be denied that these batteries have certain disadvantages when used in conjunction with portable receivers, in spite of the fact that extremely compact and almost unspillable patterns are obtainable commercially. It is largely because the type of set under consideration is not in constant use that sufficient attention is seldom paid to the accumulator, which is allowed to stand—perhaps in an almost discharged condition—for protracted periods, with consequent deterioration.

It must be admitted that there is a certain attractiveness about the idea of using dry cells, which are the only other really practicable alternative. A suitably chosen battery, even if it is of small capacity and consequently of light weight and low in cost, will give good service on the intermittent discharges likely to be required, and may be thrown away when exhausted.

Dry batteries, however, suffer from several disabilities, the most serious being their inability to provide heavy currents; 0.3 amp. may be taken as the maximum which even large (and very heavy) cells will supply for extended runs. This limits our choice of valves, and almost rules out the use of a loud-speaker. When the current consumed is as low as, say, 0.1 amp., comparatively small cells will put up a good performance, so the type of valve with this consumption (at about 2 volts) is one to be recommended. The fact that two or three of them may be used in the set need not mean a heavier demand on the L.T. battery, as their filaments may be connected in series, as shown in Fig. 2. This arrangement will necessitate a higher battery voltage, but in spite of this it has a real advantage, as three comparatively small cells ($4\frac{1}{2}$ volts) supplying 0.1 amp. are almost certain to have a longer life than two larger cells (of the same total weight) which would be discharged at 0.2 amp. were the filaments connected in parallel as usual.

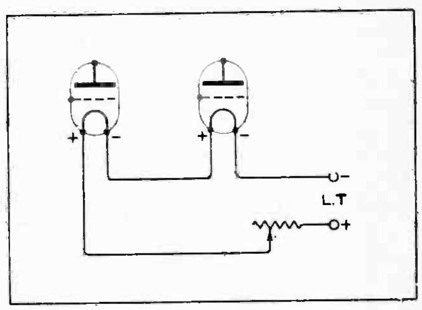


Fig. 2.—Valve filaments in series.

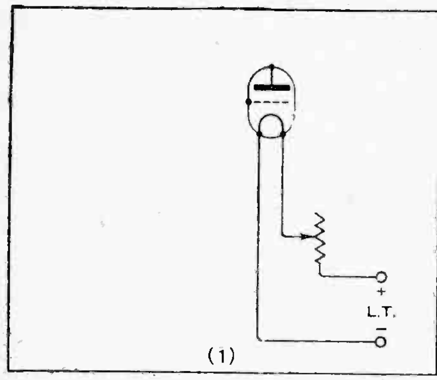
The connections of the grid return leads are often a source of difficulty to those who are using series-connected valves for the first time. Except in the case of a leaky-grid condenser rectifier, these are always made to the negative side of the filament of the valve in question. In the diagram the polarity of the filament terminals is indicated, as a guide.

DISSECTED DIAGRAMS.

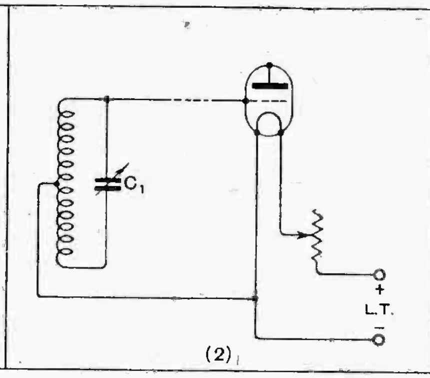
Practical Points in Design and Construction.

No. 69.—A Single-valve "Hartley" Receiver.

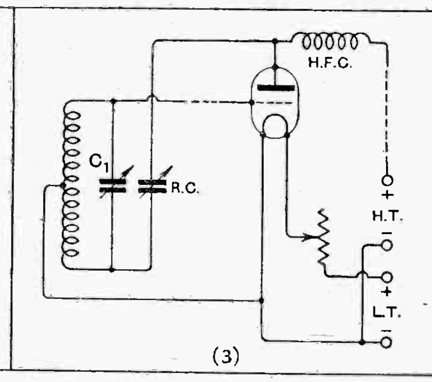
The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless receivers, and at the same time to assist the beginner in mastering the art of reading circuit diagrams. The effective and simple method of obtaining capacitative control of reaction, which is shown below, can be recommended.



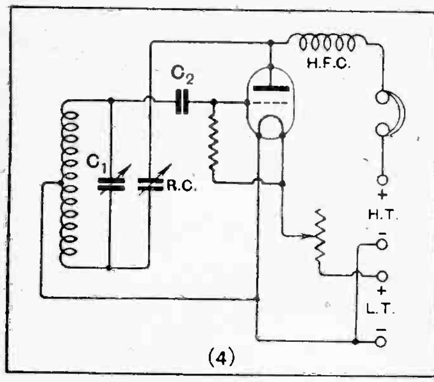
The conventional method of connecting the valve filament circuit. Following the usual practice, the controlling rheostat is inserted in the positive low-tension lead.



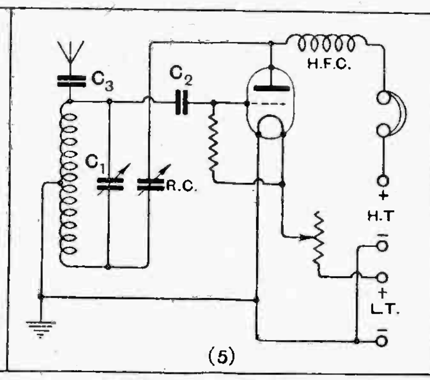
One half of a centre-tapped coil, the whole of which is tuned by a parallel variable condenser, is connected between grid and filament of the valve.



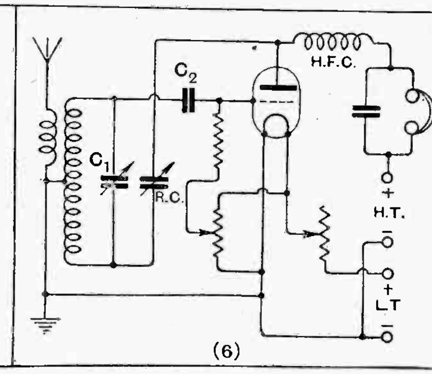
The anode circuit is completed through a choke and the H.T. battery, a portion of the H.F. energy being fed back to the grid circuit through a reaction condenser.



The addition of a grid condenser and leak, with the insertion of phones in series with the anode, completes the detecting circuit.



An aerial is connected to the grid end of the coil (through a series condenser). The earth connection is added.



An improvement is effected by providing a separate "untuned" aerial winding, tightly coupled to the grid.

As the valve is to operate as a grid detector, the considerations affecting its choice are in no way different from those applying in a more conventional circuit. Generally speaking, one of not more than 30,000 ohms impedance is recommended.

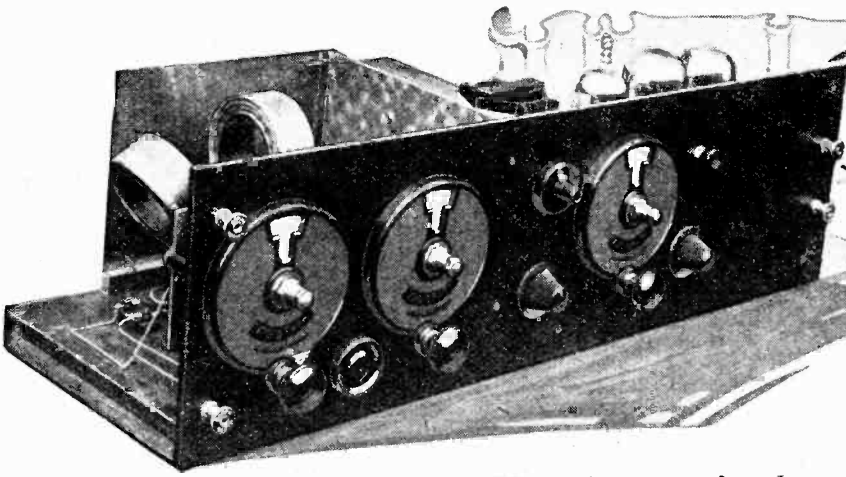
A commercial pattern of centre-tapped coil may be used; one with from 60 to 75 turns will cover the normal wave band, while a No. 250 is suitable for the majority of the long-wave stations. A tuning condenser (C_1) of 0.0005 mfd. is assumed. Both sides of this condenser are at high potential; some form of extension handle should, therefore, be fitted to minimise hand-capacity effects.

In (3) the reaction condenser (R.C.) should be carefully chosen, as the sensitivity of this circuit depends almost entirely on the smoothness of regenerative control. Its capacity must be small; in general a maximum of 0.00005 mfd. (50 micro-microfarads) is more than ample, so a "vernier" or "balancing" type will serve. Again, both sides are at high oscillating potential, so an extension handle is again desirable. The inductance of the H.F. choke is not critical, nor is its efficiency of prime importance. It should have a restricted external field, and thus will be of small size.

In (4) the grid condenser (C_2) and the grid leak may have the conventional values of 0.0003 mfd. and 2 megohms. This circuit, with the substitution of a centre tapped frame aerial for the coil mentioned above, is a complete self-contained receiver and may form the basis of a portable set.

The connections of aerial and earth shown in (5) are the most convenient where interchangeable coils are used. The series condenser C_3 has the effect of reducing damping and improving selectivity; its capacity, on the normal waveband, may be from 0.0001 to 0.0002 mfd., and for the longer waves about 0.0003 mfd.

In (6) a still more effective aerial coupling arrangement is shown; this is mainly applicable to the 300-500 metre waveband or to the short waves. For the former, the secondary may have a total of 60 turns of wire (Litz may be used) on a 3in. former. The aerial winding, which is preferably tapped, has about 15 turns of fine wire, wound on spacers over that part of the grid section of the coil adjacent to the centre tapping. Control of reaction is greatly improved by adding a potentiometer as shown to regulate the mean grid potential.



ALL-WAVE "FOUR"

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

Interchangeable H.F. Transformers for Long and Short Waves.

During his life the average man is almost certain sooner or later to run up against some of those fatuous individuals who, in the course of a conversation concerning subjects about which they know nothing, seem impelled by some malignant force to shout their ignorance from the housetops by indulging in such feeble-minded and hackneyed phrases as "Wireless is still in its infancy," "Necessity is the mother of invention," etc., in a futile effort to cloak their aforementioned ignorance.

Now half these phrases, such as the former of the two quoted, are inaccurate, and the rest, such as the latter, are only half-truths, which are far worse than honest straightforward lies. It is with the latter kind of statement that we are most concerned here. This phrase, beloved as it was of our grandfathers, is undeniably the truth, but it is neither the "whole truth" nor is it "nothing but the truth." To be absolutely true, the phrase should read "Laziness is the mother of progress," the word "necessity" being merely a polite synonym for laziness, whilst "progress" is a more all-embracing word than necessity. The exercise of a little not-too-fatiguing thought will speedily reveal the truth of these assertions, as we shall now proceed to demonstrate.

From that dim and distant age, umpteen centuries ago, when the man-like ape first began to merge almost imperceptibly into the ape-like man, or from the time when Adam fell into his unfortunate sleep up to the present enlightened age of chewing-gum and chauvinism, and henceforth up to the final cooling-down of the earth and consequent disappearance of man (or until Tuesday, May 29th, A.D. 1928 (according to a recent broadcast from 2LO), the whole of mankind has been, and will be, generation after generation, afflicted with a dread disease which has even yet not found its way on to the statute book of the B.M.A., namely, the almost universal affliction (?) of laziness. In reality, of course, the great gift of laziness has ever been a blessing in disguise, con-

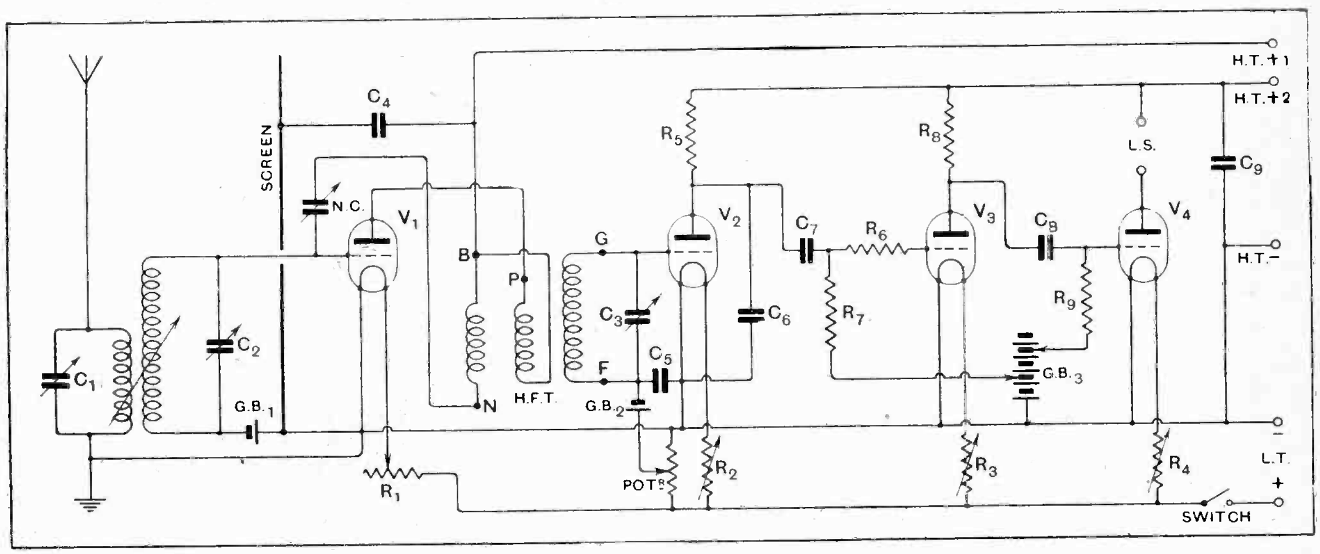


Fig. 1.—The circuit diagram. C_1, C_2, C_3, 0.0005 mfd.; C_4, 1 mfd.; C_5, 0.1 mfd.; C_6, 0.0001 mfd.; C_7, C_8, 0.002 mfd.; C_9, 2 mfds. R_1, R_2, R_3, R_4, depending on valves used; R_5, R_8, 0.5 megohm; R_6, 0.25 megohm; R_7, R_9, 3 megohms.

All-Wave "Four"—

stantly urging man to hitch his wagon to the stars, as we shall now indisputably prove.

Talking of wagon hitching, what was it that caused primitive man to hitch his yet more primitive soap box to a particularly docile Brontosaurus and so commence the great trek of progress in locomotion, which has culminated in the almost universal Ford? Laziness, of course: nothing more certain, and so has it been throughout the ages, until in the early days of the present century man invented the gramophone in order to avoid the necessity for turning out to go to a concert hall or theatre. But laziness is, always has been, and always will be like an insidious drug, insomuch that the more it is indulged the greater is the desire for indulgence, and so twenty years later we see mankind, tired of "changing the record," inventing broadcasting in order to avoid this exertion. Even in the short time that broadcasting has been extant, we see the insidious craving at work, once more bringing forward the battery eliminator in order to avoid the effect of lugging the old accumulator to the charging station. It will be realised, therefore, that laziness, and the fact that the more it is indulged in the greater is the craving for it, is responsible for all modern progress. All men are fortunately infected with it, except those few who boast of rising at unchristian hours of the morning in order to indulge in strenuous mental or physical exercise before breakfast. No man, surely, who exercises his imagination to this extent can possibly be accused of laziness.

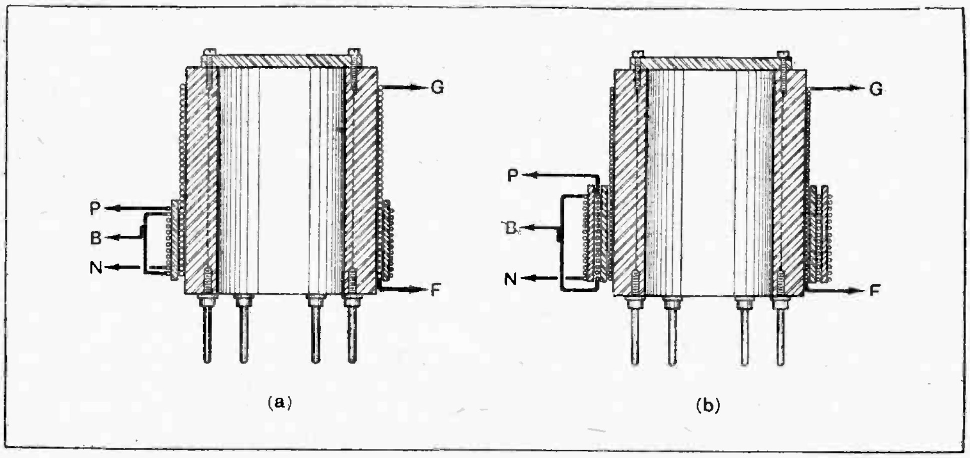
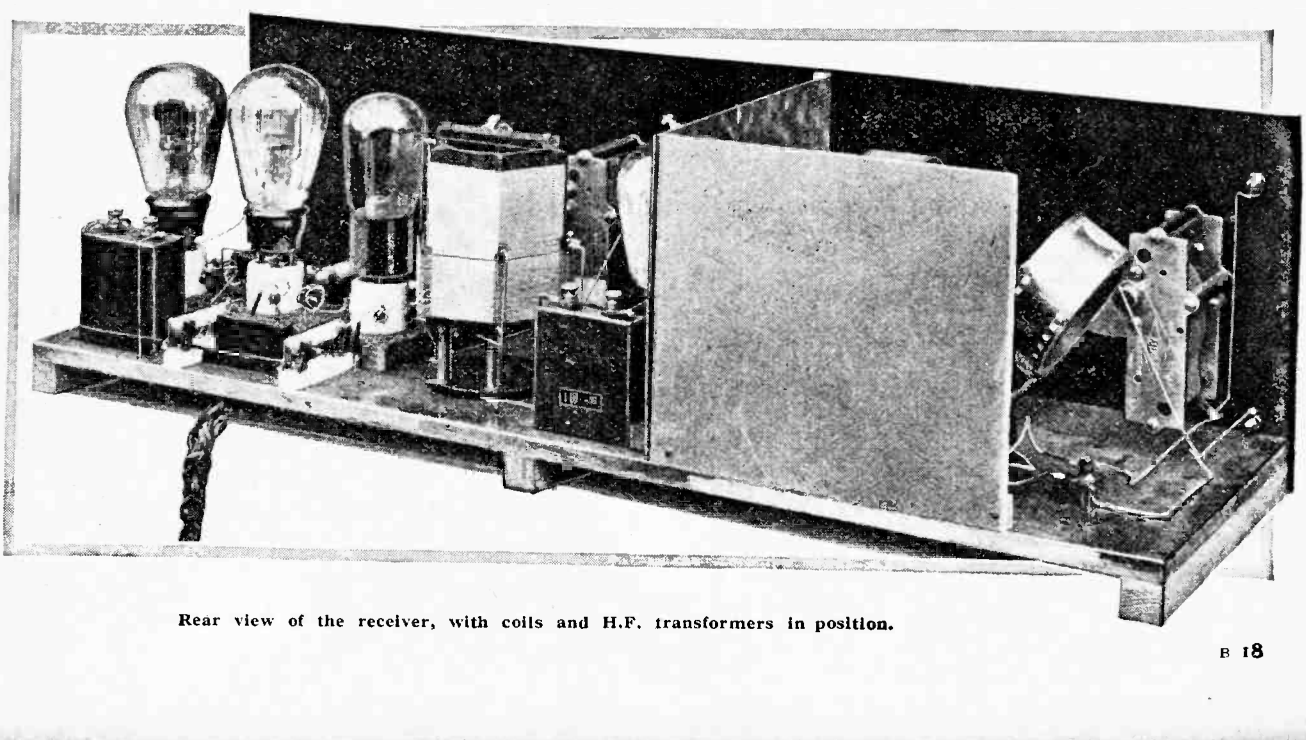


Fig. 2.—Sectional drawings showing construction and connections of the H.F. transformers. The lettering on the various ends of the windings corresponds with that shown in Figs. 1 and 6. The short- and long-wave transformers are shown at (a) and (b) respectively.

"But what on earth," writes "Red Hot Enthusiast" from Tristan Da Cunha, "has all this to do with the four-valve set about to be described. Was laziness the motive that prompted its production?" Most certainly.

The Long-wave Problem.

All last winter, if anybody wished to receive 200- to 600-metre stations at maximum efficiency he used an "Everyman-Four"; but what happened if he desired long-wave stations, like Moscow and Königswusterhausen? He had to change over all his batteries, valves, loud-speaker, etc., to his long-wave receiver (if he possessed one), for, of course, the "Everyman-Four" lays no claim to DX on long waves. Shocking! What a waste of labour! What unnecessary exertion! (at least, so the writers thought), and what is the result? Progress once more! A set which is efficient both on the "normal" and on the "long" broadcasting wavelengths. This receiver does, however, require that coils and H.F. couplings be



Rear view of the receiver, with coils and H.F. transformers in position.

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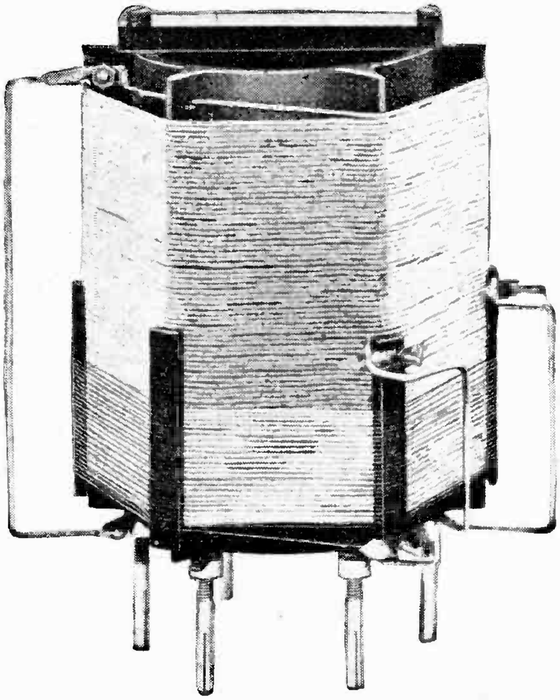
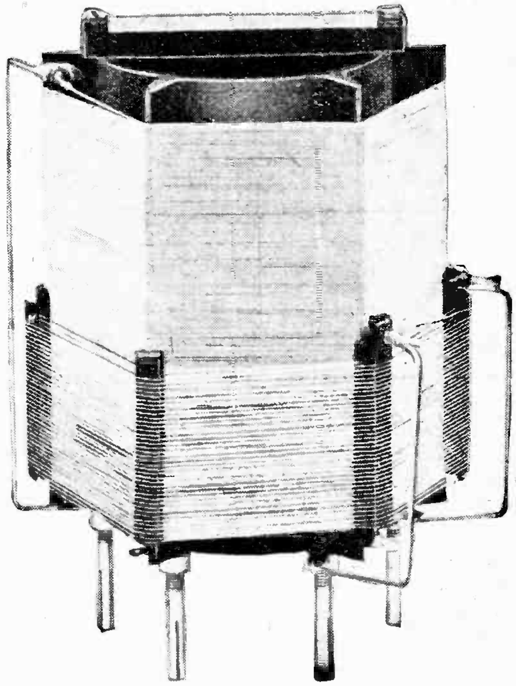
changed, but for the moment the writers' appetite for progress is satiated. Long before the next season commences, however, the old craving will once more arise; the designers will feel too feeble to go on with this plugging-in business, and the result will be the production of a set the operation of which looks less like work. A set, in fact, which will cover the whole wavelength band from an Angstrom unit to a light-year, with one dial and no plugging, switching, or jacking.

The present receiver naturally falls considerably short of this ideal, but it may well be asked by those already possessing receivers made up from constructional details provided by this journal during the past year whether



The short-wave transformer.

the receiver will be of greater utility to them than their existing sets. The best way to answer this question is to briefly review the salient points of one or two typical receivers of the past year. For purposes of comparison, therefore, we will pick out two typical general purpose receivers published in this journal during the past year and discuss how the "All Wave Four" shows a superiority or inferiority complex (with apologies to Professor Freud) relative to these two typical receivers. The first of these which we have chosen is the "Everyman-Four," and, as we have already pointed out, this present receiver is superior on the long-wave side, the "Everyman-Four" never having been intended to receive *distant* long-wave stations. We will now take another typical receiver which uses an H.F. stage, and which *was* intended to receive both the "normal" and the "long" broadcast wavelengths, namely, the "Neutralised Tuned Anode Receiver" (W.W., 20/10/26). This particular receiver, useful as it was in the matter of wavelength flexibility and in its ability to receive stations of medium distance, cannot be put into the same class as the "Everyman-Four" from the point of view of sensitivity and selectivity. It was therefore thought not undesirable to profit by the experience gained from both these receivers with



The long-wave transformer.

what result the reader must judge after he has read the description of the present receiver, the salient points of which we will now proceed to discuss.

The first thing to strike our notice is that two plug-in coils are used in a two-way coil holder, each circuit being fully tuned. In other words, straightforward loose coupling. "Shades of Michael Faraday," cries "Advanced Experimenter, Wigan," "have the writers been

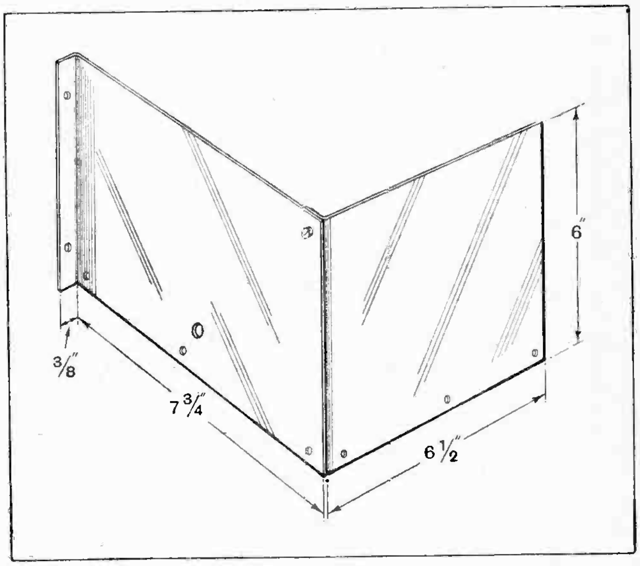


Fig. 3.—Dimensions of the screen. It is screwed to small wooden battens secured to the baseboard, also to the panel.

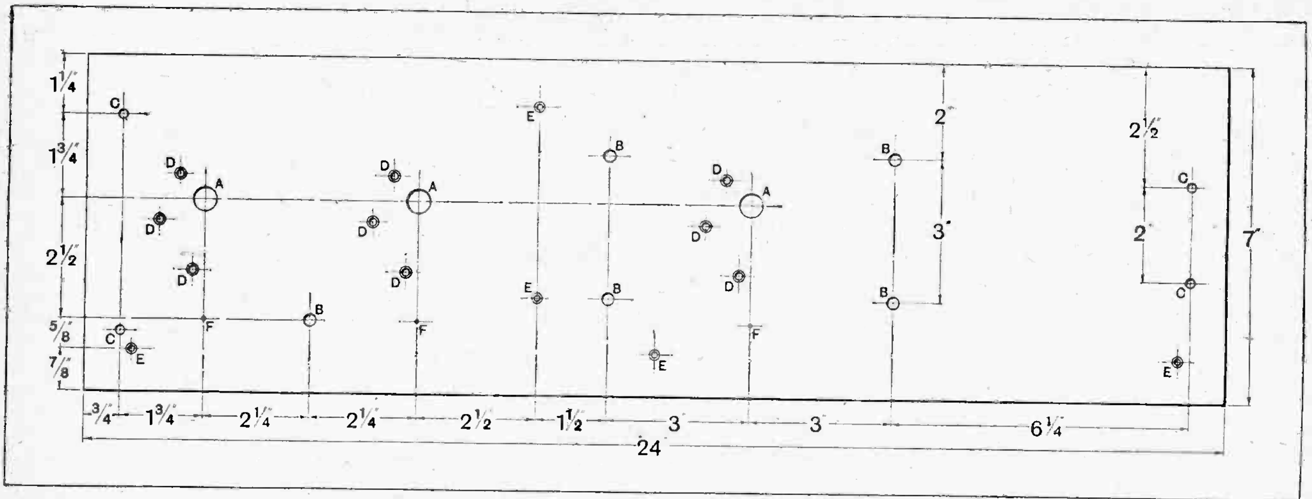


Fig. 4.—Drilling details of the panel. A, 1/2in. dia.; B, 1/4in. dia.; C, 3/16in. dia.; D, 5/32in. dia., countersunk for 4 B.A. screws; E, 1/8in. dia., countersunk for 6 B.A. screws and No. 4 wood screws; F, 3/32in. dia., tapped 6 B.A.

excavating in Tutankhamen's tomb?" Not so. Selectivity is desired, is it not? What better method than loose coupling? "Why not aperiodic coupling?" replies "Experienced Engineer" (who invariably uses the practical wiring plan rather than the theoretical diagram when studying the principal features of any new circuit). Very nice, too, on all wavelengths not exceeding 600 metres or so; probably, indeed, the only method below 100 metres, possibly the best method on the normal broadcasting wavelengths (with ordinary tuned loose coupling a very good second), but on long wavelengths a doubtful starter. This method of aerial coupling, then, is in reality the only one to use in order to avoid undue complications.

The H.F. Transformers.

The next point of interest is the coupling between H.F. and detector valves. This is of a similar type to that employed in the "Everyman-Four" on the normal broadcasting wavelengths, the long-wave transformer design being the result of a considerable amount of experimental work. It is considered to be a good compromise between the highest possible amplification and that high selectivity which is so desirable for distant work. The very important factors of ease and simplicity of construction are also taken into account. It is not denied that it could possibly be made more efficient by entirely jettisoning constructional simplicity. Both these transformers are mounted in six-pin bases, one pin being "dead." Please note, however, that use is made of an efficient type of mounting, with the pins arranged around the circumference of the former, so keeping the termination of the various wires spaced fairly well apart rather than running them in such a way that, owing to capacity effects, the H.F. energy is apt to emulate the birds in spring by lightly leaping from twig to twig, and so cause losses and possible instability.

The particular formers and base used do not provide a non-reversible mounting, and there is some slight risk of short-circuiting the H.T. battery if the transformer is incorrectly inserted. This should not occur, however, if

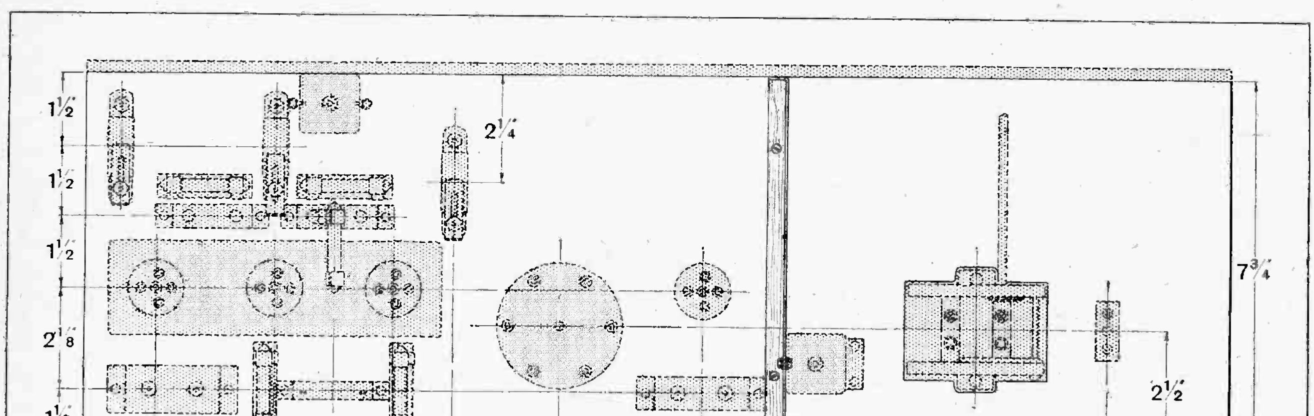


Fig. 5.—The layout of components on the baseboard.

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reasonable care is taken, as the cross-bar acts as a guide. The maker's trade-mark stamped on one end acts as a register line. It would be better, however, if manufacturers could produce a more fool-proof design from the point of view of elimination of risk of coil reversal without sacrificing the efficiency of the present mounting.

The next point to claim attention is the potentiometer controlling the grid voltage of the detector valve, which, with modern types of valves produced specially to function in this position, is a real necessity, since the correct location of the bottom bend is too critical for the $1\frac{1}{2}$-volt gain in amplification. The stabilising resistance R_6, which prevents the application of H.F. voltages to the L.F. amplifier, should not be omitted, as it is not put there for ornamentation.

Three similar tuning condensers are used, mainly to obtain symmetry in the appearance of the front panel, but expense may be reduced by using a plain "semi-circular plate" condenser for aerial tuning. There is no real point in using a S.L.F. instrument for this circuit, and its tuning is not particuluarly sharp, due, of course, to the heavy damping of the aerial. Semi-fixed filament resistors are inserted in series with the detector, first L.F.,

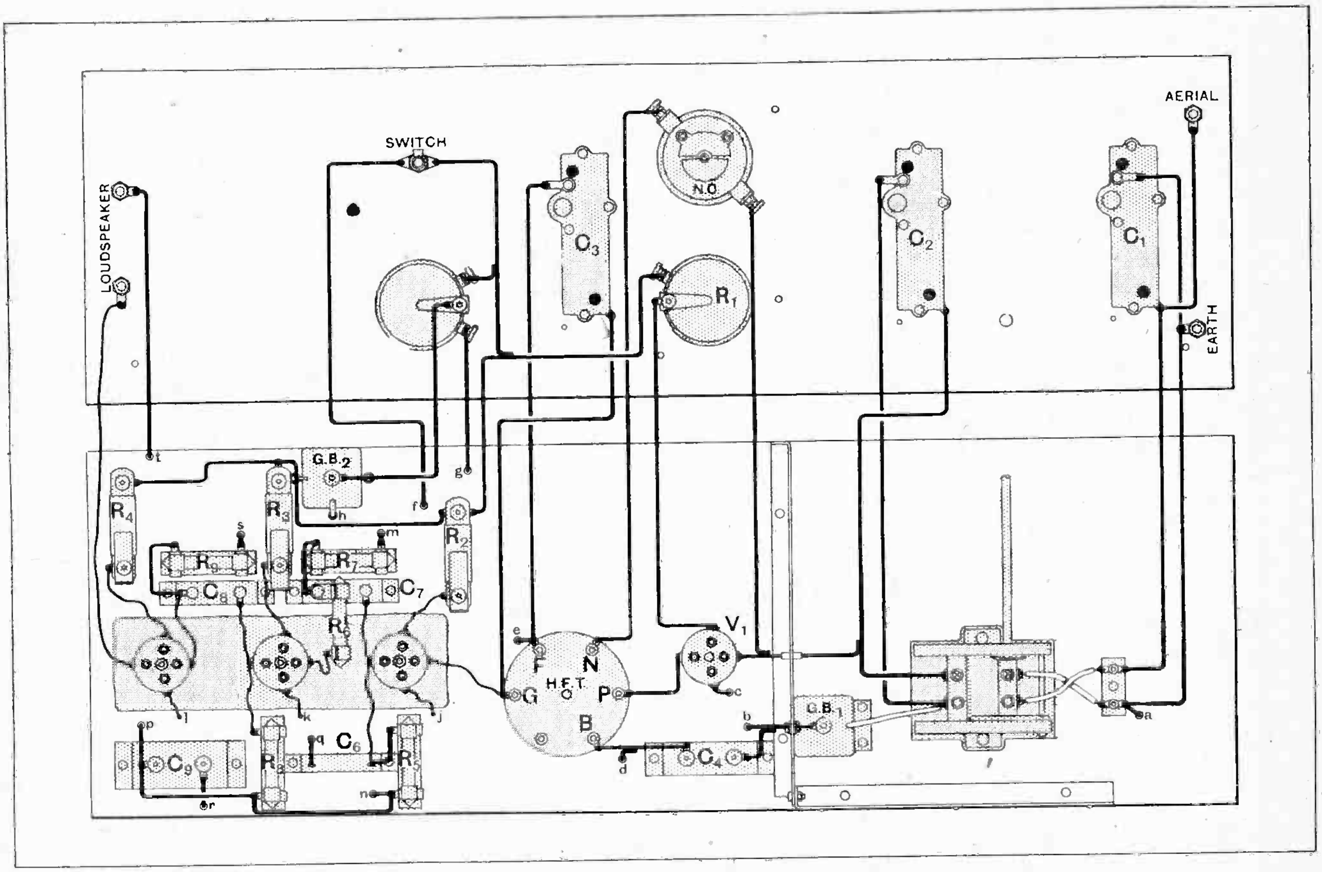


Fig. 6.—The practical wiring plan. Note that R_6 is supported at one end only, the clip at the other end being connected to the grid of V_3 by a flexible wire. The lettering on the wires passing through the baseboard corresponds to that in Fig. 7.

tapping of the grid battery. ["No, 'Puzzled Pimlico,' it is no use trying to stir up the manufacturers to produce bias batteries with half-volt tappings."]

We will now pass direct to the L.F. amplifier, which, it will be noticed, consists of two resistance-coupled stages. It may well be asked why a transformer is not used in the final stage. Reduction of cost is the primary reason; moreover, under moderately favourable conditions the amplification provided by the arrangement as specified will give adequate loud-speaker volume on most signals which are really worth while reproducing in this manner. Those working under unfavourable conditions, or whose primary object is the reception of really distant stations at loud-speaker strength, may easily substitute a *good* transformer for the second resistance with a considerable and output valves. It should be pointed out that, as the two former have a high ohmic resistance in their anode circuits, full emission is not required, so in the interests of economy the filament current should be kept down as much as possible. This peculiarity accounts for the fact that the set is extremely economical in upkeep cost; in fact, the H.T. current of the detector and first L.F. valves is almost negligible, while their L.T. consumption is also low. The rheostat R_1 controlling the H.F. valve should be regarded as a volume control. We now come to the vital constructional details.

A standard panel was chosen, as this, together with a suitable ready-made cabinet, should be obtainable from dealers. The holder is sunk below the baseboard by cutting a hole and screwing it to an ebonite sheet secured

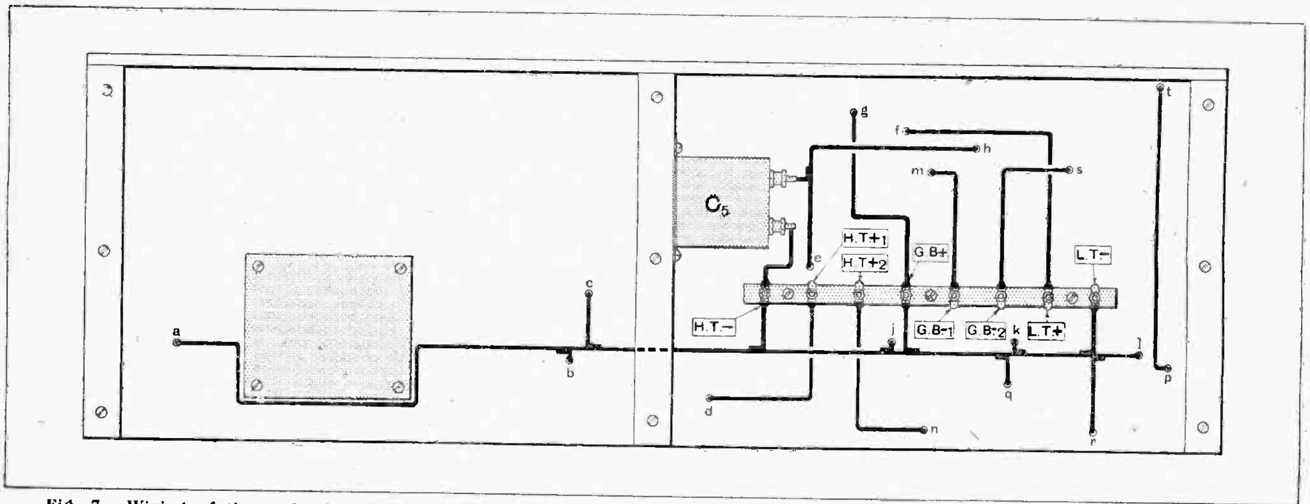


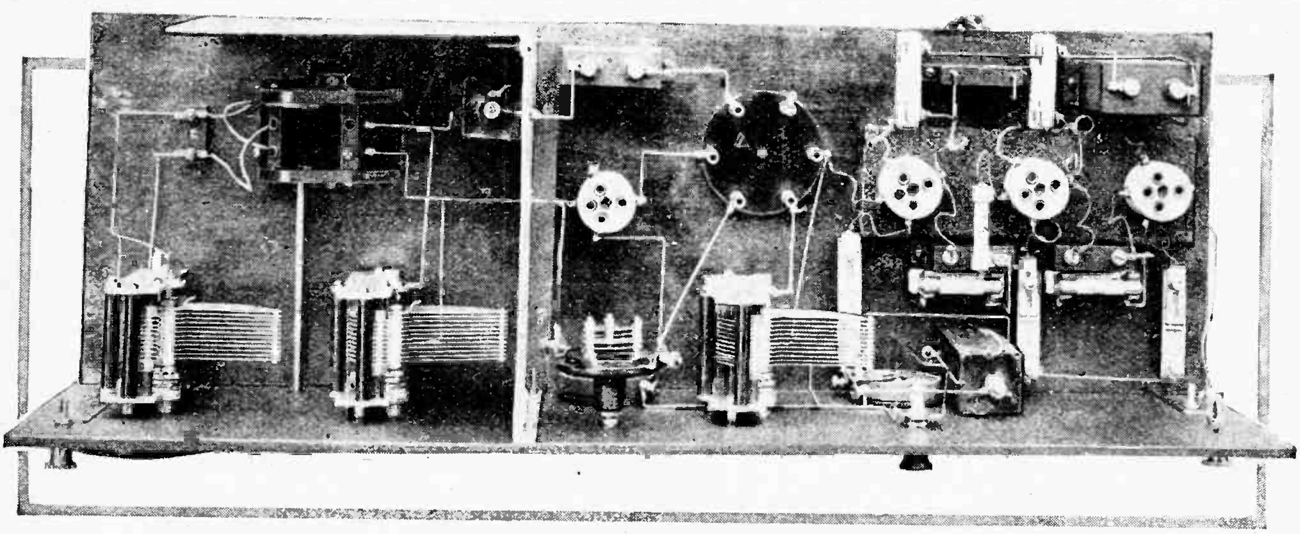
Fig. 7.—Wiring of the underside of the baseboard. Flexible leads for external connections to the batteries should be soldered to the appropriate points, and then be plaited together and passed out through a single hole in the back of the cabinet. The terminal strip measures 8in. by 3/8in. and is 1/4in. thick.

to the underside. This avoids the trouble of obtaining a special panel, although those readers who desire to use coils of unduly large diameter must naturally obtain a panel having an extra half-inch in height. It is difficult to find a better shock-absorbing substance than sponge rubber; a strip of this, about $\frac{1}{2}$in. in thickness and measuring 2in. in width and 7in. in length, carries the sockets for detector and L.F. valves, which are fixed by means of screws fitted with large washers to prevent their pulling through. The nuts on these screws are tightened up until the heads lift clear of the baseboard, to which the rubber is attached with solution.

The short-wave H.F. transformer, which covers a wave band of from about 200 metres to well over 600 metres with the condenser specified, is wound on a "Radiax" ribbed former with a mean diameter of about 3in. and a length of $3\frac{1}{2}$in. The secondary, with a winding length of slightly under 3in., is wound with 70 turns of 27/42 Litz, the lower end terminating at the appropriate pin, while the top end is soldered to the head of a screw passed through one of the ribs. This is ultimately joined to the pin which connects to the detector valve grid. In deciding the ultimate connections of all the ends of the windings, the constructor should consider Fig. 2 in conjunction with Fig. 6 and the theoretical circuit diagram. The same lettering is adopted in each case.

Primary and Neutralising Windings.

The primary and neutralising sections are interwound exactly as in the case of the "Everyman Four" coils, to the description of which the reader is referred for fuller details. Each winding has a total of 15 turns of No. 40 D.S.C. wire, carried on six ebonite strips with 32 grooves to the inch, $\frac{1}{4}$in. wide, $\frac{1}{8}$in. thick, and $1\frac{1}{2}$in. long. A longitudinal V-shaped depression is filed on their under surfaces, so that they may fit snugly over the angle formed by the secondary winding where it passes over the ribs. The depth of these depressions is such that the spacing between windings is about $\frac{1}{16}$in. One of the strips carries



Plan view of the receiver, with coils and transformer removed; note sponge rubber base for the valves.

LIST OF PARTS.

1 Ebonite Panel 24in.× 7in.× ¼in.	1 Condenser type No. 600 0.0001 mfd. (Dubilier).
1 Two-coil holder (Lotus).	1 Condenser Mansbridge 0.1 mfd. (T.C.C.).
4 Porcelain grid leak bases. (A. F. Bulgin & Co.).	4 Valve holders (Athol).
3 Variable condensers 0.0005 mfd. (Eureka).	3 Semi-fixed resistors (Peerless).
2 Plug-in ribbed formers 3½in. (Radiax).	1 Rheostat 35 ohms (Lissen).
1 Base for above.	1 Potentiometer (Lissen).
1 Condenser 1 mfd. (Dubilier).	1 Single pole "On and Off" switch (Benjamin).
1 Condenser 2 mfd. (Dubilier).	1 Micro condenser with 1½in. Indigraph dial (Igranic).
2 T-size cells (Siemens).	3 Indigraph vernier dials (Igranic).
2 Resistances 0.5 meg. (Ediswan).	4 Terminals (Eelex).
2 Resistances 3 meg. (Ediswan).	1 Baseboard 24in.× 7¾in.
1 Resistance 0.25 meg. (Ediswan).	20 yards Litzendraht wire 27/42.
2 Condensers type No. 620 0.002 mfd. (Dubilier).	Wire, sleeving, screws, ebonite, aluminium, sponge rubber.

Approximate cost using the above components but exclusive of cabinet and accessories, £8 15s.

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.

a 10B.A. screw at each extremity for the purpose of anchoring those ends of primary and neutralising windings which connect to +H.T. (marked B in Fig. 2). The heads of these screws are deeply countersunk to avoid the possibility of a short-circuit to the secondary. Two other strips carry a single screw for connection to the top end of the primary winding, and the lower end of the neutralising winding.

The long-wave transformer, which covers a waveband of from under 900 to about 2,000 metres, is wound on a similar former. Its secondary, with 265 closely wound turns of No. 36 D.S.C. wire, is approximately 3in. long. Over the lower end is wound the primary, with 45 turns of No. 40 D.S.C. on similar spacing strips, which here are 2in. in length. Over this, again, is the neutralising section, with the same number of turns. The strips supporting this winding will be held in position by the wire, but matters are facilitated by securing them with a trace of melted Chatterton's Compound at each end. As in the case of the short-wave coil, the spacers have a depression filed on their under-sides, so that there is a spacing of about $\frac{1}{16}$in. between windings. All the windings of both coils are in the same direction.

Choice of Valves.

It is intended that an H.F. valve (V_1) of from 20,000 to 30,000 ohms should be used, and both transformers are designed with this in view. Greater selectivity, particularly on the short waves, is obtained with a valve of higher impedance (which should, incidentally, be accompanied by a corresponding increase in amplification factor, or the sensitivity will be disappointing). As a detector, one of the new high-magnification valves (impedance 70,000-100,000 ohms) is recommended. Most of these valves require about 1½ volts negative on the grid for good detection; this is, of course, the maximum provided by the single cell as shown. A 3-volt battery may be substituted if necessary; two-cell torch refills are of convenient size. It is rather difficult to make a definite statement as to the best valve for the first L.F. stage (V_3). Where maximum magnification is desired, the same type as is used for the detector will naturally be adopted, a very small negative grid bias voltage being applied to it, or none at all if the valve is of the type where grid current starts "late." A good measure of amplification is obtained from a 20,000 ohm valve with a voltage factor of about 20. Financial considerations will largely decide the type of valve to be used in the output stage; one with as large a voltage handling capacity as possible should be selected. Nowadays the amateur has a wide choice of suitable low-impedance valves which operate well on anode voltages of about 120.

It should be pointed out that the type of neutralising condenser used has an unnecessarily high capacity for this particular receiver; two moving and two fixed plates were accordingly removed. This plan can be recommended, as a lower maximum capacity makes for easier operation.

Final Adjustments.

The last screw having been driven home and the final connection soldered in position, we come at last to the operating details. For the short waves a No. 35 or 40 coil in the (moving) aerial socket will cover the greater part of the "normal" waveband, while a No. 75 of most makes is suitable for the secondary circuit. For the long waves we must substitute Nos. 150 and 250 in these respective positions, remembering that on the upper and lower limits of the waveband to be covered a size larger or smaller will probably be necessary in the aerial circuit.

Once neutralised, the receiver will be stable over the whole of the wave-range covered by the transformer in use; indeed, favoured by fortune, it is probable that the same adjustment of the balancing condenser will hold good for both long- and short-wave couplings. This is actually so in the set as described. In any case neutralising is an extremely simple matter ["No, 'Doubtful Durham,' we do *not* habitually use the balancing condenser as a furtive reaction control in order to bring in distant stations—the set is capable of doing this without such adventitious aids, although a little de-neutralisation is admittedly rather helpful when receiving a particularly elusive signal."]

The receiver is sensitive and selective on both the short and long wavebands. Moscow, for instance, on the long wave side, was received at very convincing volume on the

All-Wave "Four."—

loud-speaker without any trouble. As to the selectivity, whilst of course tuning is not so sharp that readers need be afraid of cutting themselves on it, it is considerably better than that of many receivers having a popular reputation for this particular quality. On London it was possible to go down to 385 metres without the faintest trace of that station at a distance of 2¾ miles. Not the slightest difficulty was experienced in getting Radio-Paris at over-powering loud-speaker volume with no whisper of Daventry in the background, even during the rather prolonged intervals for refreshments which this particular foreign station is in the habit of taking. This test was made at a distance of just over thirty miles from Daventry. All the worth-while long-wave European stations were received on the loud-speaker with no trouble. As for the stations working on the lower wavelengths it is not proposed to waste time and space by printing a lengthy list. Incidentally, such lists convey no useful information to the knowledgeable wireless man unless they are accompanied by a lengthy description of receiving conditions and a list of stations which can be heard *in daylight* on some standard receiver with which he is familiar in order that he may have a definite basis for comparison.

It might be thought that with three tuning controls this receiver would be rather difficult to operate, but this is not so because with the aerial moderately closely coupled the tuning of this circuit is naturally flat, and searching can be carried out over a reasonably broad wavelength band with the remaining two condensers, selectivity being brought into play and unwanted stations cut out by loosening the coupling immediately the desired station is located. This control over the selectivity of the receiver is, indeed, one of its most useful points. It should be remembered that all three circuits must be kept in tune. The beginner should search carefully until the positions of the controls corresponding to a number of stations have been noted, when it will be an easy matter to find intermediate wavelengths.

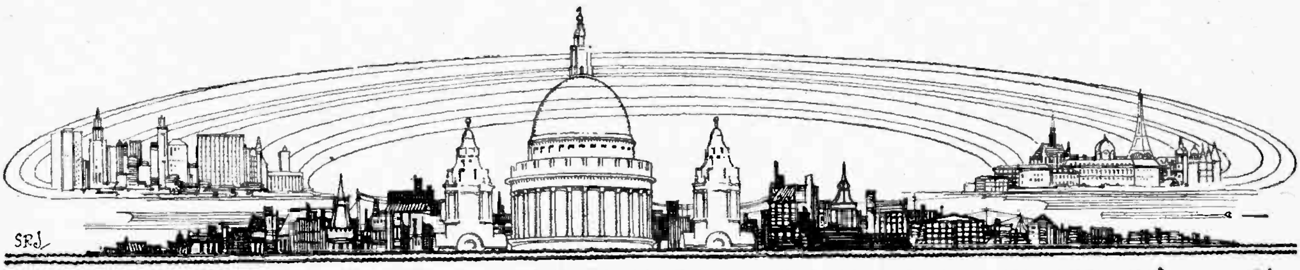
This receiver will, it is hoped, fill a long-felt want, since it is neither expensive nor is it difficult to build and operate; moreover, it does not depend for its success on the use of certain unalterable components. Results will depend largely on the excellence or otherwise of the H.F. transformers; every care should be taken to see that they are carefully constructed exactly in accordance with the specification given above, and that the pins make good contact with their sockets.

VALVE DATA.

The following amendments and additions should be made to the Valve Data Sheet which accompanied the issue of April 6th, 1927.

In order that the information contained in the List may be kept up to date, additions and amendments will be given from time to time.

Make of Valve.	Type.	Amplification Factor.	A.C. Resistance (Ohms).	Filament Amps.	Price.	Remarks.
	(FOUR VOLT.)					
B.T.H. British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.	Substitute **B.5**	7.0	17,000	0.06	14/-	
	Delete .. **B.6**	8.0	12,000	0.12	22/6	
MARCONI. Marconiphone Co., Ltd., 210–212, Tottenham Court Road, London, W.1.	Add .. **D.E.H.410**	40.0	70,000	0.1	14/-	
	Add .. **D.E.L.410**	13.0	14,000	0.1	14/-	
	Add .. **D.E.P.410**	6.25	6,250	0.1	18/6	
MULLARD. Mullard Wireless Service Co., Ltd., Mullard House, Denmark Street, London, W.C.2.	Add .. **P.M.3A**	35.0	63,000	0.1	14/-	
	Substitute **P.M.4**	7.0	7,000	0.1	18/6	
OSRAM. General Elec. Co., Ltd., Magnet House, Kingsway, London, W.C.2.	Add .. **D.E.H.410**	40.0	70,000	0.1	14/-	
	Add .. **D.E.L.410**	13.0	14,000	0.1	14/-	
	Add .. **D.E.P.410**	6.25	6,250	0.1	18/6	
	(SIX VOLT).					
BENJAMIN. Benjamin Elec., Ltd., Tariff Road, Tottenham, London, N.17.	Substitute **S.P.55/B.**	35.0	55,000	0.09	14/-	Blue Spot.
	Substitute **S.P.55/R.**	6.0	3,500	0.25	22/6	Red Spot.
B.T.H. British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2.	Substitute **B.7**	8.0	12,000	0.06	18/6	
COSMOS. Metro-Vick Supplies, Ltd., 145, Charing Cross Road, London, W.C.2.	Substitute **S.P.55/B.**	35.0	55,000	0.09	14/-	
	Substitute **S.P.55/R.**	6.0	3,500	0.25	22/6	



CURRENT TOPICS

Events of the Week in Brief Review.

THE BIG VOICE.

Cologne Cathedral has been fitted with 22 loud-speakers.

oooo

NEW R.A.F. STATION.

Land has been purchased near Mitcham Common by the Air Ministry for a wireless transmitting station.

oooo

ANOTHER SHORT-WAVE BROADCAST.

WLW, the Crossley broadcasting station at Cincinatti, must be added to the list of American stations transmitting on short wavelengths. WLW now broadcasts on 52.02 metres in addition to its normal wavelength of 422.3 metres.

oooo

WIRELESS IN THE WATER.

Otto Kemmerich, the German swimming champion, has set a precedent by swimming for an hour in the North Sea while listening to a broadcast programme from Hamburg. The headphones were secured in a specially constructed cap. He considers that broadcast music is more invigorating than that supplied by tug musicians, who often become seasick!

oooo

D.F. TEST FLIGHT.

An aerial voyage from Paris to Dakar, *via* Tunis and Timbuctoo, has been undertaken by two French officers, Lieutenant Girardot (pilot) and Captain Cornillon (observer), with the object of testing the efficacy of wireless direction-finding in the air. In the outward and return journeys the airmen will cover a distance of over 4,000 miles.

oooo

LISTEN TO-NIGHT FOR PCJJ.

The Philips short-wave experimental station PCJJ, which has aroused so much interest by establishing communication with Bandoeng and Sydney and with amateurs in various parts of the globe, has issued a working schedule for the present week.

Transmitting on 30.2 metres, the station will work from 7 p.m. to 11 p.m. (G.M.T.) on Wednesday, Thursday and Friday. High power is used, and PCJJ should be heard with ease on all short-wave sets in this country.

BETTER LATE THAN NEVER.

The Bulgarian Government has decided to issue permits to private citizens to operate wireless sets.

oooo

AN IRISH DEBUT.

The Cork broadcasting station (6CK) was officially opened by the Irish Free State Government on Monday last, April 25th. Its wavelength is 400 metres.

oooo

TONGUE TEST BY TELEVISION.

The success attending the recent television demonstration in New York has already stimulated the imaginations of American journalists. One genius has discovered that television would make it possible for a physician in New York to ring a patient in some other city and examine his tongue.

GERMAN LICENCE FIGURES.

The number of licensed German listeners increased during March by 51,664 to 1,635,728. This figure is still considerably behind that of Britain.

oooo

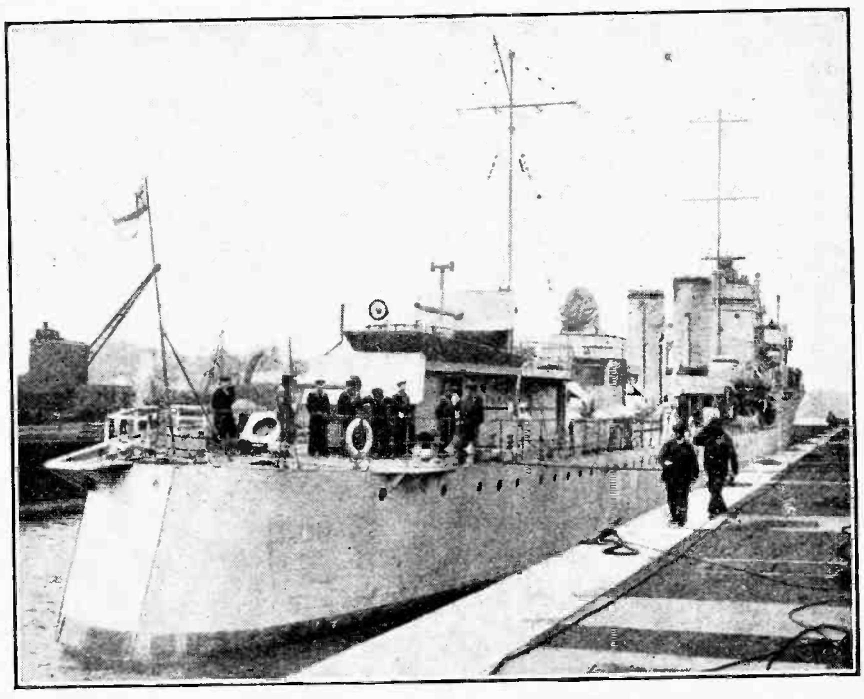
LECTURES IN BATTERSEA.

Readers in the Battersea district will be interested in an announcement regarding a new course of wireless lectures appearing under "News from the Clubs."

oooo

INDIAN BEAM SERVICE IN JUNE?

Official tests with the beam wireless station at Poona (Bombay Presidency) are expected to begin in May. If they are successful a public beam service between this country and India may be inaugurated before the end of June.



DESTROYER WIRELESS. H.M.S. "Ambuscade," a new destroyer, built on the Clyde, which has just been commissioned at Chatham. A feature of the aerial system is the abundance of insulators; no power leaks are tolerated in the Navy!

ALMSHOUSE WIRELESS.

Each of the almshouses associated with St. Giles-in-the-Fields Church, Bloomsbury, W.C., has been presented with a wireless set by Mr. C. Shortland, a warden of the church.

oooo

MARCONI CONCESSION IN BOLIVIA.

A Decree has been signed granting to Marconi's Wireless Telegraph Co., Ltd., the administration of the post, telegraph and wireless services in Bolivia for 25 years from April 15th.

oooo

BELGIAN-U.S. WIRELESS SERVICE.

Successful experiments in two-way wireless communication recently conducted between the Belgian station at Ruysselede and New York are likely to lead to the establishment of a public service in about two months' time.

oooo

THE SURPLUS FIVE HUNDRED.

"From the listener's point of view, out of 733 stations (in the United States) there are about 230 stations that the listener wants," says the Iowa Radio Listeners' League, in evidence given before the new Federal Radio Commission.

oooo

FREE RECEIVERS FOR THE BLIND.

A free receiving licence is an ironical concession to a blind man who cannot afford a receiving set. For the benefit of blind people unable to buy wireless sets, the National Institute for the Blind is raising a fund for providing them with receivers free of cost.

Persons wishing to contribute to the fund are asked to send their gifts to Mr. Henry Wagg at the offices of the Institute, 224-228, Great Portland Street, W.1.

oooo

BRAILLE WIRELESS JOURNAL.

From the well-known French publishing house of Etienne Chiron, 40, Rue de Seine, Paris, 6e, we have received a copy, printed in Braille, of the *International Radio Review*, specially intended for blind readers.

Written in Esperanto, the *International Radio Review* should have a wide appeal among blind wireless enthusiasts of all nations. The editors are Dr. Pierre Corret and M. E. Aisberg, and the paper is now in its second year.

oooo

THE U.S. BROADCASTING POSITION.

The new U.S. Federal Radio Commission has granted temporary permits for 27 old broadcasting stations to continue operations on their present wavelengths, writes our Washington correspondent.

Every broadcasting station in the United States which desired to continue transmissions after April 24th had to secure a temporary permit from the Commission. At the time of writing it is doubtful whether all the stations will secure this coveted privilege.

At least 40 stations are being penalised by being placed at the bottom of the waiting list for the crime of seizing Canadian wavelengths.

oooo

LOUD-SPEAKER LAMENTATION.

With the approach of warmer weather comes a renewal of the unpleasant practice of planting the loud-speaker in the open window so that all the world can hear what is going on at 2LO.

The correspondence columns in the daily Press are growing eloquent on the subject, and one writer cites a case in which a raucous loud-speaker produced nervous prostration and a doctor's bill in the house next door. Another complainant recommends that all loud-speakers sold should be incapable of producing a greater volume than is necessary.

The sensible remedy lies with the owners of the loud-speakers. When the instrument is placed in the open air the considerate listener will remember to cut down the volume to the comfortable minimum.

oooo

A DRASTIC REMEDY.

A summary method of dealing with the loud-speaker nuisance is described by a correspondent of the *New York Times*, who writes :—

> For the benefit of previous correspondents may I describe a method of silencing objectionable loud-speakers and getting as much enjoyment out of doing so as an artilleryman gets out of watching his shells do their stuff?
>
> My friend Mike, who is a radio fan when he is not delivering ice, has perfected but not patented the process. . . .
>
> Now Mike built a set on a board and used the famous "Carpet of Bagdad" circuit, which is a "blooper" of the first order. He gives it a little extra in the way of plate voltage and then turns his dials and listens for the squeals in the near-by sets. If they detune, he follows them up until they become disgusted, and give up. It's rare sport: better even than poisoning howling cats. AL.

This is so simple that we wonder why we hadn't thought of it before.

NEWS FROM THE TRADE.

Cabinets for Every Type of Receiver.

Home constructors are generally able to make a good and workmanlike job of the electrical parts of their receivers, but may not have the necessary tools or experience for the superfine cabinet work. For these Messrs. Carrington Manufacturing Co., Ltd., "Camco" Works, Sanderstead Road, South Croydon, can supply any size or make of cabinet at a reasonable price. Though they have recently moved to more extended premises in South Croydon, their vans still make daily deliveries in London.

oooo

Hart Batteries at School Exhibition.

The Hart Accumulator Co., Ltd., exhibited several types of "Hart" batteries at the Commercial Exhibition of the Haberdashers' Aske's Hampstead School held at Westbere Road, N.W.2, on March 29th, 30th, and 31st. The display included batteries for wireless, traction, motor starting and lighting purposes, together with samples of the raw materials used in their manufacture. The exhibition interested many past and present pupils of the school.

oooo

The "Polar-three" Envelope.

From the Radio News Bureau, Ltd., Brownlow House, 50-51, High Holborn, W.C.1, we have received a constructors' envelope containing the information necessary for building the well-known "Polar-Three" receiver manufactured by the Radio Communication Co., Ltd. The envelope contains a full-size blue print wiring diagram, full-size drilling template, photographs, coil chart, and other information.

oooo

A Crime Averted.

The London showrooms of Messrs. Leslie McMichael, Ltd., were recently the scene of the exciting arrest of a man subsequently sentenced to four years' penal servitude at the Old Bailey for fraud. The man had attempted to obtain by dishonest means a 7-valve supersonic receiver de luxe, valued at £49, and the set was to have been demonstrated at his flat on the evening of the day in question. The police intervened, however, and the man received a surprise when he returned to the showrooms in the evening to take possession!

CATALOGUES RECEIVED.

Readers wishing to obtain copies of the catalogues mentioned below should apply to the manufacturers direct. It is advisable to enclose stamps for postage.

J. Dyson and Co., Ltd., 2, Coleman Street, London, E.C.2. Leaflets describing the "Thornburn" and "Godwinex" H.T. Eliminators, the "Microtune" variable condenser, and the "Airmax" Low-Loss Coil.

C. Ede and Co., Ltd., Byfleet, Surrey. Leaflet describing the C.E. Precision Floating Valve Holder, Rheostats, Potentiometers, and Grid Leaks.

C. A. Vandervell and Co., Ltd., Acton, London, W.3. Abridged list (Publication No. 72) of new C.A.V. Broadcast Receivers, Loud-Speakers, and L.T. and H.T. Accumulators.

Garnett, Whiteley and Co., Ltd., "Lotus Works," Broadgreen Road, Liverpool. Pamphlet No. 1,013, "The Uses of *Lotus* Jacks, Switches and Plugs," together with blue-print showing circuits for use with *Lotus* jacks and switches. Also blue-print and directions for *Lotus* Remote Control House Wiring System.

Afa Accumulators Limited, 120, Tottenham Court Road, London, W.1. List No. 4, dealing with the Varta "Duplex" Rectifier for charging H.T. and L.T. batteries from A.C. supply.

Electradix Radios, 218, Upper Thames Street, E.C.4. 68-page catalogue of wireless transmitting and receiving experimental gear, including sets, components, and accessories.

NEW FOUR-ELECTRODE VALVES.

High Efficiency on Low-plate Voltage.

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

SOME time ago[1] the writer pointed out some of the possibilities of the four-electrode valve when suitably designed for the work it has to do, instead of being, as it was at that time, an even worse compromise than was the old type " general-purpose " valve.

Since that time a large amount of research has been carried out by the writer on four-electrode valves in the electrical laboratories of East London College, and many experimental valves have been made and tested in the course of evolving really efficient designs for H.F., L.F., and power valves to operate on very much lower plate voltages than the three-electrode type of valve.

The complete results of these experiments will be published in due course, but it may be said here that it has been found possible to construct a four-electrode valve to have characteristics the same as, or, in some cases, much better than a corresponding three-electrode valve operating on from twice to three times the plate voltage required by the four-electrode valve; and that, too, without a corresponding increase in plate current. Hence the efficiency of the four-electrode valve is much greater than that of the more usual type.

In view of the foregoing remarks, it is extremely interesting to see what the applications of an efficient four-electrode valve are likely to be.

Valves of the Immediate Future.

The writer is strongly of the opinion that the valve-types of the immediate future —*i.e.*, those valves the use of which will extend rapidly—are three in number, namely :

(1) The externally heated cathode or " Mains " valve.

(2) The " Short Path " type of valve.

(3) The four-electrode valve.

The " Mains " valve will obviously extend in use in those districts where power supplies are available, since it does away with all batteries, and is capable of dealing with large volume outputs with very good quality, since large plate voltages are obtainable without much bother and fuss. It is probable that high amplification valves of this kind will be produced which will still further extend the usefulness of this type of valve, but it must be remembered that the use of this type is stictly limited to places where main supplies are available.

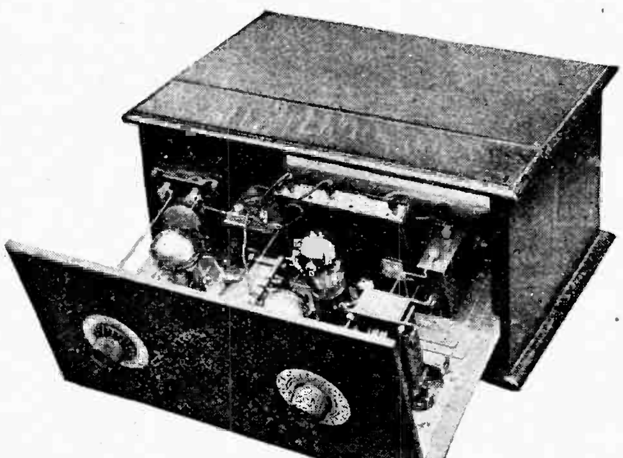
The " Short Path " type of valve is, or can be, made more efficient than the normal three-electrode owing to its peculiar construction, which enables high amplification to be obtained with relatively low resistance, so that it appears that this type should be among the survivors in the course of the next few years.

The four-electrode valve, designed to operate on low plate voltages will have an immediate application in country or other districts where main power supplies are not available, and also for portable sets, where any economy in batteries is at once appreciated, and will enable a really light portable loud-speaker receiver to be constructed which is capable of receiving many stations on its own self-contained frame aerial.

The Neglect of the Four-electrode.

The four-electrode valve has been sadly neglected, in this country especially, and probably what has contributed more to its present unpopularity with most valve manufacturers than anything else is the so-called H.T.-less circuit, to which attention was devoted some time ago.

This scheme was all right for oscillation and detection, though, of course, not so efficient as when a high-tension battery was used, but when it comes to amplifying for loud-speaker results, it simply *cannot* be done with good quality results combined with good volume without the use of a high-tension supply.

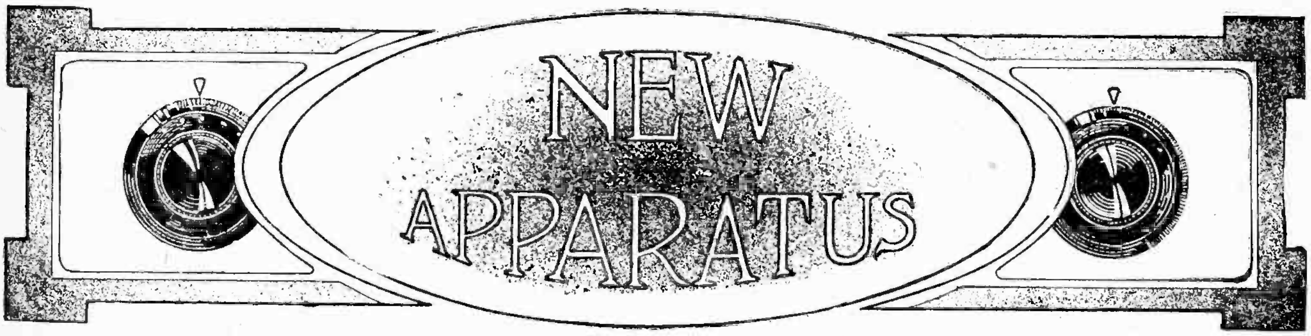


A power amplifier for 40 volts H.T.

However, when the valve is *properly* designed for low voltage (not *no* voltage) operation, it then compares more than favourably with the usual type of valve, and valves so designed may be used in sets formerly employing three-electrode valves with no alterations to the components and with the addition of only one extra lead to the high-tension battery, which latter may be reduced to a half or even a third of its original value, thus considerably reducing the upkeep or maintenance cost of the set, while still keeping the same output volume and with probably better quality reproduction.

A two-stage power amplifier, using *efficient* four-electrode power valves, will be described, with full constructional details, in an early issue. This amplifier (see photo) is capable of giving an output volume more than sufficient for the average room on as little as 30 volts H.T., while the volume obtainable using 60 volts H.T. is sufficient for filling a small hall—these large volumes being given with good quality reproduction.

[1] *The Wireless World*, July 21st, 1926

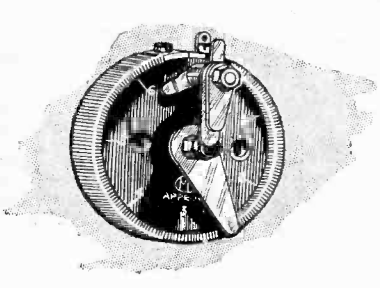


A Review of the Latest Products of the Manufacturers.

M.H. BASEBOARD RHEOSTATS.

The practice of using variable filament resistances controllable from the front of the instrument panel is now being discontinued in favour of the adoption of adjustable resistances secured to the baseboard. New types of valves introduced within the past few months do not require a critical adjustment of filament potential, and when once suitably adjusted these valves will give good performance in spite of small changes in the voltage derived from the accumulator.

A new component for controlling filament current has just been placed on the market by L. McMichael, Ltd., Hastings House, Norfolk Street, Strand, London, W.C. It consists of a turned ebonite former carrying a strip mounted resistance winding. The arm rotates over the resistance wire as in the usual form of knob-controlled rheostat, and when the best setting has been found no further adjustment is required. A useful feature is that the rheostat is actually calibrated in ohms, and the resistance introduced into the circuit by the rheostat can be read off from engraved markings. These baseboard mounting rheostats are available in values suitable for use with either bright or dull emitter valves. The centre spindle revolves in a brass bush, and the contact spring makes hard contact on the wire, though giving quite a smooth



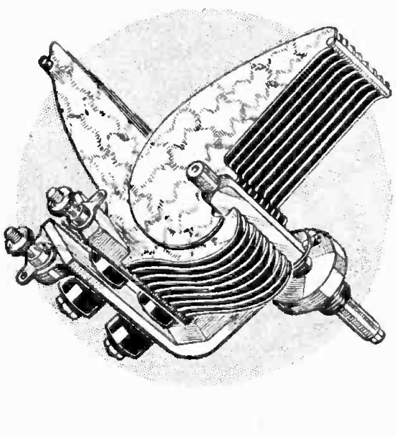
The new M.H. baseboard mounting adjustable rheostat carrying a scale calibrated in ohms.

movement, while a hard spring reinforced by a stiffening plate picks up contact with the spindle. The metal parts are plated, and this component possesses a first-class instrument finish.

THE FORMO CONDENSER.

A condenser of novel construction has recently been designed by the Formo Co., Crown Works, Cricklewood Lane, London, N.W.2.

Instead of the usual end plates with spacing washers and rods, the fixed plates are held in position by means of a stiff metal casting. Support for the fixed



The new Formo condenser. A stout metal casting supports the fixed plates and spacing washers are dispensed with.

plates is obtained by two bolts passing through the frame with stand off insulating washers and to minimise dielectric loss a liberal air space is left between the fixing screws and the holes in the frame. Instead of spacing washers both fixed and moving plates are securely clamped in position on slotted bars. The plates are firmly held in position, making reliable electrical contact. The shape of the plates is a little unusual as they do not truly follow either a straight line wavelength or straight line frequency law and neither does the increase in capacity follow a logarithmic scale. For tuning circuits possessing an appreciable capacity when the condenser setting is at zero the straight line frequency condenser has been found a little inconvenient, and the shape adopted in this case appears to give a useful spacing between stations over the scale divisions of the dial.

PILOT ART DIAL.

Geared condenser dials operating under a cover and provided with an aperture through which the scale is viewed are now practically standard as tuning controls on American receiving sets. Dials of this type are now becoming popular in this country, though as a rule they are more costly than the simple form of bevelled disc.

An inexpensive dial of American manufacture is now obtainable from Messrs. Rothermel Radio Corporation of Great Britain, Ltd., 24-26, Maddox Street, Regent Street, London, W.1, and is a product of the Pilot Electric Manufacturing Co., Inc. In spite of its low price, is well made and possesses all the features to be found in the more expensive types. The cover is a clean moulding of good design, and two scales are provided, advancing in opposite directions, so that the dial can be used with condensers in which the capacity increases either in a clockwise or anti-clockwise direction. The scales are divided into one hundred divisions. Gearing is arranged by means of a positive friction drive which entirely avoids backlash. The operating knob projects about an inch above the surface of the dial cover, so that the hand is well removed from the plate of the condenser in the process of tuning. Covered dials of this type should not be

The new Pilot dial.

as large as the circular bevelled dial, and this new Pilot dial measures 4in. in height by 3⅜in. in width. The dial is easily attached to the condenser shaft by means of a grub screw, while a nut and bolt, together with template card, are supplied for locating the cover.

FIELD WINDINGS for Moving-coil Loud-speakers.

Calculation of the Turns for Different Magnet Cores and Supply Voltages.

By G. W. SUTTON, B.Sc.

SEVERAL enquiries have recently been received from experimenters wishing to wind an exciting coil for a moving-coil loud-speaker to work from some particular voltage, such as the 100- or 200-volt D.C. mains. Since the available winding space in such instruments is likely to vary with the type of construction adopted in different cases, it is scarcely sufficient to work out the approximate number of turns and gauge of wire required in a given instance. A method of estimating these quantities for any voltage and winding space is therefore given below, so that experimenters may readily meet their particular requirements.

The governing factor is, of course, the number of ampere-turns (*i.e.*, the product of the turns on the exciting coil and the current flowing in it) which it is thought necessary to employ. This in its turn is determined by the air-gap field-density required for satisfactory operation. If great care is taken in the construction of the moving-coil, so that it may be accommodated in a very short air-gap, say, $\frac{1}{16}$in., 700-800 ampere-turns will be found to give a sufficiently intense field. With longer gaps a proportionately larger number of ampere-turns will be required. Such proportions result, incidentally, in a field density three or four times as great as can be obtained from an ordinary permanent magnet system.

Winding Space.

The cross-sectional area of the winding will be determined by the size of the casting or stampings to be used. If we take, for example, the case of the instrument described in *The Wireless World*, February 9th, 1927, the area available is $3.5 \times 1.9 = 6.65$ sq. cms. Allowing a space factor of 0.75 for uneven winding and overall insulation the space actually occupied by the winding is approximately 5 sq. cms. In the construction described in that article D.C.C. wire (No. 22 S.W.G.) was used. The thickness of the cotton insulation further reduces the space in that case to about 2.6 sq. cms. of actual copper. The finer the wire the greater would this reduction become, and considerable improvement would obviously result from the use of enamelled wire.

If T and d represent the correct number of turns and diameter of wire (copper only—not including insulation)

$$T \times d^2 = \text{some constant, } k_1 \quad \ldots\ldots\ldots \quad (1)$$
$$= 2.6 \text{ sq. cms. in above case.}$$

The second determining factor in our calculation is the allowable temperature rise in the winding. This limits the current which may be passed through a given coil without charring the insulation on the innermost and therefore hottest turns. A large proportion of the heat generated in such a construction as the one being considered has to be conducted to the iron stampings and radiated from their surface. If the coil is totally enclosed, as in the case of the "Magnavox," the whole of the heat has to traverse such a path. It is, therefore, necessary to have the best possible thermal contact between the surfaces of the coil and the iron on which it is wound. A layer of enclosed air is particularly bad in this respect. The coil should be wound on a thin, built-up, leatheroid former, which fits the iron-core both internally and at the ends as closely as possible. This is a point well worth attention, as it directly affects the possible efficiency of the finished instrument.

The power which may safely be dissipated in the winding is estimated in the following manner. The surface being normally situated in still air, the power radiated per sq. cm. of surface may be taken to be 0.0012 watt per degree Centigrade rise in temperature. A rise of about 40° C. on the outside is allowable so long as the constructional detail mentioned above is satisfactory. The internal temperature should not then be more than 65° or 70° C. The radiating surface is roughly estimated from the dimensions of the coil and core. In the present case it is 170 sq. cms.

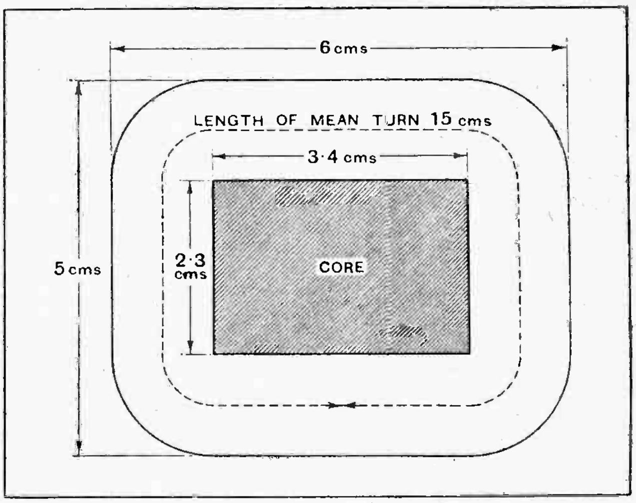


Fig. 1.—Example showing method of arriving at length of mean turn.

The power radiated from the surface under conditions of continuous running is therefore $0.0012 \times 40 \times 170 = 8.1$ watts.

For our second equation we may therefore write

$$V^2/R = k_2 = 8.1 \text{ watts} \quad \ldots\ldots\ldots \quad (2)$$

The resistance R may be readily expressed in terms of the number of turns, diameter of wire, length of mean turn and specific resistance of copper. R will be directly

Field Windings for Moving-coil Loud-speakers.—proportional to the number of turns T and inversely proportional to the square of the wire diameter d,

i.e., $$R = T \times \frac{1}{d^2} \times k_3 \text{ ohms} \quad \ldots\ldots (3)$$

The length of mean turn is estimated from the dimensions of the bobbin (see Fig. 1) to be 15 cms., while the specific resistance of copper (hot) may be taken to be 0.02 ohm per metre per sq. mm. If only one turn were wound on in such a way as to fill the whole winding space the resistance would be

$$\frac{15}{100} \times \frac{1}{\frac{\pi}{4} \times 2.6 \times 100} \times 0.02 = 14.6 \times 10^{-6} \text{ ohm},$$

i.e., when $T = 1$, $d^2 = 2.6$ and $R = 14.6 \times 10^{-6}$; hence from equation (3) $k_3 = 38 \times 10^{-6}$.

In the present case, therefore, $k_1 = 2.6$ sq. cms., $k_2 = 8.1$ watts, and $k_3 = 38 \times 10^{-6}$ ohm.

From equations (1), (2) and (3)

$$V = \frac{\sqrt{k_1\,k_2\,k_3}}{d^2} \quad \ldots\ldots\ldots (4)$$

and

$$IT = \sqrt{\frac{k_1\,k_2}{k_3}} \quad \ldots\ldots\ldots (5)$$

The first expression enables the correct diameter of wire to be at once obtained for any operating voltage; and then from equation (1) the number of turns may also be found. The second expression shows that the ampere-turns which can be obtained in a given winding-space, allowing a definite temperature-rise, is independent of the working voltage, provided, of course, the number of turns and gauge of wire are adjusted to the voltage.

An Example.

In the present case the operating voltage is 6. The required wire diameter is found from equation (4) to be 0.069 cm.; and the turns from equation (1) to be 550. Actually 520 turns of 0.071 cm. (No. 22 S.W.G.) were used. The calculated ampere-turns are 745; the instrument as wound having 710 at 6 volts.

As mentioned above, if it is desired to operate the coil from a higher voltage it would be preferable to use enamelled wire so as to avoid waste of winding-space. If, therefore, a coil is required to operate direct from 100-volt mains, the winding space may be taken as 5.0 sq. cms. instead of 2.6. The diameter of the wire is found to be 0.0198 cm., nearly No. 36 S.W.G.; the number of turns is 12,700 and the resistance 1,100 ohms.

To work straight across 200-volt mains about 25,000 turns of 38 or 39 S.W.G. would be necessary. The labour of winding such a coil is scarcely worth the economy effected, and a preferable arrangement would be to connect a 200-volt 40-watt lamp in series with the 100-volt coil mentioned above.

Calls Heard.

Extracts from Readers' Logs.

Antwerp.

Great Britain :—G 2AO, 2OD, 5BY. U.S.A. :—NU 1AHI, 1AJM, 1ALZ, 1AMJ, 1AMN, 1AQT, 1ASF, 1AYX, 1BUX, 1BYV, 1CMX, 1CQ, 1IC, 1RD, 1RY, 1SW, 1VC, 2ADM, 2AKV, 2GP, 2OX, 2TP, 2XAD, 3BGG, 4BL, 8AHC, 8AHK, 8ALY, 8AXA, 8BAJ, 8OQ, 8ZG, 98RN, 9CCA, 9SD. Canada :—NC 2FO. Saigon :—AF 1B. Brazil :—SB 1AD. Jamaica :—NJ 2PZ. Chile :—SC 3AG. South Africa :—FO A5X, A6N. Norway :—LA1A. Spain :—EAR 41. Sweden :—SMUK. Austria :—EA OHK. France :—EF 8JN, 8CT, 8YOR. Irish Free State :—GW 18P. Belgium :—EB 4AU, 4WW, 4ZZ. L. Era. On 20 metres. (EB 4BC).

Wimbledon.

Jan. 1st to April 10th.

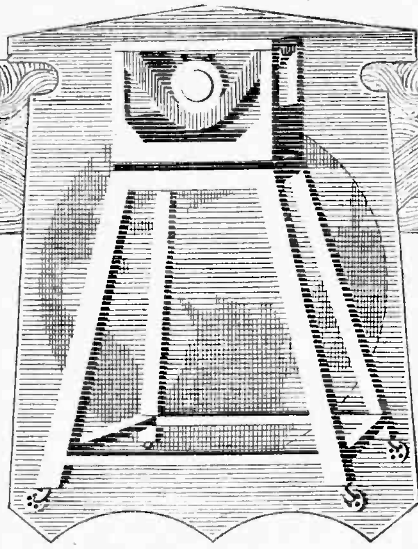
U.S.A. :—NU 3ACM, 3ACW, 3AFW, 3AHL, 3AJ, 3AJC, 3ANY, 3AUV, 3AY, 3BG, 3BHV, 3BQJ, 3BWT, 3CAH, 3CDS, 3CE, 3CKL, 3CKJ, 3EF, 3GB, 3GP, 3GX, 3HG, 3JO, 3KU, 3LD, 3PF, 3QE, 3QF, 3SK, 3TE, 3TN, 3VF, 3WID, 3WJ, 3ZO, 4AAH, 4AAO, 4AK, 4BN, 4CV, 4DD, 4DV, 4EC, 4FT, 4GZ, 4HX, 4HY, 4IO, 4IT, 4IZ, 4LL, 4NH, 4OB, 4RM, 4RR, 4RY, 4TE, 4TK, 4TU, 4YB, 5EW, 5HE, 5ZAV, 6BZF, 6OI, 7DBE, 9AAO, 9ADN, 9AEK, 9ARN, 9BE, 9BRC, 9BTZ, 9CN, 9CPM, 9CWN, 9CYW, 9DIH, 9DQR, 9DQW, 9DR, 9DVG, 9MN. India :—AI 2KX, DCR. Philippines :—OP 1AU. Canada :—NC 1AD, 1AR, 1DJ, 1DQ, 2AX, 2BE, 2DO, 2FO, 3AEL, 3WAB, 8RG. Australia :—OA 2MS, 2NO, 2YI, 3BQ, 3DC, 3HL, 3XO, 5AX, 5JA, 5WH, 6WA. Tasmania :—OA 7CW, 7DX, 7HL. New Zealand :—OZ 2XA, 4AA, 4AC. South Africa :—FO A3W, A3X, A5X, A6N, A9A. Argentine :—SA DB2, DH5, HG1. Uruguay :—SU 1BU, 1CD, 1CX, 1OA, 1XM, 2AK. Chile :—SC 2AS. China :—AC 8FJE (?8FJT), 8FLO. French Indo-China :—AF 8FOK, 1B, HVA. Siam :—AE 1BK. Costa Rica :—NR CTO. Brazil :—SB 1AD, 1AF, 1AJ, 1AK, 1AL, 1AO, 1AR, 1AW, 1BK, 1BR, 1BY, 1BU, 1CA, 1IB, 1IC, 1ID, 2AB, 2AG, 2AJ, 2AM, 2AR, 2AS, 2AV, 2AX, 5AB, 5AE. F. Pemberton. On 20-45 metres (0-v-1).

Wolverhampton.

January 23rd to March.

Great Britain :—G 2LJ, 2HQ, 2GF, 2WN, 2CS, 2VR, 2VG, 2DL, 2YQ, 2QM, 2WJ, 2PZ, 2DN, 2AY, 2VL, 2GV, 2BM, 2DR, 2BI, 2DB, 2DX, 2QC, 2SO, 5OC, 5LK, 5UW, 5US, 5TG, 5XD, 5KU, 5ZA, 5WQ, 5SK, 5GO, 5HX, 5GQ, 5VL, 5PM, 5KZ, 5UL, 5DH, 5IS, 5LF, 5WH, 5JW, 5TU, 5W, 5GU, 5SZ, 5TG, 5XH, 5TD, 5RZ, 6UT, 6FT, 6RY, 6QO, 6LL, 6LR, 6BT, 6OU, 6DR, 6BD, 6YU, 6XP, 6YR, 6QL, 6VP, 6WG, 6TW, 6CL, 6WK, 6HQ, 6FD, 6OO, 6YD, 6MA, 6ZG, 6TG, 6JS, 6YV, 6ZD, 6HW, 6DA, 6IA, 6RO, 6XL, 6TY, 6AT. GC 6NX, 6IZ, 6KO, 6MS, 6JS, 5JD. GI 2IT, 5MO, 5WD, 6MU, 6WG, 6QD. GW 11B, 14B, 16B, 18B. France :—F 8IL, 8FL, 8RV, 8OUI, 8UT, 8JD, 8DDH, 8FLM, 8CP, 8IH, 8DS, 8KU, 8VAA, 8GDB, 8CA, 8JR, 8HIP, 8JRK, 8ESP, 8GER, 8DL, 8YA, 8OQA, 8PJW, 8SSY, 8NCX, 8PI, FFY. Morocco :—8MB, 8RIT, AIN. Belgium :—B O5, O8, K4, K3, K44, C9, 4RE, 4AI, 4BL, 4RK, 4XX, 4CB, BAR. Canada :—3CF. U.S.A. :—KDKA, WIK, WIZ, U980. Holland :—N OBX, OM, OGA, ONF, OFK, OMAR, OLY, OWJ, OBLX, OEC, PCMM. Sweden :—SMVR, SMUK, SMZY. Italy :—I 1RE, 1DM, 1CE, 1FO (1CE 1 watt). Spain :—EACI, EAR6, EAR22, EAR28, EAR44, EAR48, EAR50. Denmark :—D 7WA, 7MT, 7EC, 7LO, TFJ. Portugal :—1AF, 1AO, 1AA. Tunis :—OCTU. Luxemburg :—L 1P. Germany :—K K4, K6, 4ABF, 4AEM, 4ABK, 4DKA, 4BCE, 4AAP, 4DR. Egypt :—SUC2. Various :—B W1, EC 1AB, EAKL, GBM, GFY, GBZ. W. O. Wigg. On 35-60 metres (0-v-0).

BROADCAST BREVITIES



SAVOY HILL TOPICALITIES.

By Our Special Correspondent.

S O S.—Crowding at Savoy Hill.—Ship Broadcasts.—Regional Scheme Reflections.—The Music Halls.

New Job for the B.B.C.?

There are still people who, to use an Army expression, "want jam on it." Among this optimistic throng I am inclined to class a celebrated actress whose letter appeared in an evening newspaper a few days ago.

"Could not the B.B.C. (she wrote) in sending out its SOS messages tell the relative concerned the time of the next train from his or her town to the town where the sick person is? For London people it would be a help, too, to be told which terminus to proceed to."

It would be a pity to spoil the ship for a ha'porth of tar, and I feel sure that the B.B.C., if asked politely, would gladly supply a fleet of SOS vans equipped with camp beds, refreshment hampers and other aids to comfortable travel. It would only entail an addition to the licence fee.

oooo

Pity the Poor Announcer.

If the B.B.C. had to search for train times before distress messages were broadcast much valuable time would be lost. A larger staff would also be needed, otherwise awkward gaps in the programme would ensue while the overworked announcer rummaged through Bradshaw.

Standing Room Only.

Mention of a larger staff reminds me of the lamentation poured into my ear by a B.B.C. official at Savoy Hill a few days ago.

"Enlarging the staff?" he exclaimed in reply to a query. "The building is packed already!"

There is no doubt that the B.B.C. headquarters are unpleasantly congested, despite the additional suites of rooms obtained two years ago when the old Savoy Mansions became B.B.C. property. So serious has the problem of accommodation become that discussions are taking place as to the feasibility of securing further offices somewhere in the Strand.

This will involve decentralisation and will raise mildly invidious questions as to who can and who cannot be spared from H.Q.

oooo

New Premises?

An alternative to decentralisation would be the acquisition or erection of a new broadcasting building, on the precedent set forth by the American National Broadcasting Co. in New York, in which the administrative offices would be grouped round a large hall designed, architecturally and acoustically, for broadcasting purposes. In fact, something on these lines will be almost a necessity in view of the public demand for symphony concerts on a larger scale.

It is hardly conceivable that the recently concluded series of National Concerts at the Albert Hall will find no equivalent next winter, particularly as it was evident that during the last three or four of the series the public began to develop the habit of attending.

oooo

On April 30th.

Nelson Keys will broadcast from 2LO on Saturday next, April 30th.

oooo

Launching Ceremony to be Broadcast.

The ceremony of the launching of the Commonwealth and Dominion liner *Port Gisborne* from the shipyard of Messrs. Swan, Hunter and Whigham-Richardson, Wallsend-on-Tyne, will be broadcast from 2LO and 5XX on April 30th. The transmission will include the christening ceremony, performed by Mrs. John Royden Rooper, a speech by Sir G. B. Hunter, and a description of a modern shipyard and the building of a ship.

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On Board Ship.

Dance music from the R.M.S. *Majestic*, the largest steamer in the world, will be relayed to the Bournemouth station during the evening of May 2nd. The Majestic will be in Southampton Docks on May 2nd, and a ball is to be held on board ship in aid of the Royal South Hants and Southampton Hospital.

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"Daventry Junior" Still Preparing.

The long-delayed experiments from Daventry Junior will probably start early in May, and I hear that the engineers are

THE COMMUNAL AERIAL. Instead of the usual array of unsightly aerial poles, these new houses of a Bradford estate are provided with the modern "maypole," shown in the photograph.

fairly confident of success. The main uncertainty associated with high-power transmissions on the short broadcast band is in regard to the question of interference with ship and commercial stations.

In this respect it is assumed that Daventry Junior will benefit from its position in the centre of England, far from the shipping routes and other channels of wireless intercourse.

If, as is expected, the tests are completed in a shorter time than was originally planned, I should be prepared to wager that the first regional high-power station will be in regular operation much earlier than the time originally mentioned, viz., November.

oooo

Choosing Sites.

Then (if the B.B.C. has any money left!) we may see the rapid prosecution of the complete regional scheme. The biggest job—a job beside which the picking of winners would be child's play—will be the choice of suitable sites. Of this, more anon.

oooo

Community Plays in Belfast.

Community plays, like community singing, are on the increase. It is the policy of the Belfast station to assist the growth of the native drama. To this end the Carrickfergus Players, a band of enthusiasts from County Antrim, have been asked to produce one of their own plays in the Belfast studio. This is called "Miss Clegg's Legacy," and will be given on May 6th.

oooo

Russian Exiles at the Microphone.

Russian exiles in the home of their adoption, which is England, are to give a programme from 2LO during the first week in June. Vladimir Polunin, who lives in Chiswick, and is the scene painter to the Diaghileff Russian Ballet, will take a leading part in organising the programme, and his children, who are reputed to be among the most beautiful in England, will sing. A Russian noble who was a prominent figure at the Tsar's Court when Rasputin was killed, will also take part. Princess Zinovieff is another of the singers. The *compères* will be A. P. Herbert, of *Punch*, and L. de G. Sieveking, both of whom will, I hope, make the announcements in English.

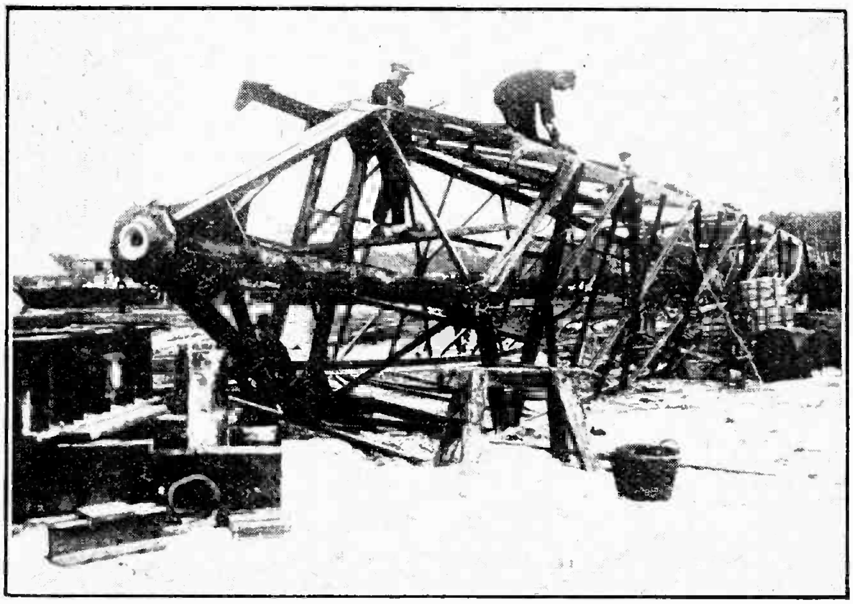
oooo

The Music Halls.

At the moment of writing the air is thick with rumours anent a proposed subsidy of the music hall industry by the B.B.C. in return for permission to employ artists who are in the habit of serving contracts with the "halls."

In the case of the B.B.C. subsidy to the newspapers' direct service in the shape of news is given for value received; in subsidising the music halls, however, the B.B.C. would reap no direct gain, and would, of course, have to pay artists in addition to paying the subsidy.

An annual sum of £60,000 has been mentioned, and although this may seem large, it can at least form a basis for discussion. But I understand that neither Mr. Charles Gulliver nor Sir Oswald Stoll, the leading music hall proprietors, has approached the B.B.C. direct, all the controversy having been conducted through the Press. Until the B.B.C. are approached directly in the matter no end to the present *impasse* is likely.



A CALAMITY IN GERMANY. An aerial mast at Königswusterhausen, erected only a few months ago, which has been blown down in a gale.

FUTURE FEATURES.

Sunday, May 1st.

LONDON.—Light Orchestral Concert.

BIRMINGHAM. — Symphony Concert.

MANCHESTER. — Fodens' Motor Works Band.

Monday, May 2nd.

LONDON.—Act I of "Der Rosenkavalier" relayed from Covent Garden.

Tuesday, May 3rd.

ABERDEEN.—Variety Programme.

BELFAST. — "Handel in other Countries."

Wednesday, May 4th.

LONDON.—Annual Demonstration of the Boys' Brigade relayed from the Royal Albert Hall.

BOURNEMOUTH.—Orchestral Concert relayed from Winter Gardens.

CARDIFF. — Winners at Bristol Eisteddfod—programme.

NEWCASTLE.—A Tyneside Evening.

Thursday, May 5th.

LONDON.—Tchaikovsky Programme.

CARDIFF.—"A May-Time Revel."

ABERDEEN.—"At the Nineteenth Hole," a Golfing Programme.

Friday, May 6th.

DAVENTRY.—St. George's Dinner Speeches.

BIRMINGHAM.—Popular Orchestral Programme.

Saturday, May 7th.

LONDON. — Augmented Military Band.

GLASGOW. — Scottish Humour Series, No. 3.

ABERDEEN.—"The Third Degree," a play by Frank Bremner.

oooo

Broadcasting as an Anæsthetic.

Two or three weeks ago I cast doubts upon the authenticity of a news story from New York concerning an elderly man who successfully underwent a surgical operation to the accompaniment of an "anæsthetic" in the form of a broadcast programme on the headphones.

That the story was not so extravagant after all is shown by the fact that the wireless programmes are frequently put to the same use at King's College Hospital, Denmark Hill, London, S.E. The Chief Engineer at the hospital tells me that patients undergoing painful operations of a minor character are very grateful for the distraction afforded by listening to the 2LO programmes.

The phones in the operating room are connected to the main hospital set—an eleven-valve instrument installed recently under the *Daily News* scheme.

oooo

"Living Composers'" Night.

On May 8th Birmingham listeners will hear a programme of music by living composers, including the "Wand of Youth" suite by Sir Edward Elgar, the Concert Piece for 'Cello and Orchestra by Dohnanyi, in which the soloist will be Leonard Dennis, a member of the Station Orchestra, and also the "Bridal Song" from the cycle of "Sappho" songs by Granville Bantock.

BATTERY ELIMINATORS.

Appliances for the Operation of Radio Receivers by Energy Derived from Electric Supply Mains.

By PHILIP R. COURSEY, B.Sc., M.I.E.E., and H. ANDREWES, B.Sc.

(Abstract of Paper read before the Wireless Section of the Institution of Electrical Engineers.)

THE frequent replenishing or recharging of batteries or accumulators used to supply radio receiving apparatus with H.T. and L.T. has given rise to considerable dissatisfaction, and has created a demand for apparatus which will replace them and provide equivalent voltages and currents derived from the public electric supply mains.

These pieces of apparatus used to supply radio receiving sets are very commonly termed "battery eliminators," but since some types of apparatus which properly belong to this class still make use of batteries or accumulators this term scarcely seems suitable. For this reason they are referred to herein as "radio supply appliances," with the idea that this term is of broader application than the other. A more suitable and general term that could be universally accepted would, however, be desirable.

Theoretical Considerations.

A radio receiver customarily requires three sources of energy, viz., L.T., H.T., and grid bias. It should be particularly noted that these three sources of voltage necessarily have a common connection to the valve filaments. This introduces a complication which must not be overlooked when considering the application of radio supply appliances, since these necessarily have a further common connection in the electric supply mains. Fig. 1 represents the theoretical arrangement rather than a possible actual one, and two at least of these appliances are commonly combined into one unit, or alternatively batteries or accumulators are retained for one of the supplies. The precise arrangement of apparatus necessary to provide an H.T. supply to a radio receiver depends in the first place upon whether the electric supply system from which the radio supply is to be derived is direct or alternating current. In the latter case some form of rectification must be provided.

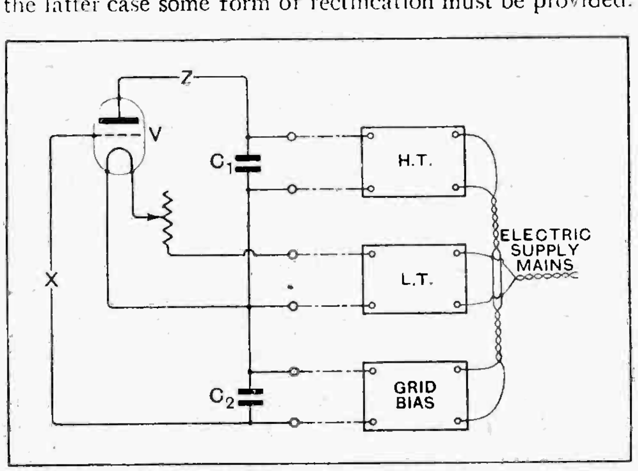


Fig. 1.—Theoretical arrangement of radio supply appliances.

The first essential element of the H.T. appliance is a filter to perform the smoothing action, and this must be combined with a potentiometer or some equivalent device for subdividing the applied voltage into two or more parts. For the A.C. supply circuits some rectifying device must also be added. The essential elements of an H.T. supply appliance suitable for use on a D.C. supply circuit are sketched in Fig. 2. It comprises two input terminals T_1 T_2, across which is shunted usually a pair of condensers

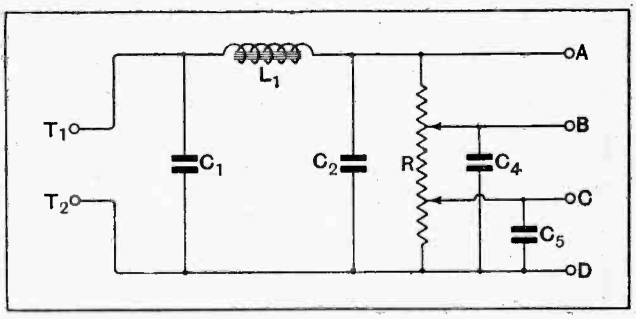


Fig. 2—Simple filter circuit for H.T. supply appliance.

C_1 C_2, between which a choke coil L_1 is connected. This combination acts as a filter to suppress currents of the higher frequencies and to allow the lower frequencies and zero frequency (direct current) to pass through. The first condenser, C_1, by-passes a proportion of the ripple frequencies, since the reactance of the condenser falls for increasing frequencies. The choke L_1 offers an impedance to these ripples which increases with the frequency, thus allowing only the lower frequencies to pass through to the second condenser C_2. This offers a further selective action similar to the first condenser C_1. The general form of this filter is of the well-known "low pass" type.

Double Filter Circuits.

Frequently a further filtering stage consisting of an additional choke coil L_2, and condenser C_3 (Fig. 3), is added to improve the filtering efficiency.

The full voltage across the last or output condenser C_2 (Figs. 2 and 3) is obtained from the terminals A and D, to which the radio set may be connected. With a 220 to 240-volt supply, at least 200 volts is usually available at these output terminals, the difference being the voltage drop due to the resistance of the choke coil or coils L_1 and L_2. Most radio apparatus, however, requires one or more lower voltages in addition to the full output voltage. These may be obtained by a potentiometer arrangement connected across the output terminals A, D, such as is indicated by the resistance R in Figs. 2 and 3, with the

Battery Eliminators.—

two (or more) tapping points connected to the terminals B and C. It is usual and desirable to connect additional condensers—of at least 1 microfarad capacity—across these additional voltage tapping points, as shown at C_4 and C_5. These condensers provide a certain measure of additional smoothing action, but more important is their action in preventing excessive coupling between valves when more than one valve stage is operated from any one tapping point. If the condensers were omitted the varying anode currents drawn by each valve of the radio receiver would be forced to travel through a portion at least of the resistance R, producing across its terminals a voltage drop of the same frequency, which would in consequence be communicated to the remaining valves in the receiver. Low-frequency oscillations, or "howling" of the receiver, would then be very liable to occur. The low impedance offered by the by-pass condensers C_4 and C_5 to the passage of alternating currents effects a considerable diminution of the voltages available for producing such feed-back effects. It is for this reason also that the capacity of the output condenser C_2 must likewise be large. A minimum capacity of 2 microfarads is customarily used, but larger values are desirable.

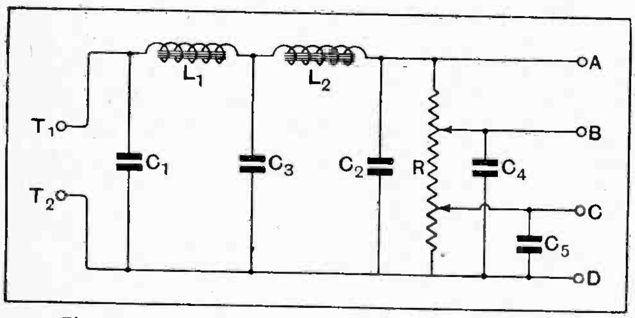


Fig. 3.—Double filter circuit for H.T. supply appliance.

In lieu of the potentiometer arrangements for tapping the output voltage a very frequently used arrangement omits the portion of the potentiometer between the tapping point and the H.T. negative terminal D, so that merely a series resistance is used between the H.T. positive terminal A and the load applied to the tapping terminals B and C. This modification is shown in Fig. 4, in which these series resistances are indicated at R_1, R_2, one being connected in series with each tapping point B and C.

Two by-pass condensers, C_4 and C_5, are shown, connected in the same way as in Figs. 2 and 3. This arrangement is simpler than the potentiometer one, and has the additional advantage of somewhat reducing the coupling between different valves in the radio receiver, since the total H.T. current

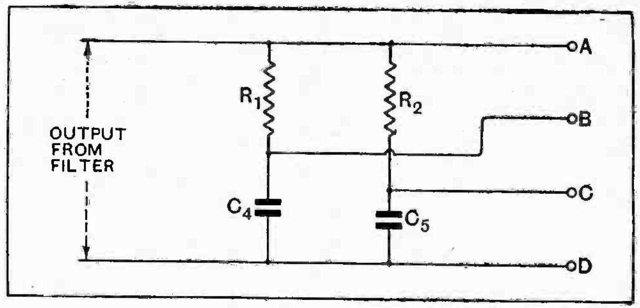


Fig. 4.—Alternative arrangement of multiple H.T. voltages.

drawn by these valves is subdivided through the different resistances. This results, however, in a somewhat greater voltage variation of the tapping points B and C with changes in the load current drawn by the valves.

If a potentiometer arrangement is used on the lines of Figs. 2 and 3, the total resistance, R, needs to be high, or it will draw too large a current through the filter. Normally, the resistance of the chokes L_1 and L_2 is much in excess of 1,000 ohms, in order to obtain a large inductance in a small space, and at a reasonable cost, so that only a few milliamperes can be drawn through the filter without causing excessive voltage drop. For this reason also the method of Fig. 4 is advantageous, as it makes a smaller demand upon the filter. Convenient values for the resistances of R_1 and R_2 are generally found to be between 10,000 and 100,000 ohms, depending upon the voltage and the current desired at each of the tapping points. A small demand for current will obviously require the use of a high resistance, and any considerable change made in the output requirements will necessarily involve a change being made in the resistance values, unless a considerable change in operating voltage is also permissible.

Filtar Circuit Design.

It may be said that there are, in the main, three important electrical factors affecting the design of the filter, apart from economic considerations. In this, as in most other apparatus, the commercial design is to a greater or less extent a compromise between the considerations of

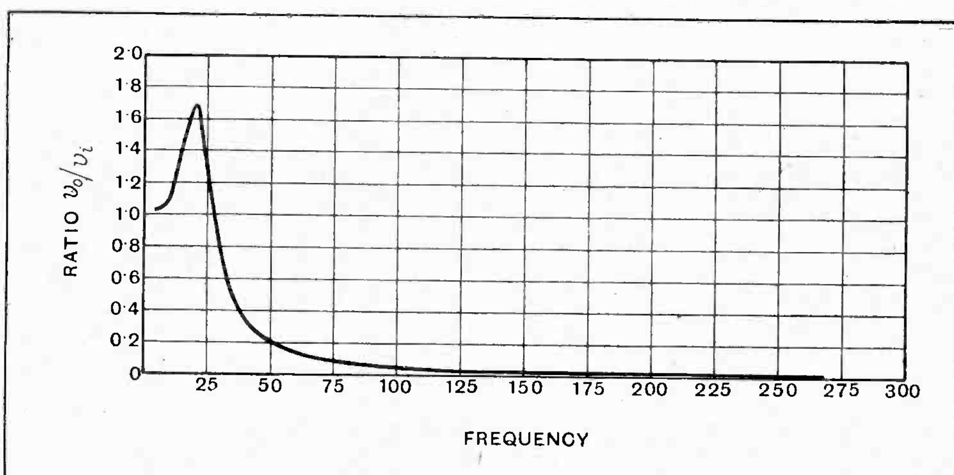


Fig. 5.—A.C. characteristic of a single filter circuit.

Battery Eliminators.—

electrical efficiency and of cost. These three factors are :

(1) The internal resistance of the choke winding.

(2) The resonance or "pass" frequency of the filter.

(3) The output impedance of the output circuit of the filter at audio frequencies.

Improvement of the desirable qualities of all three factors invariably increases the cost of the apparatus.

As regards its effect in suppressing ripple frequencies from the supply circuit, the simple single filter of Fig. 2

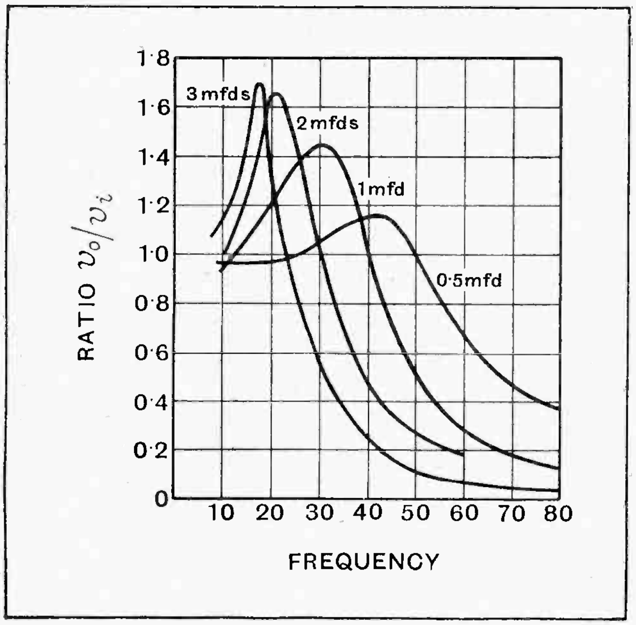


Fig. 6.—Effect of output capacity on A.C. characteristic.

may be regarded as a resonant circuit, consisting of an inductance in series with a condenser, the input being applied across the two in series and the output being taken from across the condenser terminals. This resonant circuit is damped by the resistance of the load circuit (radio receiver) which is connected across the condenser terminals. This resonant circuit is independent of the completely closed circuit consisting of the coil L_1, and the condensers C_1 and C_2 in series. This has been conformed experimentally by plotting the characteristics of such a filter when subjected to applied alternating potentials of various frequencies. The characteristic curve of the filter was, under these conditions, found to be totally unaffected by the capacity of the input condenser C_1. A typical characteristic curve of this type taken on the components of a filter as used in an H.T. supply appliance is reproduced in Fig. 5. The output capacity of the filter does, however, affect the characteristic, as it alters the resonant or pass frequency (see Fig. 6) in which filter output characteristics are plotted for four different values of output capacity for a given choke coil.

Filter Characteristics.

In these curves the ordinates plotted are the ratio of the output voltage to the input voltage. They therefore express the effectiveness of the filter to reduce the amplitude of an applied ripple voltage of various frequencies. Other measurements of similar character have also been made with other factors of the filter varied in turn, and similar characteristics plotted out. These enable the appropriate design of the filter for any given conditions to be arrived at from a consideration of the curves.

The general form of these characteristics shows that for the higher frequencies of 50 cycles and over, particularly for the larger inductance values for the choke coil, the use of the filter gives a considerable reduction in the output of the ripple component. A further reduction in these unwanted components is obtained by the use of a second filter circuit, of the form given in Fig. 3. A group of characteristic curves for such an arrangement is reproduced in Fig. 7.

It may be particularly noted that some of these curves show a subsidiary "hump" which might have a serious effect on the efficiency of the filter, if such a hump should occur near 50 or 100 cycles. The possibility of such occurrences emphasises the desirability of plotting out the

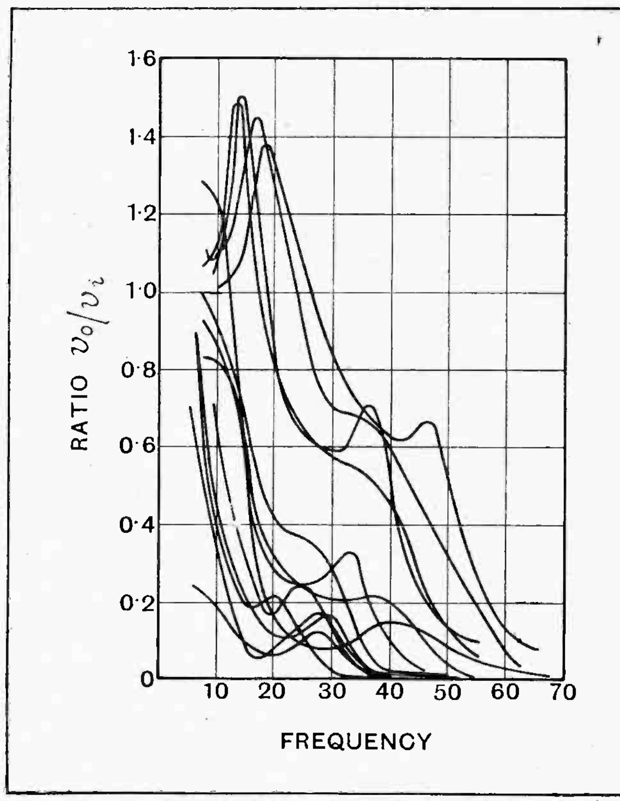


Fig. 7.—A group of A.C. characteristics for various arrangements of double filter circuits with different capacities and inductances. These curves show that a double filter circuit may give worse results than a single filter using the same components unless the correct arrangement is chosen.

frequency characteristics of any filter that it is proposed to use in an H.T. supply appliance.

It is suggested that some definite method of rating the output and characteristics of these supply appliances might be formulated on the lines of the three main electrical characteristics of the filter which are mentioned above, and that such factors might provide a means of adequately expressing the performance of the appliance

Battery Eliminators.—
under working conditions. Probably further experimental work is still required before such a scheme could be formulated completely.

A commonly adopted arrangement for grid bias supply is to insert a resistance in series with the negative return lead to the H.T. appliance, so that the negative terminal of the supply circuit is made more negative than the valve filaments of the radio receiver. This resistance should be shunted by an additional by-pass condenser.

To enable filter arrangements of the above type to be used with an A.C. supply circuit, a number of special rectifying valves are now marketed. Some of these are designed for single-wave, and some for double-wave rectification. Several of these have already been described in these pages.

When the available electric supply system is D.C., the provision of a L.T. supply to the radio receiver is comparatively simple, but is far from economical, since the total current required for the L.T. circuit, which is utilised in the receiver at 4 to 6 volts, must be paid for at the supply circuit voltage. This latter may be as much as 240 to 250 volts, in which case the efficiency of the arrangement cannot exceed about 2½ per cent., while the remaining 97½ per cent. of the energy taken from the mains must be wasted as heat in the series resistance.

Probably the most useful filtering arrangement for L.T. supply is provided by a floating battery connected across the L.T. circuit, appropriate resistances or rectifiers being arranged to provide the requisite magnitude of L.T. supply current, so that the battery across the line is not under discharge, but merely serves to by-pass the undesired ripple frequencies. The battery acts in this connection as a very low resistance shunt, or as a condenser of enormous capacity. A method of L.T. supply, however, which is at the same time a true battery eliminator, would be more desirable.

At the present time it may be said that the most commonly adopted arrangement for supplying a radio receiver is an accumulator for the L.T. supply, with an appropriate supply appliance, or battery eliminator, for the H.T. supply. The L.T. accumulator may be maintained charged by means of some form of trickle charger, or by ordinary charging means. Doubtless, however, further developments in L.T. supply appliances will be made in due course, resulting in the manufacture of apparatus having the reliability and efficiency of some of the present forms of H.T. supply appliance. With some of these latter more attention to the details of design would result in more effective apparatus, capable of greater output, and it is hoped that some of the methods of testing these appliances which are outlined in the paper will be of service to manufacturers, and will lead to a better understanding of their action and design.

TRANSMITTERS' NOTES AND QUERIES

International Relay Contest, May 9th-22nd.

With reference to our note on page 344 of our issue of March 23rd, we are asked by the Communications Manager of the A.R.R.L. to correct the statement, made in error, that only one reply might be received from any one country. While the rules of the contest limit amateurs in U.S.A. and Canada to sending "one message per country," each entrant may accept reply test messages from several stations in each country, but only one message may be accepted by each individual from any one foreign station.

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General Notes.

Mr. Louis Era (EB 4BC), 46, Avenue Van Put, Antwerp, city manager of the *Reseau Belge*, tells us that he has lately been in two-way communication with amateurs in various parts of the world, including O A5A in Johannesburg and FK KTC in Khartoum. The latter station was worked on 32.5 metres with an input of 50 watts at a time when he was unable to pick up any Swedish, American or Canadian stations on 20 or 40 metres.

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A correspondent, who claims to be the first English amateur to receive signals on 20 metres from Honolulu, informs us that OH 6AG is working on 19 and 20 metres and wishes to get into touch with a British transmitter. He is usually on the ether from 2100 to 0000 G.M.T., is also working traffic with U.S.A. from 0130 to 0300 G.M.T., and will be glad to hear from anyone receiving his signals.

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Mr. Collins (NE 8JC), St. Johns, Newfoundland, will be glad if British and Irish amateurs will look out for his signals on 44 to 46 metres. He transmits regularly from midnight (G.M.T.) onwards.

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Mr. W. E. J. Moree (OD PK9), 89, Nakoelaweg, Bandoeng, Java, was in two-way communication on February 20th, between 2055 and 2145 G.M.T., with G 5HY, Mr. Baynham Honri, in London. This he states to be the first intercommunication between amateurs in England and Java. Atmospherics were prevalent and interfered a good deal with the interchange of greetings.

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Mr. Yoshio Imaoka (J KZB), of the research laboratory of the Tokyo Electric Co., in Kawasaki, Japan, is visiting Europe this summer. He expects to be in London from August 4th to 10th, and would like to get into communication with amateurs interested in communication with Japan. Letters should be sent c/o Otto Reimers, Alsterdamm 4-5, Hamburg, Germany. During his absence Mr. S. Osaka will operate J KZB, which sends a regular test every Tuesday, Thursday and Friday from 0800 to 1300 G.M.T., and on the first Saturday of every month from 0800 G.M.T. to the next day. CQ will be sent for 3 minutes each hour, 20 and 40 minutes after each hour, during the 24 hours.

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New Call-Signs Allotted and Stations Identified.

G 5FQ E. H. Capel, 11, Gerrard Road, Harrow. (Change of address.)

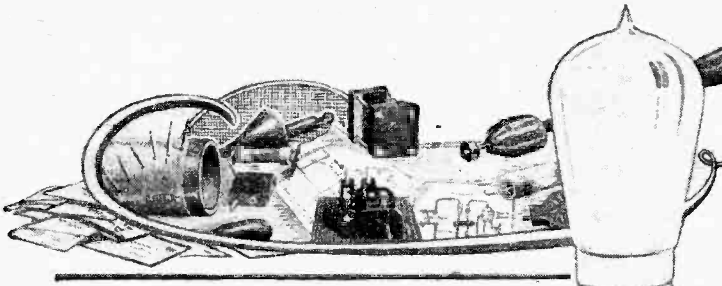
G 5KH H. D. Cohen (144, West Hill, Putney, S.W.15. (Correcting the entry on page 500 of our issue of April 20th, when the name was incorrectly given as R. H. P. Collins.)

G 5NQ A. C. Mercer, Straithgate, 222, Rooley Lane, Bankfoot, Bradford. (Change of address.)

G 5RT R. W. T. Brewer, "Dorchester," Mile End Road, Colchester. (This call-sign was formerly owned by C. D. M. Hamilton, at Hull).

G 6YU J. Hanson, 'Abbeydore," Wyken Avenue, Wyken Grange Estate, Coventry. (Change of address.)

2ACQ F. W. Woodward, 5, Portland Gardens, Harringay, N.4. (Mr. Woodward particularly wishes to notify that he no longer holds the call-sign G 20W).



READERS NOVELTIES

A Section Devoted to New Ideas and Practical Devices.

EARTH PIN.

If any wire is left over after erecting an aerial it can be used for an earth connection in the following manner :—

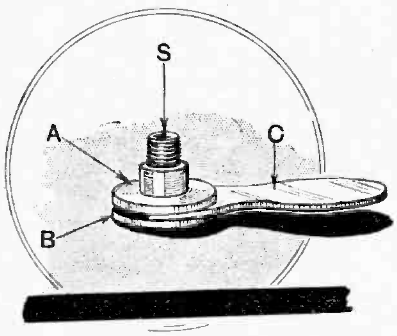
A wooden stake, 2ft. or 3ft. in length is obtained (a broom handle will serve) and the end pointed to drive into the ground. A lateral hole is then drilled through the stake from side to side about 3in. from the point. The end of the surplus wire is then inserted in this hole and the entire length of the stake closely wound with the wire. To finish off the winding the end of the wire may be pulled into a slot cut in the end of the stake.

The advantage of this method of earthing is that a continuous length of wire without joints can be used between the earth terminal of the set and the ground.—D. R. V.

Wire-wound earth pin.

GECOPHONE CONDENSER HINT.

The main bush B securing the frame of the Gecophone condenser to the panel is tightened up by means of a special spanner C supplied with the condenser.



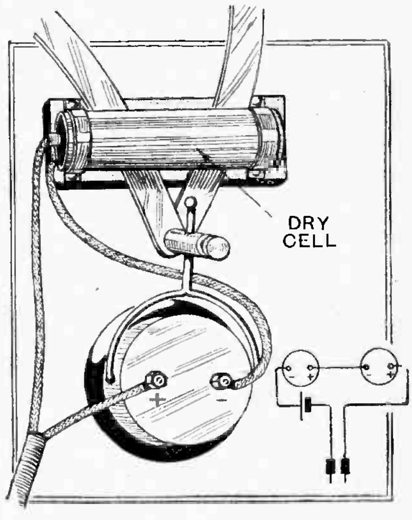
Use of dial bush of Gecophone condenser to keep spanner in position when tightening panel bush.

Two holes are drilled in the flange of this bush on opposite sides of the main spindle S, and into these holes fit the two claws at the end of the spanner.

Now a certain degree of downward pressure is required to keep these claws from slipping out while tightening up the bush. To get over this difficulty, the dial bush A should be brought into use. This may be temporarily screwed down on to the spanner, and will effectively prevent the claws from rising out of the holes in the bush.—J. P.

PORTABLE TESTER.

The use of telephones in conjunction with a dry cell for testing continuity has been referred to on many previous occasions in these pages, but the testing unit has been built in the form of a box with terminals to which phones and testing leads are attached. With this arrangement portability is seriously impaired, and one is virtually tied down to one place.



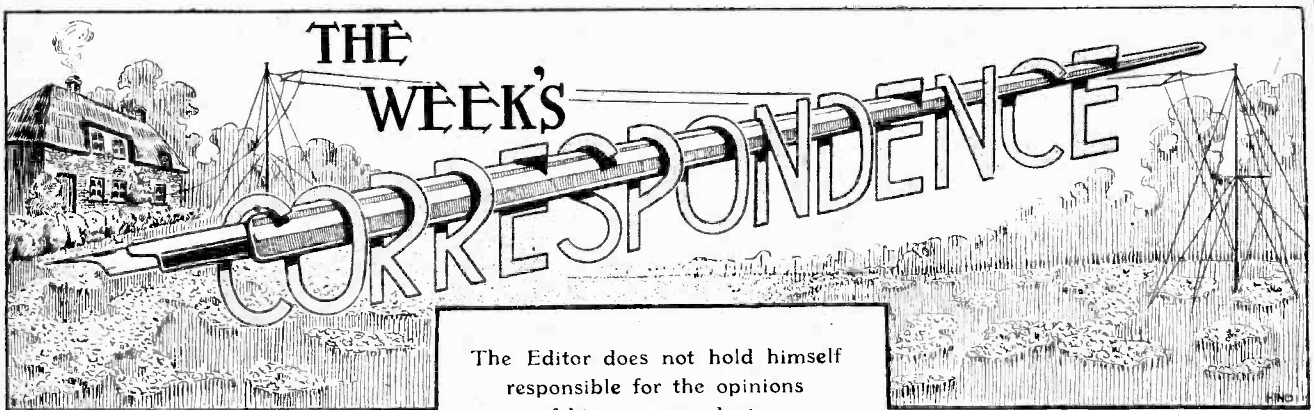
Portable testing outfit with dry cell attached to headbands.

By fixing the dry cell to an old pair of phones, and connecting as shown in the diagram, it is possible to walk about with the headphones in position and to carry out tests in any part of the room with the two free telephone tags.—W. D.

VALVES FOR IDEAS.

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

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



The 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.

B.B.C. HIGH-POWER STATIONS.

Sir,—I have read with great interest two letters, one by Mr. W. J. Randall and the other by Miss A. M. J. Shorter, in your issue of the 13th April.

As both these correspondents labour under a misapprehension, may I be allowed the courtesy of your columns again to make clearer the basic ideas underlying the new Regional Scheme?

Mr. Randall is quite right in stating that the scheme we have in mind is to establish five two-wavelength high-powered stations, provided Post Office permission is forthcoming. Mr. Randall says that this will prevent any possibility of persons living near these stations being able to listen to foreign stations, and he proposes that six central stations, perhaps at Daventry, would solve the whole trouble.

We have to balance up, however, two factors; first of all, the strength required for a service area, and secondly, the strength above which we must not go to enable valve set users to reach out. At the outset one must indicate that one is sympathetic with both claims, but it must be realised that the first claim has priority.

I, personally, would like to see a central station radiating six wavelengths. This idea was, in fact, seriously considered. Calculation, however, shows that to give anything like a service area over the whole of the British Isles, these stations would have to be of the order of hundreds of kilowatts. Firstly, they would probably not be allowed by the authorities; secondly, they would be far too expensive; and thirdly, they would possibly in any case "fade" at 100 miles whatever their power.

Is it realised that these new stations will not be in the centre of large cities, but will be located outside them, so that the large city will have in general about the same field strength as it has to-day, which, except very near the transmitter, is not prohibitive? For instance, Miss Shorter says she lives a mile from 2LO's aerial. She will find when the regional station is erected that the field strength from the regional station will be about one-tenth of what she now receives, and that so far from making it difficult for her to reach out, she will be much more favourably placed. This, as a matter of fact, will cause us a good deal of trouble, because a great many people who listen only to the local station will be crying out for the very loud signal which they have been used to and which they will continue to expect, instead of the sufficiency they will receive.

Our object is to make Britain a service area with alternative programmes, and it may interest technicians to know that we consider that the "A" service area is bounded by the field contour line of about 10 millivolts per metre, while the "B" service area may be considered to be bounded by 5 millivolts per metre.

The fears of both your correspondents would appear to me to be on the whole groundless, since neither of them is likely to live under the shadow of the aerial of any of the new regional transmitters, which will be remotely placed.

London, W.C.2. P. P. ECKERSLEY.
April 14th. 1927.

B.B.C. RELAY TRANSMISSIONS FROM AMERICA.

Sir,—May I be permitted to write and confirm the remarks regarding American relays as mentioned by your correspondent Mr. A. W. Sikes?

We are usually informed that we are going to be given more or less "a special treat" by the B.B.C. in the form of a programme from one of the American broadcasting stations. In due course we get it, more or less; but, really, it can hardly be called clear enough to be enjoyed.

I am in the habit of tuning in both 2XAF and KDKA very frequently, and on nearly every occasion receive the transmission with remarkable strength and purity.

Possibly this branch of relaying does not lend itself for successful results when "boosted up" by the amplifiers of a powerful broadcasting station, and if this is the case I stand corrected. E. T. BELL.

Southampton.
March 23rd, 1927.

B.B.C. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—I have read with interest your correspondent's (Messrs. Rossiter & Brown) letters in the current issue of your periodical.

As an amateur musician of very many years I would strongly advise these gentlemen to blame either their sets or their loud-speakers, or perhaps the tuning of them, before blaming the B.B.C.

I live at a place called Maisons Laffitte, about 17 kilometres on the western side of Paris; my receiving set is an 8-valve superheterodyne made by Mr. F. Plew, of Paris, with a Brunet 2-tone loud-speaker, and I would like to say that the pianoforte transmission which I receive either from 2LO, Daventry, Bournemouth or Manchester is, without any exaggeration, *perfect*, whether from the studio or relayed from other places.

Might I add that I am an organist of over 22 years' standing, an ex Chapel Royal chorister, and an engineer by profession, with a very delicate and sensitive ear for music of any description. R. E. GOUGH.

Anvers.
April 11th, 1927.

EMPIRE BROADCASTING.

Sir,—In view of the paragraphs that have appeared in *The Wireless World* from time to time concerning the suggestion that 5XX should operate a short-wave station for the entertainment of the Empire, it might interest you to hear that our old friend PCGG, operating on 30.2 metres, is now being received with remarkable strength in this country. His programme two nights ago, consisting of English gramophone records, was listened to here for two hours (1530 to 1730 G.M.T.), and although reception was not as perfect as, say, a local broadcast station, it is much more enjoyable to listen to than most Continental stations are in England. Distortion and fading were much less noticeable than when listening to 2XAF at home, due to greater power being used, it would seem.

This demonstrates that good short-wave broadcasting is possible. That the programmes would be appreciated here is certain, whatever objections may be raised at home. The news bulletins alone would be a great boon as even local papers are one or more days behind, except in the big cities. Also a daily Empire news bulletin would surely have an excellent influence everywhere in the world, for our language is not confined to the Empire.

By providing such a station the B.B.C. would open a big prospect to British manufacturers. "British Short-wave Sets for British Broadcasting!" would be an effective slogan.

Meerut, U.P., India. E. J. H. MOPPETT.
March 26th, 1927.

WIRELESS SETS FOR THE BLIND.

Sir,—It seems almost impossible that, for a few pounds, a blind man may be made equal in all respects to a man with sight for a few hours every day during the rest of his life! Yet it can be done. Wireless does it.

The National Institute for the Blind has already distributed hundreds of wireless sets, and from experience knows that these have not only brought endless pleasure to blind people, but have literally changed their entire outlook. But there are thousands still without sets and to provide them funds are urgently needed.

Thanks to Captain Ian Fraser and other members of Parliament, the blind do not have to pay for their wireless licences, but a free dog kennel is not of great use to one unable to afford a dog!

Yet the granting of free licences is one step forward; while the provision by the National Institute of a Braille *Radio Times* is another. And if your readers will help me, the provision of free wireless sets will soon crown with success our several attempts to bring to the blind poor the inestimable benefits of wireless. Will they remember that *one* £5 note alone will provide *two* blind people with an endless source of happiness for the rest of their lives.

All sets will be distributed by the National Institute through the County Associations for the Blind in all parts of the country.

Donations for this purpose should be sent to me at the National Institute for the Blind, 224-8, Great Portland Street, W.1. HENRY T. WAGG.

London. Chairman of the Technical and Research
April 12th, 1927. Committee, National Institute for the Blind.

VALVE NOMENCLATURE.

Sir,—Your Editorial, "The Valve," in the April 6th issue was of particular interest, especially the final paragraph. This question of nomenclature should be given more attention, the various symbols used by different writers being confusing. I was particularly pleased to find you had not used the term "impedance" in your valve supplement.

I cannot agree with you that the voltage of 4 should become the standard. The unit for a lead cell being 2, why use multiples?

The case could be made out for three types of user (receiving valves only):—

(a) Town with supply mains to house.
(b) Town with no supply.
(c) Country.

Surely sections (b) and (c) would be in favour of one cell provided it was possible to obtain types now made only in the 6-volt rating.

Section (a) have easy access to recharging or A.C. heating, and so the voltage would not affect them. One other point: you did not mention the important question of cost. Surely the cost to the public is too high compared with the cost of manufacture? C. E. CHESTER.

Southampton.
April 14th, 1927.

NEWS FROM THE CLUBS.

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

A Visit to Croydon Aerodrome.

By kind permission of the Air Ministry, a party of members of the Muswell Hill and District Radio Society paid a visit to the Croydon Aerodrome on April 9th. The party were conducted round the hangars and were given the opportunity of closely inspecting the saloon and pilot's cockpit of one of the new German all-metal monoplanes. Great interest was displayed in the wireless apparatus.

A visit was then made to the wireless transmitter and the operators' room. The transmitter at Croydon is worked by means of remote control from the signal tower. Its operation was clearly demonstrated by the engineer-in-charge. The receiver has been in use for six years and is shortly to be replaced by modern apparatus.

Full particulars of future meetings and open-air events may be obtained from the hon. secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, N.10.

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Looking Backwards.

During the past year the Muswell Hill and District Radio Society has provided four lantern lectures, twelve ordinary lectures, nineteen combined lectures and demonstrations, two visits to places of interest, besides other attractions. Altogether 41 meetings have been held, and the Society is justly proud of its record.

Summer Wireless in Battersea.

Wireless enthusiasts in the Battersea district are cordially invited to join the Battersea and District Radio Society, which has just started the summer term of regular lectures (Tuesdays and Wednesdays, 7.45 to 9.45 p.m.). Enrolment can be made during the present fortnight, the subscription being 1s. per term (no extras). Lectures are classified under three headings, viz., elementary, intermediate, and advanced. In the elementary department a new beginners' class is being formed for theory and practice. The intermediate department will deal with the theory of electricity, magnetism, and wireless reception, including practical work and Morse, with field days. Advanced students will experiment in short-wave reception and transmission, with Morse practice and field days.

Those interested should communicate at once with the hon. secretary, Mr. A. F. Hembury, 57, Winstead Street, Battersea, S.W.11.

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Visiting 2LO.

The wireless societies are still privileged to visit the B.B.C. stations. At the last meeting of the North Middlesex Wireless Club the hon. secretary announced that he had received an invitation for a limited number of members to visit 2LO, and there was great competition among those present to be admitted to the party. This will be the third occasion on which members of the club have visited 2LO.

FORTHCOMING EVENTS.

WEDNESDAY, APRIL 27th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Demonstration by Mr. H. L. Kirke on "Distortionless Reception," using the Rice Kellogg type loud-speaker.

Tottenham Wireless Society.—At 8 p.m. At the Institute, 10, Bruce Grove. Lecture: "Short Wave Work," by Mr. S. Smith.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Lecture: "The Electrical Recording of Gramophone Records," by Mr. J. V. Farnol.

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

North Middlesex Wireless Club.—At 8.30 p.m. At Shaftesbury Hall, N.11. Lecture: "Electrolytic Rectifiers," by Mr. A. J. Simpson.

Institute of Wireless Technology.—At 7 p.m. At the Engineers' Club, Coventry Street, W. Lecture: "The Electrical Recording of Gramophone Records," by Mr. Harrie J. King.

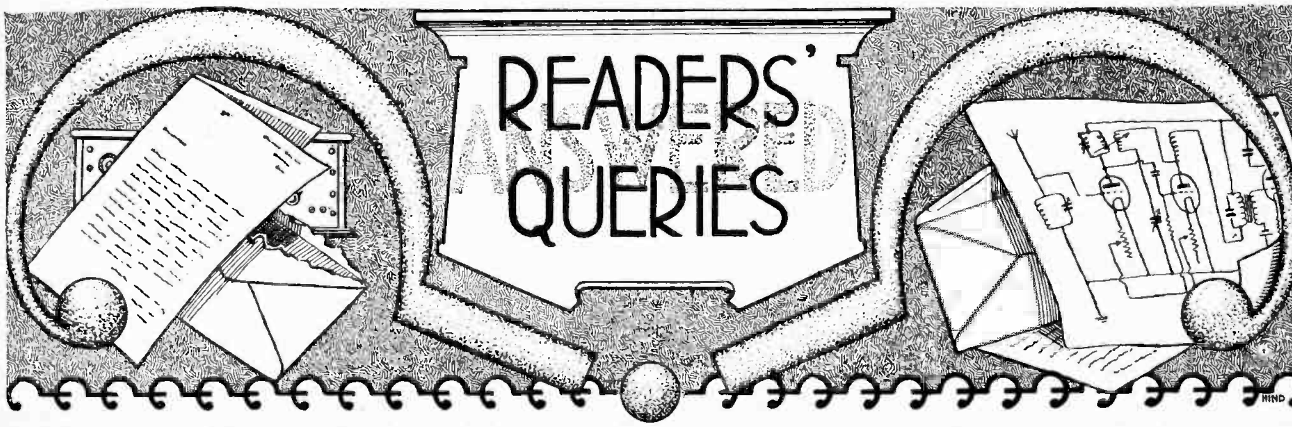
FRIDAY, APRIL 29th.

Radio Experimental Society of Manchester.—Annual General Meeting.

MONDAY, MAY 2nd.

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

Croydon Wireless and Physical Society.—At 8 p.m. At 128A, George Street. Lecture: "What is the Use of H.F. Valves?" by Mr. Purkis, A.R.C.Sc.



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

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

"Litz" or "Litzendraht"?

I am engaged in the construction of a modern type of receiver using the type of H.F. transformers developed by you and used in a large number of your sets. I purchased the necessary Litz wire for winding the secondaries, but results were none too good. A friend informed me that the wire which I was using was not Litz at all, but a poor imitation; however, on returning the wire to the retailer from whom I purchased it, he assured me that this was Litz wire. I obtained the proper wire from another source, and I at once noticed that this wire was in appearance vastly different from the other wire, and, moreover, I find that by using it I obtain vastly improved results compared to my previous efforts. Both wires were, however, stranded. It is obvious that unscrupulous retailers are selling stranded wire of an inferior type as Litz. Can nothing be done to prevent this fraud? A. M.

Unfortunately you are labouring under a delusion that the word Litz is a protected word descriptive of a certain brand of stranded wire. This is not so, of course, and the word Litz is merely the English abbreviation for the German word Litze meaning a strand, and the German word Draht meaning a wire. We thus have the combination word Litzendraht meaning roughly stranded wire, the German word Litzen being of course the plural of Litze. The word Litz, therefore, is not a trade mark, and can never be adopted as such by any firm, as it is a colourable imitation of a normal word occurring in a recognised language. By popular consent, of course, the word Litz has been taken to mean a wire built up of a large number of strands of a narrow gauge wire, *each strand being separately insulated, and appearing at the centre and the outside of the wire an equal number of times.* This condition is satisfied in true Litzendraht by *platting* the strands together in groups of three. Imitation Litz is simply twisted together. There is nothing, however, to prevent a firm from selling ordinary stranded and uninsulated wire under the name of Litz, as of course such wire would still come within the scope of the Litzendraht, meaning stranded wire. You can do nothing, therefore, except to deal only with reputable retailers.

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A Worrying Whistle.

I have built a four-valve receiver consisting of H.F., detector, and two L.F. stages, using a 4 to 1 ratio transformer in the first stage, and a 6 to 1 in the output stage. Both these transformers are made by a firm of repute, but I get a continuous whistling noise in my loud-speaker which is unaffected by turning my tuning dials. Is this oscillation? M. C. R.

This is not oscillation in the ordinary accepted sense of the term, which is usually taken to mean oscillation at high frequency, but the howl is produced by L.F. oscillation in the L.F. amplifier. If it were H.F. oscillation, of course rotation of your tuning condensers would alter the pitch of the note produced. The trouble is due, in our opinion, to the use of an excessively high ratio of 6 to 1 in the second stage, and you would have done far better and at the same time have obtained ample volume even on distant stations, and better quality also by using a 2.7 to 1 in the first stage and your 4 to 1 in the second stage. To cure your trouble now you should first see that your components are well spaced out, transformer cores being at right-angles even if shrouded so that all chance of stray coupling is minimised. See that the metal covers of your transformers are earthed, and also see that you have very large fixed condensers across each H.T.+ battery tapping to common H.T.−. If this fails to cure the trouble we think it best for you to try the effect of shunting a grid leak of ½ megohm value across the secondary of each transformer in turn, as this will almost certainly cure the trouble, and at the same time, provided the leak is not lower than ½ megohm, no perceptible decrease in volume will be experienced. Of course, a 100,000 ohm resistance across the secondary will be more certain of stopping the howl, but this would cause serious decrease in volume, and in any case ½ megohm is quite low enough to stop all howling. This method, though usually certain in practice, is a palliative rather than a preventative, because the proper way to have set to work in the first place would have been to design the amplifier properly.

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Run-down H.T. Batteries.

I have a three-valve set consisting of the conventional detector and two L.F. amplifiers. The set is built mainly for quality, and in the output stage I am using an L.S.5A type of valve with 250 volts on the plate. Both L.F. valves are supplied with H.T. from my mains, but I find it better to supply the detector, which after all does not consume a great plate current, by means of an ordinary 60-volt dry battery, as I find that a hum is produced when this valve is supplied from the mains. Lately, needing a new battery in this position, I made use of an old 100-volt battery which I had by me, the voltage of which had fallen to 60. I found that a bad howl was caused in the receiver. On substituting a new 60-volt battery all was well. Evidently the trouble is caused by the battery, but I cannot see the difference myself between a new 60-volt battery and an old 100-volt battery which, tested with a reliable voltmeter, reads just over 60 volts. G. K. M.

There is, of course, a great deal of difference between using a new 60-volt battery and an old 100-volt battery which has run down to this voltage value. In the latter case, of course, the battery has dryed up and its internal resistance is probably very high indeed, and even though you have only one valve running from it, this resistance will set up a howl such as you mention. In the case of your new battery, of course, the internal resistance is very low. You might be able to use your old battery by putting large fixed condensers across that section of the H.T. battery you are using, but it is infinitely preferable to use a new battery. You would find that the difference would be accentuated were you running two or more valves off the same H.T. battery.

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A Ratio Riddle.

A friend has built for me a crystal set using the ordinary catswhisker type of crystal, followed by a two-valve amplifier using a Marconi 8 to 1 and a Marconi 2.7 to 1 transformer. I notice that he has placed the 8 to 1 transformer first, and he asserts that this is the correct procedure. If this is so, can you explain why you constantly urge in your articles that when using two good transformers of different ratios the lower ratio instrument should be used first?

V. D. S.

Your friend is perfectly correct in his assertion that he has built the receiver correctly. This is on the face of it an apparent contradiction of our usual advice to readers, but it may perhaps be regarded as the exception that proves the rule. Your puzzlement arises probably from a lack of the true understanding of the reason why we advise in most cases that the low-ratio transformer comes first, and you are advised to read the special article we published in our issue dated May 26th, 1926, entitled "Coupling L.F. Valves," where the whole of this matter is fully gone into. Briefly, the impedance of the transformer primary or choke should greatly exceed the internal impedance to which it is coupled. Now a detector valve is usually a moderately high-impedance valve because a high-impedance valve usually gives best results as a detector under general conditions, since the valve impedance is high the external impedance must be much higher. This means a high-inductance primary, which in its turn means a very large number of turns on the primary among other things, and consequently there is no room for many secondary turns unless we make the instrument of unwieldy size, which we do not want to do, and in any case, if we attempted to do so, we should bring in other undesirable effects due to self-capacity. It will be obvious, then, that this transformer will have to be of low ratio. Probably our first L.F. valve will be of lower impedance than the detector valve, and therefore, following the same train of thought, we do not require so many turns of wire on the primary, so have more room for secondary turns, and therefore get a higher ratio of, say, 4 to 1, although in many cases a high-impedance valve may be used as the first L.F. valve, when it must, however, be followed by a high impedance, and, consequently, if a good transformer is used, it must be of low ratio. The ordinary type of crystal, however, is of low resistance, and a relatively few number of turns may be used in the transformer primary following it, and so we have plenty of room for secondary turns and get a high ratio.

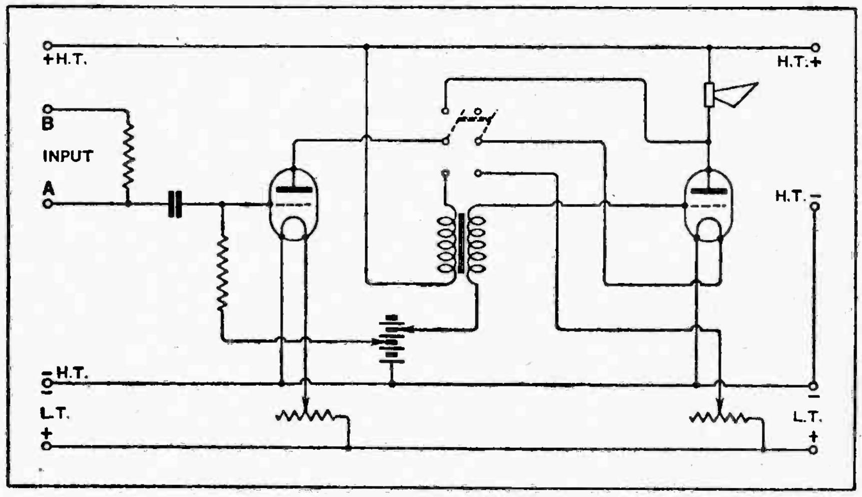
The Nucleus Receiver.

I am making a unit receiver on the general lines of the "Nucleus" set, but for reasons which I need not enter into have made up the detector valve (without an L.F. amplifier) as the basic unit. It occurs to me that the resistance and transformer L.F. units, described in your issue of March 23rd, would, if made up into a single instrument, suit my purpose very well. I should, of course, [illegible] the resistance stage first. If [illegible] recommend this arrangement, will you please let me have a circuit diagram of the combined amplifier, bearing in view the fact that I wish to feed the detector H.T. supply from its own terminal, to be able to eliminate one valve (with automatic filament control), and to connect the batteries permanently to the L.F. unit.

P. H. T.

The arrangement you propose seems to be quite practicable, and we think that the circuit given in the diagram should be suitable. The input terminals A and B will be connected respectively to plate and H.T. positive supply of the preceding detector valve.

A small condenser of about 0.0001 mfd. may generally be connected with advantage across the input terminals; as to whether it is mounted in the detector or L.F. unit will depend on the particular use to which you wish to put the former instrument.



Combining the "Nucleus" L.F. Units.

A Precarious Proposal.

I am in possession of a one-valve reflex receiver, and am desirous of adding to it a good two-valve amplifier of modern design, which will give me purity of reproduction, and shall be glad of your assistance in this matter in advising me whether my proposals are quite in order.

N. K. D.

Whilst of course we should not care to say that it is impossible to build a reflex set giving purity of reproduction, it is generally found that designers of high quality sets prefer to use absolutely straightforward circuits. In any case, since your set is a reflex you already have one stage of L.F. amplification incorporated in it, and the addition of an extra two-valve amplifier is almost bound to result in bad quality due to valve overload, and also probably trouble will be experienced due to L.F. oscillation unless you use exceptionally large fixed condensers such as two or more microfarads across from each H.T.+ tapping to the common negative, or alternatively, use a separate H.T. battery for the additional amplifier.

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Dear at Any Price.

I am in possession of a four-valve receiver and make use of dry batteries as my source of supply. I noticed that as the batteries grew old crackling noises developed, and a friend told me that if I shunted the H.T. battery with a large-capacity condenser I should eliminate these crackling noises. I consequently adopted his advice and shunted a condenser of 4 mfds. across with beneficial results, but now I notice that my H.T. batteries run down exceedingly quickly. Can you explain this? I might mention that the condensers were very cheap.

M. R. O.

It appears from the symptoms which you give us that there is a leakage either in the dielectric of your condensers or a surface leakage between the two terminals. At any rate, it would seem to us that you have purchased inferior condensers in which insulating material is used which is not above suspicion, and that consequently all the time your batteries are slowly discharging. We should advise you to connect up a suitable meter in series with your H.T. battery and a small choke coil. If you notice that a continuous deflection of the needle takes place, you can then assume that the condenser under test is faulty

Eliminating Waste.

I have built a modern type of neutralised receiver, which gives me most excellent results. On turning out the H.F. valve I find that the local station signals completely disappear, and I have to use the H.F. valve even for the reception of the local station, which is distant only a few miles. Surely this is rather absurd as I often want to listen to the local station programme it seems very wasteful to use the H.F. valve.
L. V. G.

The fact that the local station is completely cut out when the H.F. valve is turned out, shows that your set is very well neutralised, and if the local station did come in, of course, then we should say that the set was not properly neutralised unless your local station was exceptionally close. We would suggest that you mounted your neutralising condenser on the panel, so that on turning out the H.F. valve when desiring to receive the local station you will only have to move the neutralising condenser slightly to bring in this local station at excellent strength. You must not forget to return the neutralising condenser to its original setting when desiring to search for distant stations, or the set will oscillate. It would be desirable, therefore, to use a neutralising condenser with a clearly defined dial indicator, so that you could return to the original setting without having to re-neutralise every time.

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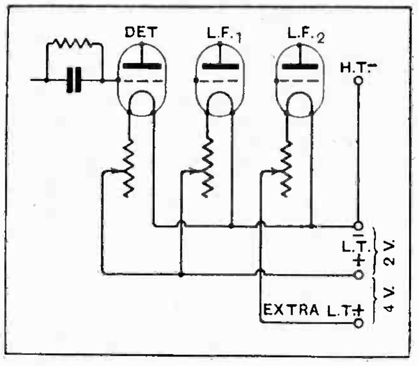
A Problem of Power.

I am in possession of a three-valve receiver employing two stages of transformer-coupled L.F. I find, however, that my output valve is overloaded, even though it is one of the best 2-volt power valves upon the market. If I increase the H.T. above the figure given by the manufacturer and increase the grid bias proportionately, I find that it still overloads on loud passages of music, my test being made by means of a milliammeter in the plate circuit. I have therefore determined to use a large 6-volt power valve in the last stage, and shall be glad if you will let me know what is the proper method to connect it up, as I still desire to use my 2-volt valves in the other stages. Shall I need to buy a separate 6-volt accumulator?
M. P. M.

It will not be necessary at all for you to buy a new 6-volt accumulator, and we advise the purchase of a 4-volt supplementary instrument. The connections which you will have to make will be as shown in the diagram. We have, of course, only put in the necessary connections, all other connections being normal. It must not be forgotten that the filament current load of your big power valve will be thrown on both the 4-volt and the 2-volt batteries, while in addition the 2-volt battery will have to supply the remaining two valves. The point that the 2-volt accumulator may become discharged before the 4-volt one must not be overlooked. If the power valve, however, is of the type consuming three-quarters of an ampere or more, then the point is not so



Filament circuit of 3-valve set using 2- and 6-volt valves.

serious, because the small extra current demanded by the other valve will not add much to the load on the 2-volt accumulator as compared with the load on the 4-volt accumulator.

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A Long-wave Trouble.

I have recently seen it stated that the Reinartz circuit is of little use on long waves. Can you inform me whether or no this is true?
R. T. C.

Our answer depends, of course, upon exactly what you mean by long waves, since certain types of amateurs are rather apt to regard even 25 metres as a long wave nowadays. The Reinartz circuit is at its best on wavelengths not exceeding 600 metres, but above that wavelength its efficiency commences to fall off very rapidly. The Reinartz circuit, as you know, employs an aperiodic-coupled aerial circuit, and while it is fairly easy to use the same number of turns for an aperiodic aerial circuit over a comparatively large part of the broadcasting band, for instance, the long waves do not take kindly to this form of aerial coupling, and, in general, it is best not to use a Reinartz circuit on long wavelengths, but if selectivity is desired to use a fully tuned aerial circuit. Daventry and Radio Paris, etc., come in much better on the ordinary loose-coupled aerial circuit than on an aperiodic aerial circuit. Since aperiodic aerial coupling is one of the main features of the Reinartz circuit, one cannot say that it is therefore an efficient circuit on the long wavelengths, and the longer the wavelength the worse it is. The other feature of the Reinartz circuit, namely, capacitative control of magnetic reaction, functions quite efficiently on the long wavelengths. In general, one can only use aperiodic aerial coupling efficiently on the long waves by experimenting with the actual aerial on which the set is to be used, and then it will be found that one could not transfer the set to an entirely different aerial and still obtain the same good results in the same maner one could on the shorter wavelengths.

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A Misleading Mishap.

I have recently built a four-valve receiver using two L.F. stages, but I notice that, when normally connected up, very poor volume and great distortion is caused; upon reversing the grid bias battery, however, and applying a positive potential to the L.F. valves, remarkably good results are obtained. Can you inform me where I have gone wrong?
B. H. W.

The trouble is undoubtedly that your grid bias battery is wrongly marked, the positive terminal being marked with a — (minus) sign, and *vice versa*. This is by no means an uncommon fault with cheap foreign-made grid batteries, while reports have come to our ears that a few batteries have emanated from the factories of British manufacturers of the highest repute with this defect. One should always look for trouble of this nature when puzzled by the behaviour of a set, while it is just as likely it would occur in an H.T. battery.

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A Valve Query.

I have in my possession a valve of 80,000 ohms impedance with a correspondingly large magnification factor, and I was wondering whether I could use this in the H.F. stage of the "Everyman-Four" and so get vastly improved amplification.
P. R. B.

Unfortunately, you could not use this in the H.F. stage of the receiver you mention, as, of course, when considering the question of H.F. amplification one must take into consideration also the valve for which the H.F. transformer was designed. It was designed for a valve of about 30,000 ohms impedance, and to get maximum amplification one should choose a valve having an impedance of roughly 30,000 ohms, and having the highest possible magnification factor for this impedance. Increasing the impedance will increase the selectivity at the expense of sensitivity.