The Wireless World AND RADIO REVIEW

(14th Year of Publication)

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THE NEXT WAR.

ALTHOUGH no official statement is forthcoming from the B.B.C., it nevertheless now seems certain that the B.B.C. officials favour a new scheme of organisation of the broadcasting stations, having as its object the provision of alternative programmes. The new scheme was outlined in our issue of February 16th, and is understood to recommend the erection of four or more stations in this country, working probably each on two wavelengths and with a power of 50 kW. With this scheme in operation the view is expressed that alternative programmes would be available all over the country.

On the face of it the scheme seems to have much to recommend it, provided that one is confident that distribution of programmes over the whole country can be obtained with the four stations; but where we find fault with the proposal is in the suggested power of the stations. With many listeners the complaint at present is that it is difficult to cut out the local station if you are anywhere near it, on account of its power. What, then, will be the position when we have two transmissions on 50 kW. in our neighbourhood? Has the B.B.C. quite forgotten its former concern for the interests of the crystal user, for with unselective sets it seems difficult to believe that, close up to a 50 kW. station broadcasting independent programmes on two wavelengths, it will be possible to have a choice of programmes; rather it would seem that two programmes will always be available, but not necessarily as alternatives!

But there will be a later opportunity for discussing the details of any scheme contemplated. For the moment our desire is to express our disagreement with any proposal which calls for the employment of unnecessarily high power. We believe that in arranging stations and their power to provide for national broadcasting the endeavour should be made to keep down the power so that transmissions do not carry far beyond the frontiers of the country concerned, except, perhaps, in the case of one high power station for international communication when required.

As things stand at present the power of stations in Europe is constantly being increased in order to overcome interference from neighbouring stations.

The first wars of history were almost invariably fought as a result of incursions being made into neighbouring territories; at a later date wars more frequently started because one nation trespassed upon the trade interests of another; to-day we have another possible source of friction between nations to take into account in so far as an invasion of the ether by some foreign nation which may interfere with the broadcasting service of neighbours may at any time excite the indignation of the listening public. We have at the moment the one consolation that, judging from popular views on the programmes, the British nation is not likely to be roused to a high pitch of resentment even if some of our home programmes are overpowered by the programmes from the Continent!

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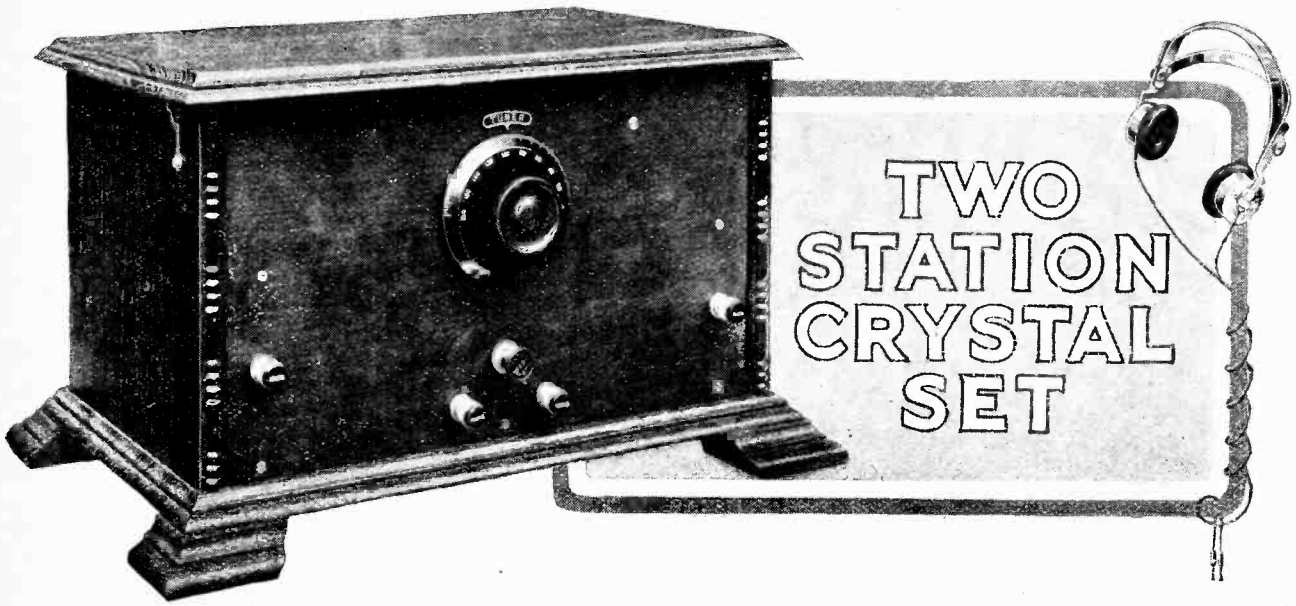


TWO STATION CRYSTAL SET

A Receiver for the Continental High-power Stations.

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

IN the early days—long before broadcasting was even thought of—enthusiastic amateurs used to build crystal sets of large dimensions and wonderful design in order to listen in to the Morse transmissions from such stations as the Eiffel Tower in Paris, POZ at Nauen, and such-like foreign stations. These crystal sets were usually innocent of any tuning condenser, except among those of more advanced ideas, and tuning was carried out by means of "sliders," which altered the number of turns of the coil in use. The crystal detectors themselves were of many designs, and very often were of the multi-crystal cup variety, so that any one of a selection of crystals might be used as desired. All sorts of weird things were tried as detectors, and altogether wireless experimenting in the early days was at least as absorbing a hobby as it is to-day—perhaps more so in some respects, as one had to be really keen to be content with what we should say nowadays was very little. However, the writer will never forget the thrill he had on actually receiving signals the first time on a completely home-made receiver.

In these days of broadcasting and multi-valve sets the humble crystal set is rather apt to be forgotten, except for local station reception, and perhaps by some it is not so much forgotten as scorned. However, there is no reason why it should be impossible to receive more than the local station with a crystal receiver, provided that a good aerial and earth are used—and that, too, without the complications of the old-time receiver, with its several slides and large bulk. Another point in our favour to-day is the existence of several forms of "stable" crystals, *i.e.*, crystals which require *very* infrequent adjustment, which are probably at least as sensitive as anything that used to be available, and thus one of the chief bugbears of old-time crystal reception—that of frequent adjustment of the detector—is removed.

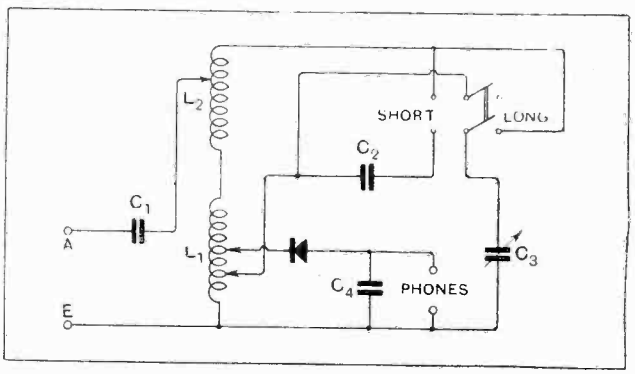


Fig. 1. The circuit diagram of the receiver: C_1=0.0003 mfd.; C_2=0.0003 mfd.; C_3=0.001 mfd.; C_4=0.001 mfd. L_1 and L_2 each 110 turns on 4-inch diameter tapped as indicated in the article.

Importance of the Aerial System.

In view of the foregoing remarks, the writer designed the long-wave set described in this article for the reception of such broadcast stations as the Eiffel Tower, Radio Paris, Daventry, and Hilversum, since most of these stations should be receivable, at any rate in the southern and eastern parts of England, with a good aerial system.

The fundamental difference between a crystal receiver and a valve receiver is that in the former *all* the energy used to operate the telephones *comes from outside* (*i.e.*, from the broadcast station), whereas in the valve set this outside energy is merely used to *control* local energy at the receiving station, so that, in the latter case, provided suitable arrangements are made, the energy available for operating the telephones (or loud-speaker) is almost unlimited.

Therefore, in the case of the crystal set, since all the energy comes in from outside, it is absolutely essential to make the collector of this energy as efficient as possible. This collector is

Two Station Crystal Set.—

the aerial system, comprising the aerial itself, the earth, and the leads from these two to the set. In this country we are allowed one hundred feet of wire for the aerial, and probably about the best arrangement of this, from all points of view, is an inverted L aerial, with the horizontal part about sixty feet long and a down lead of about forty feet. The aerial *must* be well insulated, and it is advisable to use several insulators in series at each end, and to use not the very tiniest insulators but those of reasonably large size. The point to look out for in an insulator, besides mechanical strength, is that it shall have what is referred to as a long leakage path—that is, the shortest length over the surface between the point where the end of the aerial is fixed and the point where the rope is fixed should be of reasonable length—say about two inches at least.

The Earth.

The next point to consider is the earth—and it is just as important to get a good earth as it is to get a good aerial. A connection to the main water supply, if properly done, usually makes a fairly good earth, but the writer has almost invariably found that a local buried earth is better. This may be made either by using one of the copper tube "earths" now on the market, or by using a length of wire netting, copper sheet, or a galvanised bucket with holes punched in the sides. When making the "earth" a suitable spot near the room in which the set is to be used should be chosen—preferably a spot which is usually damp—and a hole dug to take the "earth." The connection to the "earth" should consist of three or more leads *soldered* in several places to the metal, and sufficient length should be allowed for these leads to be brought well above the ground level, where they may be soldered together and to the earth lead to the set. It is usually an advantage—even in these days—to use some coke round the metal of the earth so as to increase its area of contact with the soil before filling in the hole.

The aerial down lead is one of the most important parts of the aerial, and should be kept well clear of the walls of the house—for example, it is better to run the down lead six feet away from the walls than one foot, even though the latter arrangement enables the top part of the aerial to be five feet longer.

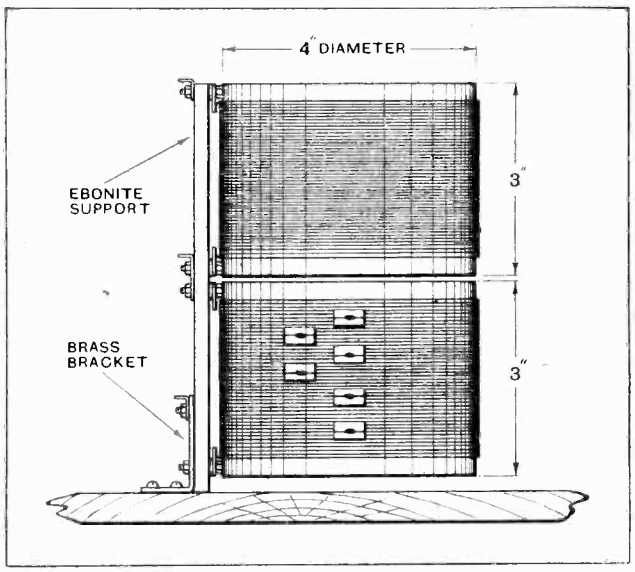
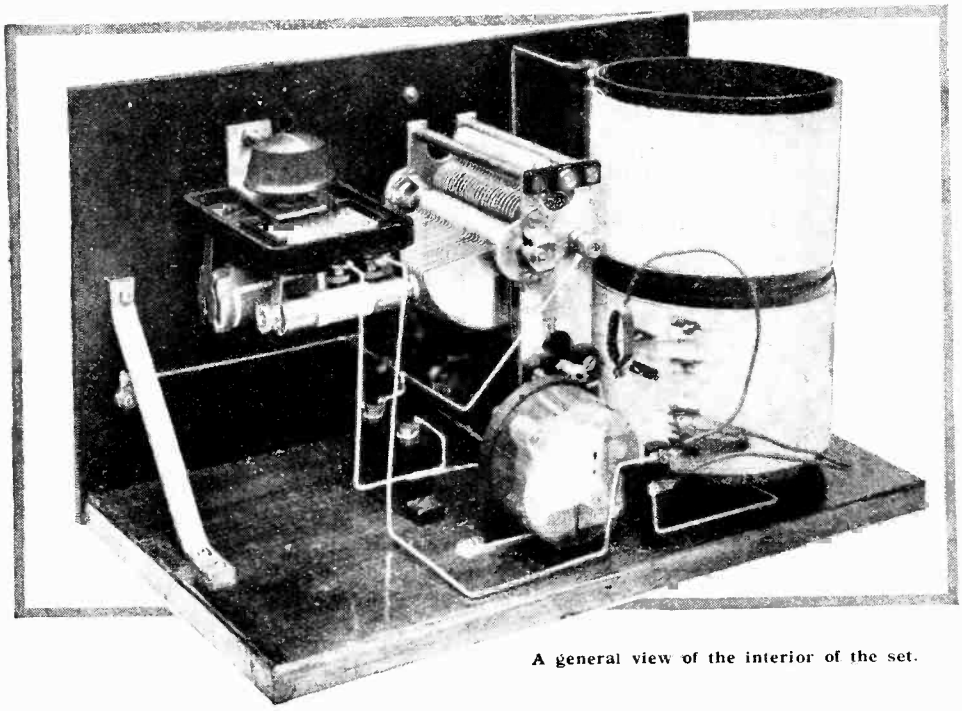


Fig. 2. Showing the dimensions and method of support of the tuning coil.

The insulation of the aerial lead-in to the house should be as good as that of the aerial itself—a point which is often overlooked. The ideal way is to use an insulator in the centre of one of the window panes, but unfortunately this is not practicable in most cases.

The question of the aerial and earth has been dealt with at some length before commencing the description of the set, because it is no use expecting to be able to receive distant stations on an inefficient aerial and earth system, although the latter may be quite satisfactory up to a few miles from the local station.



A general view of the interior of the set.

The Circuit.

The circuit of the set is shown in Fig. 1. Although it is primarily designed as a *long*-wave receiver, a simple switching device has been incorporated to enable the local station to be received as well. The long-wave section has been designed for high effi-

Two Station Crystal Set.—

ciency, and for this reason a single-layer coil of fairly large diameter (4in.) has been used, with tappings for the crystal and for the aerial.

The crystal is not connected across the whole coil, because the selectivity in this case is not at all good, *i.e.*, in London the local station 2LO will be heard quite loudly on the long-wave range *if the crystal is connected across the whole coil.* Also, if the crystal is connected across only part of the coil, not only is selectivity much improved, but the actual current available for operating the telephones may be increased. The writer does not intend to go into the reasons for this, as these points have been fully dealt with by W. H. F. Griffiths in previous issues of *The Wireless World.*

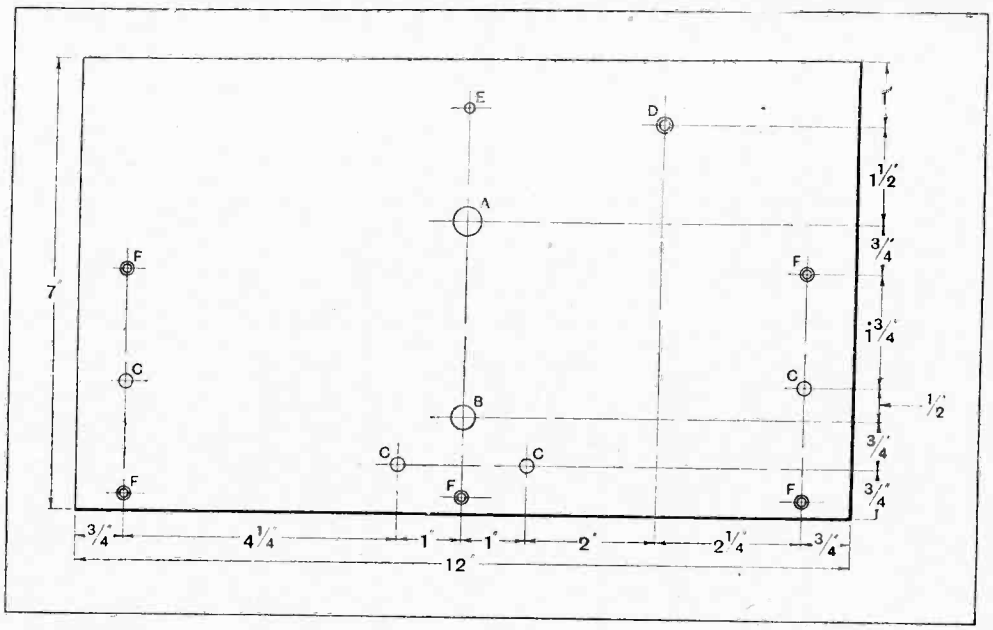


Fig. 3. Showing the panel dimensions.

Construction of the Set.

The first part to make is the coil, which is wound on a 4in. diameter paxolin tube 6in. long, or upon two separate 3in. lengths of this tube fixed together, as shown in the photograph. Three-inch lengths were actually used, as they are readily obtainable, but there is no particular merit beyond this fact in using two tubes instead of one.

The winding consists of 220 turns altogether of No. 28 D.C.C. wire, and tappings are made at 28, 35, 50, 70, 90, and 110 from the bottom end, and at 20 turns from the top (see photograph). The condenser C_3 used to tune this coil is 0.001 mfd. in value, and may, if desired, be of the slow-motion type.

Switching Arrangements for Local Station.

The arrangement adopted for receiving the local station may best be studied by reference to the circuit diagram, Fig. 1. It will be seen that a considerable part of the coil is short-circuited, and only a few turns left in use. At the same time the 0.001 mfd. variable condenser is put in series with a fixed 0.0003 mfd. condenser C_2 for the purpose of flattening the tuning for the local station, so that the latter may very easily be tuned in.

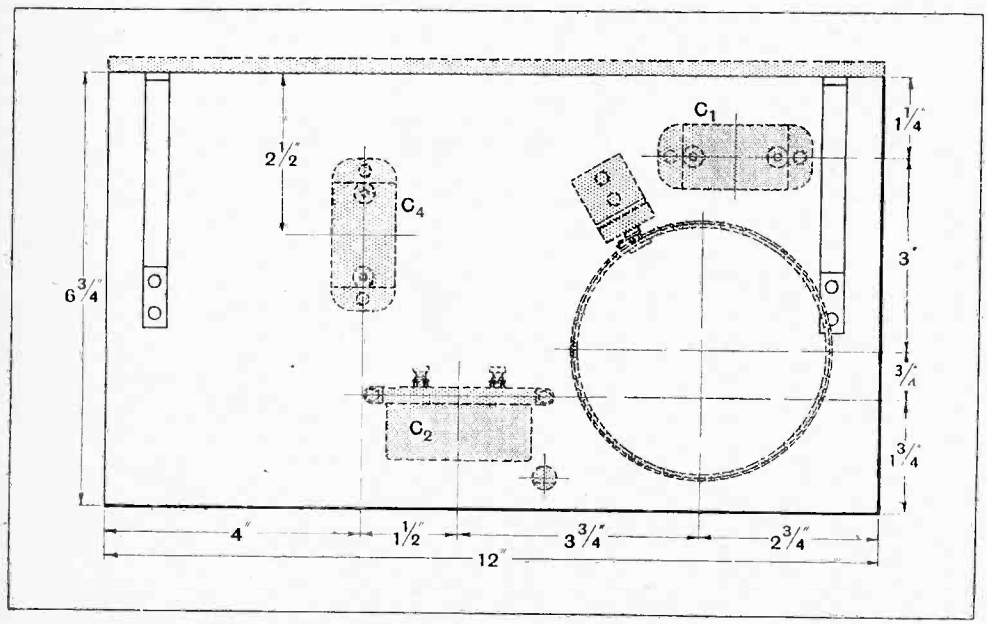


Fig. 4. Showing the layout of the various components on the baseboard.

As has been stated before, this set is designed to be efficient on long waves, and the short-wave local station is provided only as a stand-by if wanted; but if it is desired to be able to cover the shorter broadcast band the 0.0003 mfd. series condenser C_2 may be omitted.

A fixed condenser C_1 of 0.0003 mfd. is used in series with the aerial to reduce the damping effect of the latter and so improve the selectivity of the set, and on a standard P.M.G. aerial the wavelength ranges were found to be from 1,000 metres to 2,800

LIST OF PARTS.

2 Paxolin Tubes, 3in. long, 4in. diameter (Micanite & Insulators Co., Ltd., Empire Works, Blackhorse Lane, Walthamstow, E.17).
1 "J.B." Variable Condenser, plain type, low loss, 0.001 mfd. (Jackson Bros., 8, Poland Street, W.1).
1 Air Dielectric Fixed Condenser, 0.0003 mfd., type R145 (Ormond).
1 Fixed Condenser, 0.001 mfd., No. 620 type (Dubilier).
1 Fixed Condenser, 0.0003 mfd., No. 610 type (Dubilier).
1 Reversing Switch (Lissen).
1 Carborundum Stabilising Detector Unit, complete with Carborundum Detector (Carborundum Co., Ltd., Trafford Park, Manchester).
1 UW5 Dry Cell (Ever Ready).
1 pr. Brass Brackets.
½ lb. No. 28 D.C.C. Wire.
1 Ebonite Panel, 12×7.
1 Cabinet, 12×7×7in. deep (Caxton Wood Turnery Co., Market Harborough).
4 Terminals, Screws, etc.

Approximate cost (exclusive of cabinet), £2 10 0.

metres approximately on the long wave, from about 260 metres to 390 metres on the particular tapping point to the switch used (at 28 turns) with the 0.0003 mfd. condenser in series with the tuning condenser, and up to about 800 metres without this condenser. Where the local station is of longer wavelength than about 390 metres the tapping point should be at the 35th turn. it will probably be somewhere as indicated in the wiring diagram, Fig. 5.

The change-over from long to short waves is effected in practice by pushing in the Lissen switch—the pull-out position of the switch corresponding to the long waves.

The set as described has been tested for selectivity on

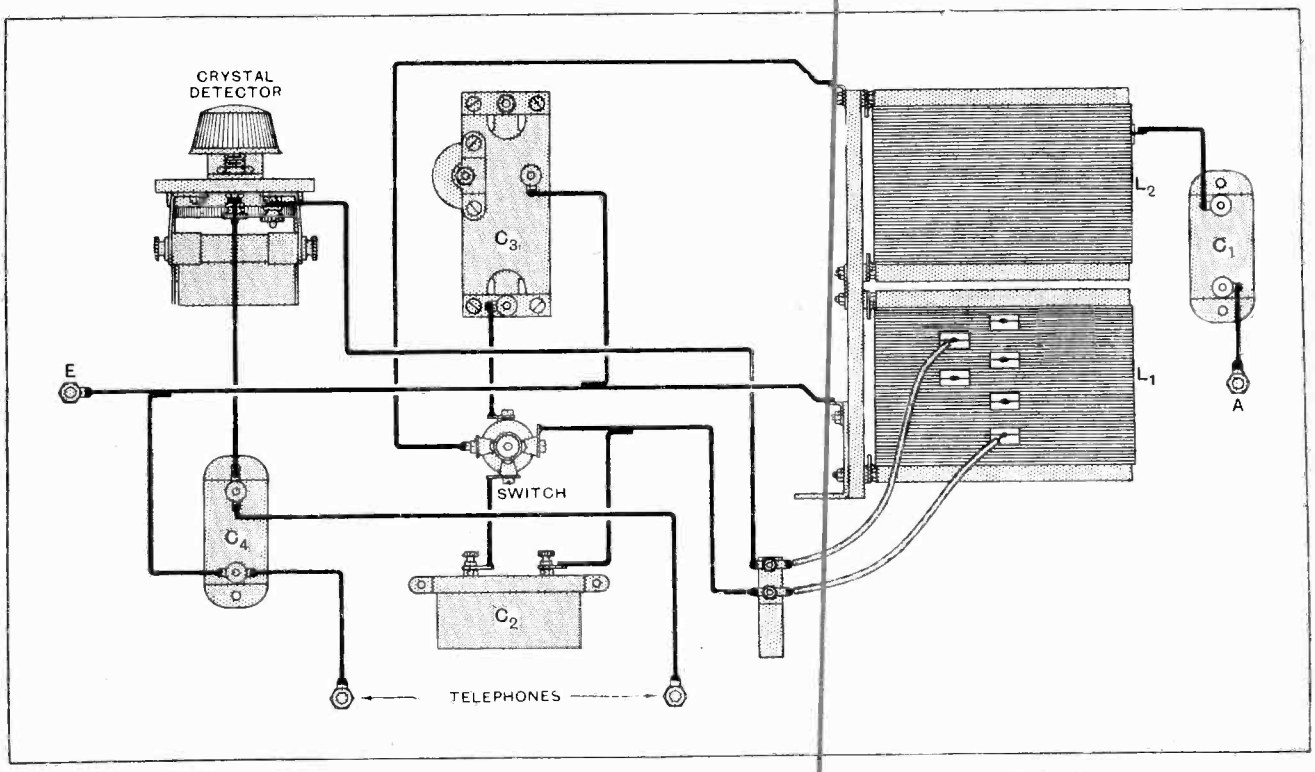
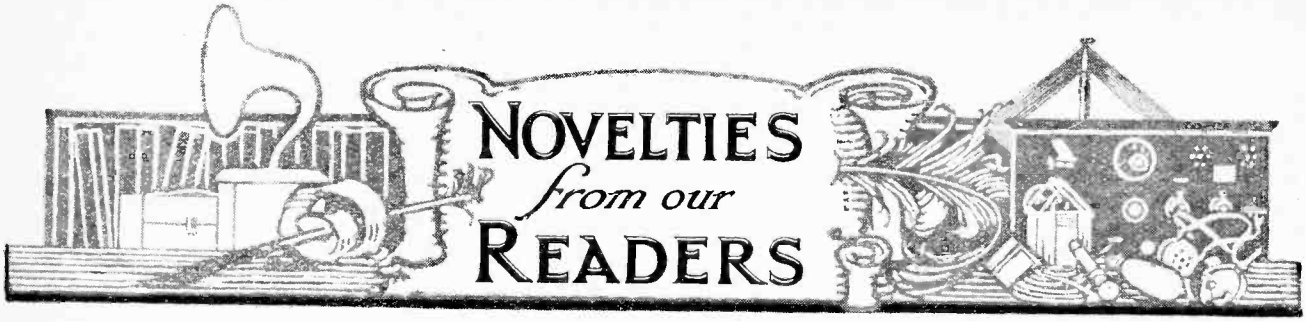


Fig. 5. The wiring diagram, which also shows the approximate positions of the tapping points.

The type of crystal advised for this set is one of the permanent variety, such as the carborundum (as used in the set) or the Harlie.

The carborundum crystal, made by the Carborundum Co., is certainly extraordinarily stable and surprisingly sensitive, but the writer has not found very much advantage in using the small bias they advise for either of two crystals tested, though, as it is probable that some of the crystals may benefit, it is as well to use the whole unit made by the Carborundum Co.. The best tapping point for the actual crystal used should be found by trial, but a good aerial about two miles from 2LO, and on the long waves Daventry was obtained at quite good strength clear of London, while Radio Paris was, of course, weaker, but quite good when Daventry was not working, and the Eiffel Tower broadcast was audible. The testing of a crystal set so near the local station is a very severe one for selectivity, as some readers will no doubt realise, so that the above results show that the design of the set has been successful.

The addition of a valve to this set for loud-speaker results will be described in an article in an early issue.



A Section Devoted to New Ideas and Practical Devices.

H.F. TRANSFORMER CONSTRUCTION.

Readers who find difficulty in keeping the spacing strips in position with a rubber band will find the following method useful when constructing transformers for "Everyman's" receivers.

The underside of each strip is coated with Bateman's vulcanising solution, obtainable at Woolworth's Stores. It will then adhere to the secondary winding quite firmly. The preparation is not ordinary rubber solution, and evaporates to dryness, leaving an almost invisible trace of adhesive which has a very high insulation resistance. Subsequent tests have shown that the high efficiency of the transformer is in no way affected by the process, which has the additional advantage that the calibration of the receiver is not likely to be upset as a result of the spacers subsequently moving their position.

T. H. G.

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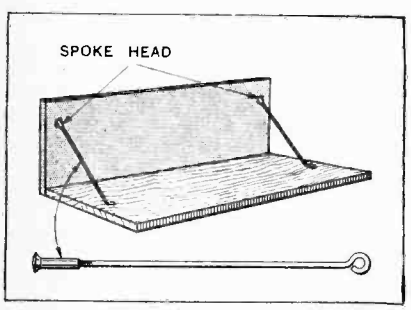
PANEL BRACKETS.

A simple substitute for the usual cast aluminium panel bracket may be made from a bicycle spoke. The



Substitute for panel brackets.

spoke is cut to the required length and a loop formed at one end which is secured to the baseboard by means of a round headed wood screw. Holes are then drilled in the front panel to take the head of the spoke, which is adjusted with a screwdriver until the requisite degree of fixing is obtainable.—P. M.

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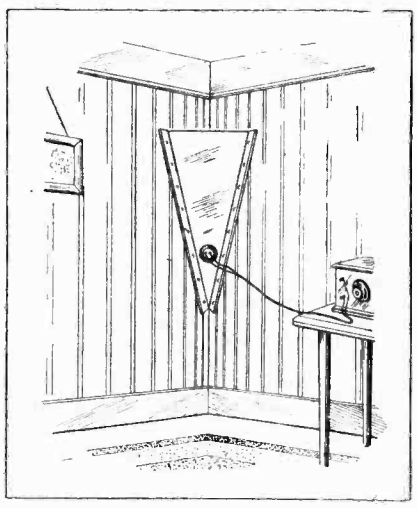
IMPROVISED LOUD-SPEAKER.

If for any reason the loud-speaker generally in use should break down, the arrangement shown in the diagram will give excellent service while the original instrument is away for repairs.



Improvised loud-speaker horn.

A triangular piece of three-ply wood or stiff cardboard is mounted as shown in the angle between two walls of the room, and an ear-piece or loud-speaker movement of proprietary make is fitted as near as is practicable to the bottom of the triangle. The space thus closed acts as a horn, and gives considerable amplification of the sound waves which are directed upwards to the ceiling and reflected downwards to all parts of the room. G. M.

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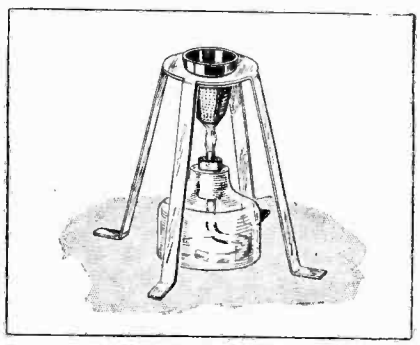
TINNING BATH.

A useful adjunct to the wireless experimenter's equipment is a tinning bath for soldering tags, etc. This may conveniently take the form indicated in the diagram. A steel thimble is used as the container for the solder, and is supported on a tripod cut from sheet brass of fairly heavy gauge. The height of the tripod should be so adjusted that the bottom of the thimble is just above the wick of the spirit lamp which is used to heat the solder.

To ensure success the surface of the solder should be skimmed before immersing part to be tinned, which should be previously cleaned and treated with flux. H. H.

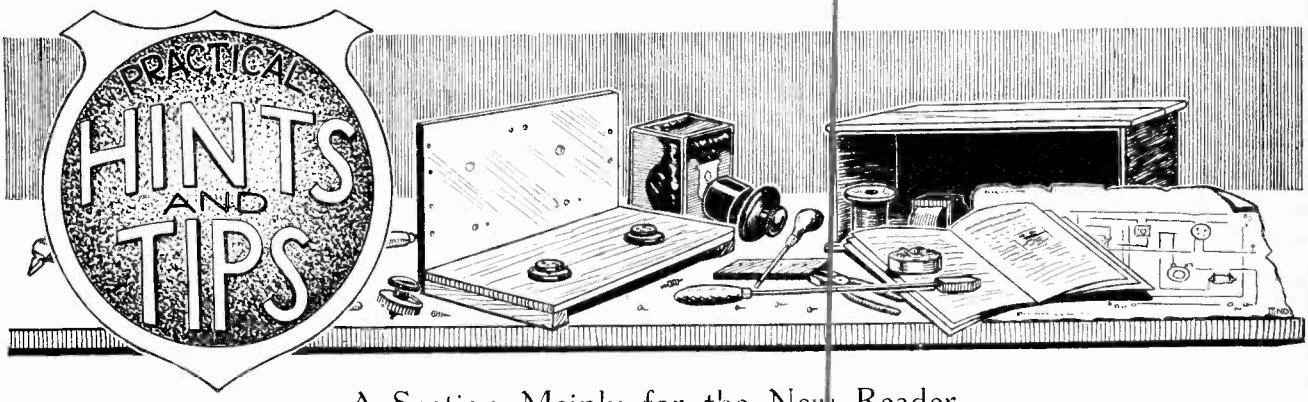


Tinning bath for soldering tags.

VALVES FOR IDEAS.

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

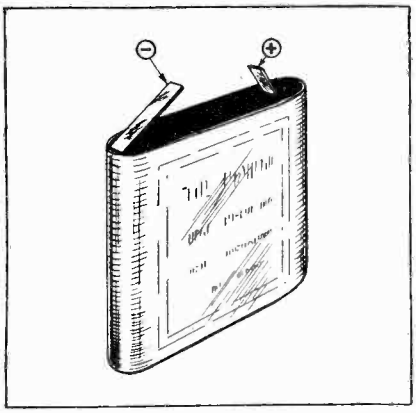
Letters should be addressed to the Editor, "Wireless World and Radio Review," Dorset House, Tudor St., London, E.C.4, and marked "Ideas."



A Section Mainly for the New Reader.

BATTERY POLARITY.

Flash-lamp batteries, usually containing three small dry cells, and thus giving a voltage of $4\frac{1}{2}$, are almost universally obtainable, and are convenient for a number of "wireless" purposes. Although they are often marked with the polarity of the brass springs which form their connections,



The positive and negative terminals of a flash-lamp battery.

this is not always the case, and it will be convenient to remember that the strip which is led out from the extreme edge of the container is always connected to the zinc shell, and is thus the negative. The positive strip is connected internally to a carbon rod, and is brought through the composition with which these batteries are sealed at a distance of about half an inch from the edge.

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FILTER CIRCUITS.

A word of warning should be offered regarding the use of transformer windings and unsuitable chokes in loud-speaker filter circuits. If the last valve has a low impedance, and thus takes a fairly heavy plate current, it should be realised that the D.C. resistance of the choke must be low, or an excessive voltage will be dropped across it, with the result that the H.T. actually on the anode is considerable reduced. Thus the power-handling capacity of the valve will be reduced, overloading will take place, and quality will be noticeably worse than if the loud-speaker is connected directly in the anode circuit.

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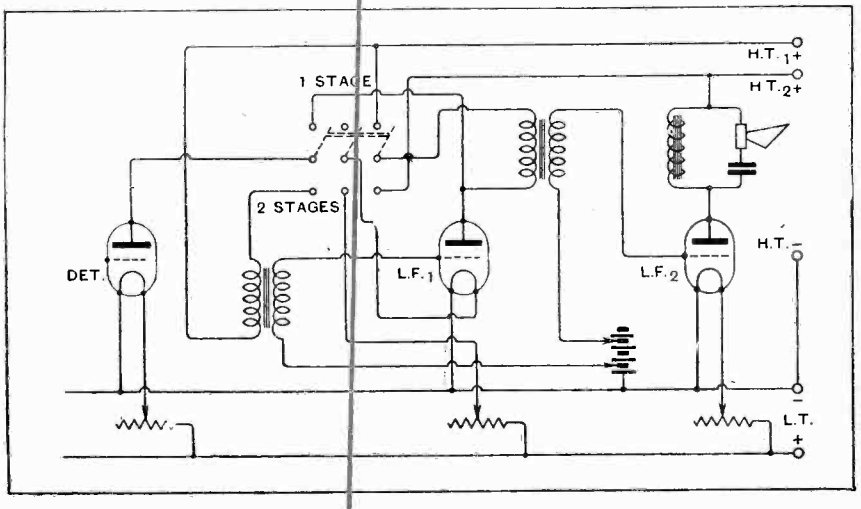
SWITCHING AN L.F. AMPLIFIER.

The increasing use of the so-called choke-condenser filter as a link between the output valve and loud-speaker tends to complicate the usual system of switching off one of the amplifying valves, particularly when it is desired to build the filter into the receiver itself. Under these conditions, the circuit shown below will be found convenient. It is arranged so that the second low-frequency amplifying valve ($L.F._1$), which will presumably be of the "power" or "super-power" type, is always in circuit; when a reduction in volume is desired, it is the first amplifier ($L.F._1$) which is cut out, thus reversing the more usual procedure. The connections may be simplified by forgoing the convenience of automatic filament control; in this case a double-pole switch will serve the purpose, instead of the three-pole pattern as shown.

Referring to the diagram, the first (left-hand) blade of the switch changes over the detector valve anode output to the primary of the transformer associated with either the first or second L.F. amplifiers, depending on its position. If the transformers have not already a built-in by-pass



Switching off an L.F. valve in a two-stage amplifier

condenser, it will probably be necessary to connect one between the plate of the valve and L.T. −.

The middle switch blade controls the filament of the first L.F. valve, while the connections of the right-hand one are so arranged that the H.T. applied to the detector and L.F. valves is not interfered with.

°°°°

VARIABLE CONDENSERS.

Many cheap variable condensers (and even some higher-priced ones) can be improved by adding a flexible connection, or "pigtail," between the moving vanes and their terminal; with a little patience, this operation will not present any great difficulty. It should always be tried when a receiver is found to be noisy in operation.

It must not be thought that every condenser without this pigtail is unsound in design; such an assumption would certainly be unjustified. A careful examination of the bearings will generally show if the electrical contact between the rotor and its terminal is likely to develop intermittency.

°°°°

CHARGING AN ACCUMULATOR.

Although the container of an accumulator battery is almost invariably marked with its normal charging rate, it must not be thought that the passing of a *lower* current through the cells will do any harm. The so-called normal rate is often nearly the maximum which can be used with safety, and accordingly should not be exceeded, but a lower charging rate is often convenient, particularly with an A.C. supply, as the design of a rectifier for a small current is much easier than for a heavy one.

It is quite permissible to charge an accumulator rated at 5 amperes at 1 ampere; the only disadvantage is that a full charge takes, in this case, five times as long.

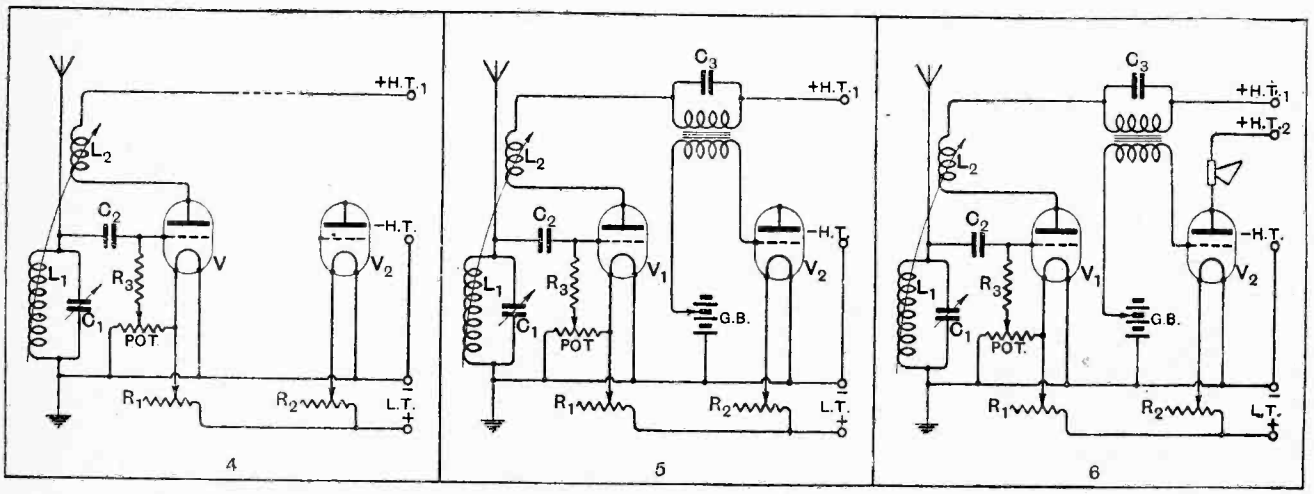
DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 61.—A Regenerative Detector–L.F. Receiver.

(Concluded from last week's issue.)

The simple circuit shown below is not highly selective, but, with careful operation, it is capable of receiving distant stations on headphones, and a near-by transmitter at loud-speaker strength. It is an arrangement which can be recommended to the beginner.



The plate circuit of the detector valve is completed through a reaction coil (variably coupled to the grid coil) and the H.T. battery.

The primary winding of an L.F. transformer (shunted by a fixed condenser) is inserted. The secondary is connected between grid and filament—

— of the L.F. valve, with bias battery interposed. The anode circuit is completed through the loud-speaker and high-tension battery.

THE best size for the reaction coil L_2 is only to be found by trial. On the shorter wavelengths it will generally be quite as large as the aerial coil. As a rule, it is as well to use the smallest coil which will give oscillation. The sensitivity of the receiver to distant signals will depend almost entirely on the "smoothness" of reaction control, so the coil holder should be mechanically sound.

From the point of view of quality of reproduction, the L.F. transformer is the most important component, so the best possible instrument should be obtained. As stated previously, a detector valve of comparatively high impedance will be chosen; therefore, the primary of the transformer, which is connected in its anode circuit, must have a high inductance. This precludes the use of a high step-up ratio. The capacity of the condenser across the primary will depend on the maker's recommendation; failing instructions on this point, one of from 0.0003 to 0.001 mfd. may be used. If the receiver is to operate a loud-speaker on strong signals, it is essential that the output valve should be of the "power" type, with an H.T. voltage of from 100-120 volts (+H.T.2 terminal) and from 6-9 volts grid bias. The best value of H.T. for the detector (+H.T.1 terminal) is easily found by trial and error; it is unlikely that more than fifty volts will be required, unless the valve is of very high impedance.

A TOUR ROUND SAVOY HILL.

Part IV.—Studio Equipment.

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

WE now come to consider the electrical equipment of the broadcasting studios at Savoy Hill.

The chain of the complete broadcast transmission equipment is of necessity divided into three parts, comprising the pick-up, the technical supervision, and the radiation of the programme, located respectively in the Studio (or outside hall), the Control Room, and the Transmitter. It would seem at first sight that the corresponding technical units would be the microphone, the amplifier, and the transmitter, but practical considerations require a different division of the chain. First of all, it is usually most convenient and necessary (especially when high power is being used) to build the broadcasting transmitter at some considerable distance from the studio. The location of the transmitter is determined primarily by the condition of giving a reliable service to its audience of listeners, but at the same time causing the least local interference to those who wish to listen to distant stations.

Division of the Broadcasting Chain.

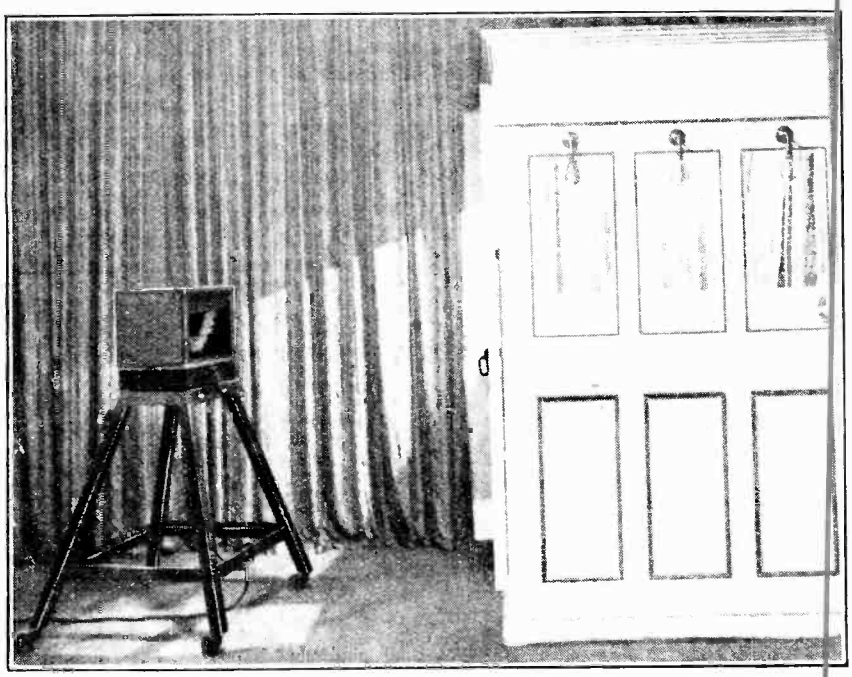
The site must be chosen where a high aerial system can be erected, and the present tendency is towards having higher power stations built in open country just outside the towns they serve. But the studio must be situated in a central position easily accessible to artists, and close to the hall and theatre area.

Consequently, the necessity for this division of apparatus between the studio part (further sub-divided in the case of an outside broadcast) and the transmitter part requires a means of connecting up which must usually make use of a public service system, such as the telephone distribution system, and this consequently means a limitation in the amount of power transmitted over such a system; it must not be too great or it will seriously interfere with other users of the system, nor too small or it will itself suffer from interference.

In practice this requirement necessitates the following division of apparatus, which is the arrangement adopted at most broadcasting stations: First, the microphone with its local amplifier at the studio (or outside hall). The high-quality microphone, of whatever type, needs an associated amplifier with a considerable degree of amplification, to bring normal music and speech, in transmission over even the shortest lines, to a suitable strength to overcome local induction noises, however carefully shielded the lines may be. The electromagnetic and electrostatic types of microphones, on account of their lack of sensitivity and giving a very weak output, usually for this reason need very short leads to their own local amplifiers. High-quality carbon microphones, being more sensitive, are not so fastidious in this respect.

Secondly, the remaining stage of amplification before leaving the studio building is carried out in the control amplifier, situated in the control room, which represents the brain centre for the broadcast transmission, where programmes are supervised, the strength level is maintained, and the modulation of the transmitter is watched and checked from the points of view of quality and strength. From this point the music passes over telephone lines, sometimes specially laid but more frequently hired from the G.P.O., to the third stage—the broadcasting transmitter—where it is further amplified before being applied to the main modulation system of the set. (In the case of pick-up from a point outside the studio, the microphone and its amplifier connect direct by telephone line to the control room.) This arrangement, which is shown diagrammatically in Fig. 15, has proved to be extremely practicable and adaptable, and the design of the necessary apparatus is much simplified by the standardisation of this method.

In British broadcasting, the use of the comparatively insensitive magnetophone has necessitated placing the



Silence cabinet in No. 4 Studio at Savoy Hill, showing indicating lamps controlled by the announcer.

A Tour Round Savoy Hill.—

associated amplifier right close to the studio. The visitor to Savoy Hill or any other B.B.C. station will see the first stage amplifier with its batteries usually situated in a cupboard or small room adjacent to the studio. The solidly built stand for the magnetophone, mounted in a suspension of sponge rubber, is a familiar feature of all studio photographs, but the adoption of a cover of copper gauze and silk, referred to by many artists as a "meat safe," which is necessary to prevent damage to the delicate suspension of the moving coil by careless handling or by air currents set up by the ventilating fans in the studios, has now hidden away the microphone from view.

Microphone Equipment.

The inquisitive visitor to Savoy Hill who now lifts up the cover to see what is inside will find not the old familiar magnetophone, but two small marble microphones of carbon type of a design invented by Reiss and developed by the Marconi Company. He will notice that these microphones, connected by a long flexible screened cable

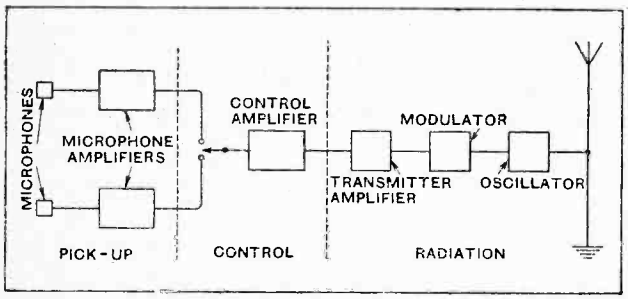


Fig. 15.—Chain of amplifiers and controls between studio and hall microphones and transmitter.

to a wall socket, lead through conduit to the first stage amplifier, which is situated fairly close to the studio. But owing to the greater sensitivity of this type of microphone it is not so necessary to have the amplifier close to the studio, and it is therefore convenient to place the amplifiers of several studios together and to operate them off a central battery system. A bank of such amplifiers is in process of being installed, corresponding to all the studios in the building. These are three-valve high quality amplifiers which, in conjunction with the Marconi-Reiss microphones, deliver a normal output which can be popularly referred to as a fair telephone strength.

The studio equipment is thus comparatively simple, consisting as it does of two microphones and a local amplifier. The reason for having two microphones is two-fold: one acts as a stand-by to the other; and is also ready for connecting up to the echo room whenever artificial echo is required—as described in the last article.

Silence Cabinets.

This arrangement has been modified by the introduction of silence cabinets into studios on account of certain programme requirements. The need for this has evolved as follows: First, it was realised that it was much easier to carry out placing of artists and the balancing of orchestras on the spot, and an ordinary telephone silence cabinet was introduced into No. 1 Studio for this purpose. The producer of a programme could listen during a rehearsal or actual performance in comparative silence with head telephones (connected after further amplification to the microphone amplifier), and correct any faults of balance that might arise. The announcer could use the cabinet for getting into touch with the control room to discuss any

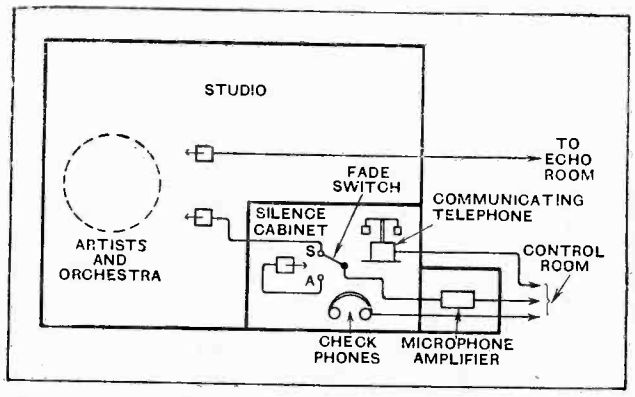


Fig. 16.—Standard studio equipment with schematic connections of microphones and amplifiers.

of the points (such as timing of the programme) which continually arise during the presentation.

Finally, the programme authorities thought it advisable to give an announcer an opportunity of making his announcements "in solitary glory," so a microphone was introduced into the silence cabinet, so that he could do this, and at the same time switch off the studio microphone and allow artists to move into position, tune their instruments, and clear their throats without having any fear of these noises being transmitted.

Silence Cabinet Equipment.

These ideas were first fully put into practice in No. 4 Studio, where a silence cabinet was built in one corner, with its own microphone and silent change-over device switching from studio microphone to announcer microphone and operating automatically at the same time corresponding lamps fixed on the outside of the cabinet to indicate to the artists in the studio which microphone is sensitive. In this case neon letter lamps (indicating S and A respectively) are in use. Similar cabinets have

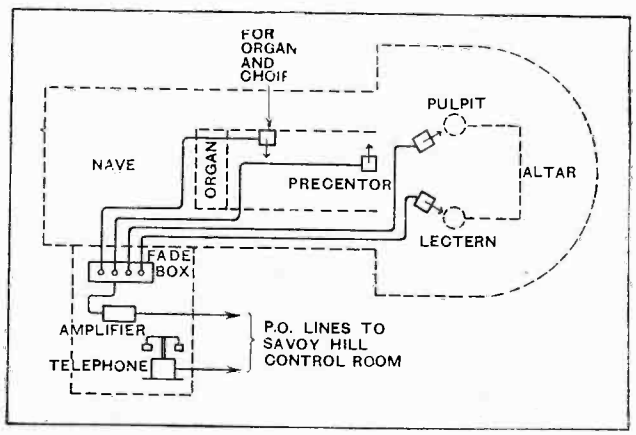


Fig. 17.—Typical outside broadcast equipment. The diagram shows the positions of microphones in Westminster Abbey.

A Tour Round Savoy Hill.—

been constructed in other studios, but they have never proved to be entirely successful for the following reasons: The cabinet must first of all be absolutely sound-proof; if it is not so, the sounds passing in from the studio, especially the lower frequencies, will upset any attempt at securing correct balance as judged on headphones. Secondly, there must be a considerable area of glass in the walls to see from inside what is going on in the studio. Thirdly, to use as an announcing box, the interior acoustics must be satisfactory. It is difficult to obtain perfection with a lightly built structure. Sound is only stopped by good, thick, solid walls, and a small lightly built cabinet with a good deal of glass in the walls does not lead to the transmission of good quality announcements unless the announcer can speak within a few inches of the microphone, and this he is not able or inclined to do if he has several papers in his hands from which he has to read extracts.

The idea of a silence cabinet built in the studio is being abandoned in favour of a small room built next to and actually outside the studio, with a view of the studio through a small window, rather like the lepers' squint in the walls of ancient churches, through which the lepers from the outside of the church were able to follow the service, unobserved by the congregation inside. The new studios are being built with this adjacent room including a microphone for the announcer, microphone change-over switch, headphones for balancing and general checking of the programme, and communication telephone to the control room. Operated from the last mentioned is a bright light in the studio which shows when the control room is calling for the announcer. The complete equipment for the studio is thus illustrated in Fig. 16.

Talks Studio (No. 5), in which is situated the necessary apparatus for broadcasting gramophone records.

The Impressive Red Lights.

Finally, one must not forget to mention the studio red lights above every studio door, inside and outside, which more than anything else inspire such a feeling of awe in every visitor to Savoy Hill. These lights, operated from the control room, indicate when the microphone in any particular studio is sensitive, and that any sounds occurring in that studio will most likely go "on the air." In conjunction with the announcer's press buttons, whereby he can "buzz" the control room, the lights form a very simple and effective means of communication (by a given code) between the studio and the control room.

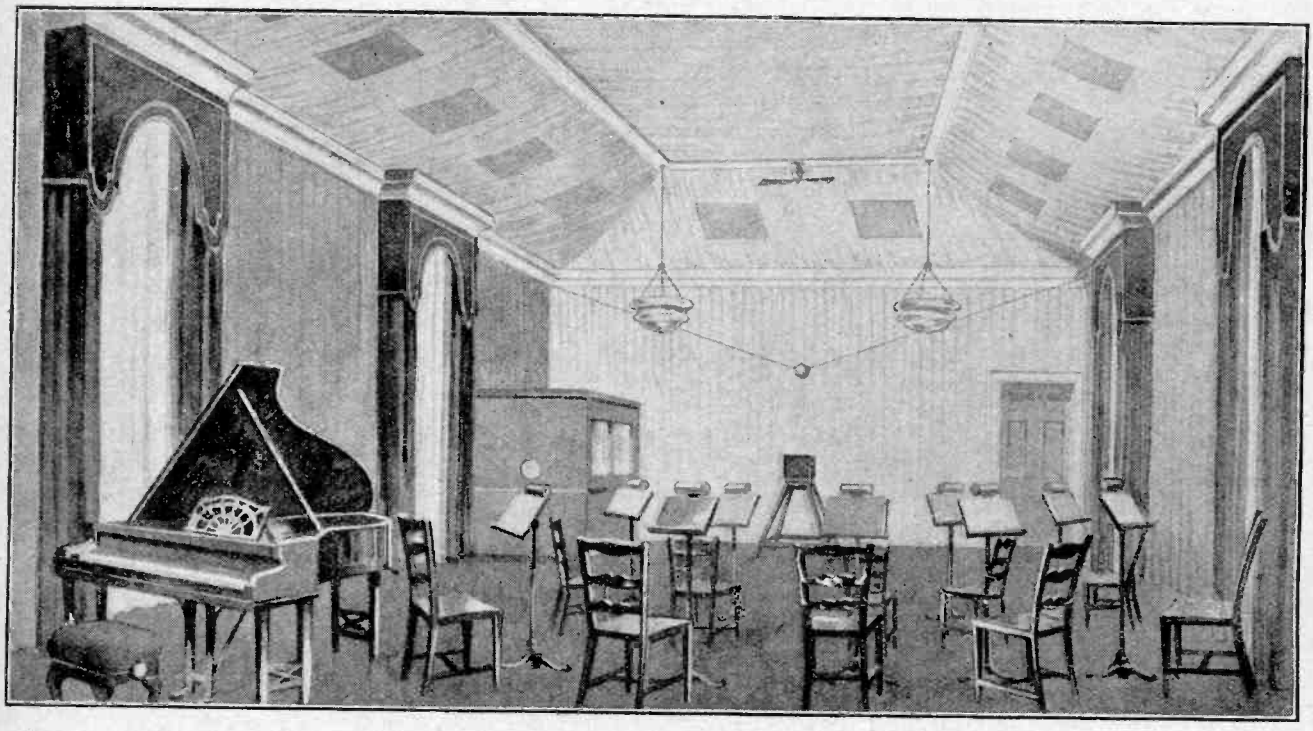
This standard arrangement needs slight modification in one or two special cases. Reference has already been made in a previous article to the special scheme for local control in the Dramatic studios. The silence cabinet is the producer's cabinet and serves both purposes. A different modification in another studio (No. 5, the Talks Studio) is the provision for the transmission of gramophone records. In this studio a special gramophone cabinet is installed with two clock-work turn-tables and electro-magnetic pick-up devices. A switch in the cabinet puts the pick-up devices into circuit, changing over from one to the other as required. The electrical energy is taken from the pick-up unit and introduced into one of the stages of the microphone amplifier for that studio.

Outside Broadcasts.

Reference might be made here in passing to the arrangement which is adopted in the case of outside broadcasts where more than one microphone is required. These microphones are connected up through a fade box to the local microphone amplifier, which is one specially designed for portability and capable of giving sufficient undistorted output power to operate over long distances in transmitting music over telephone lines to the control room at Savoy Hill. The fade box unit comprises a method of fading-in the various microphones employed during the broadcast. It enables a silent change to be made from one microphone to another, and also two or more microphones can be used at once in varying proportions, giving any balance or effect that may be desired. An example of this arrangement is shown in Fig. 17,

A Tour Round Savoy Hill.—

which shows how broadcasts of services from Westminster Abbey are carried out. It is in this type of broadcast that it is most necessary to be able to change rapidly from one microphone to another, the effective intelligible range of a microphone in such a large building being comparatively small; and therefore each speaking position during the transmission has to be equipped with a separate microphone which must be brought into circuit at the correct moment. Also the music microphones must be specially placed and combined to get correct balance—for instance, between organ and choir. The system of using several microphones enables all this to be done without any difficulty.



The big Orchestral Studio (No. 1), recently redecorated, has been in use since early in 1924.

Still More New Studios at 2LO.

Plans have been finished and construction is well advanced for two more studios and two more echo rooms, and these are being built in the basement at Savoy Hill, and when completed will take the place of the present No. 2 (Dramatic) and No. 3 studios. The new Dramatic studios will be modelled on lines very similar to the present Dramatic studios, incorporating a central studio with an echo room on one side and a noise room on the other.

The design of these studios will be on more up-to-date lines, and the equipment in accordance with the latest ideas for fading in and combining several microphones so as to give the fullest opportunity to the dramatic producer. He will have a special control room where he will be able to combine in any proportions that he likes performances not only in his own Dramatic studios, but also in studios in any part of the building. For the production of a play he will need to use only the new Dramatic studios, the players reading their parts in the central section, with provision for echo in the adjacent echo room and with the production of incidental sounds in the noises room. But on certain occasions, when big productions mean the use of one or perhaps two orchestras and various other effects, he will make use of several studios at once, and bring them in or out of action in accordance with his requirements by means of fairly simple controls, consisting, as far as external appearance is concerned, merely of a row of handles.

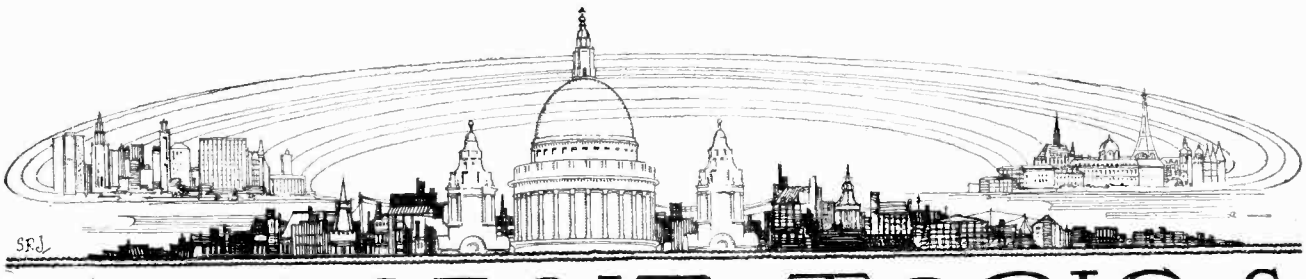
Fading-in Effects.

Studio technique has advanced very considerably in this respect since the fading-in of items (and consequent avoidance of clicks) was put into practice in broadcast transmission several years ago. The present methods are very similar to those employed in cinema production, where the proper use of fading in or out, dissolving, and superimposing, when suitably introduced, adds greatly to the artistic effect.

As regards the acoustic treatment of these new studios, experience now being gained in the new methods employed has been used, the design of the interior furnishings being similar to that at present in Nos. 6 and 7 studios.

The next article of this series will be written by Mr. A. C. Shaw, Engineer-in-charge of the London Station, on the subject of the control room at Savoy Hill, which may be aptly described as the nerve centre of British broadcasting.

(*To be continued.*)



CURRENT TOPICS

Events of the Week in Brief Review.

HOPE SPRINGS ETERNAL.

The Rhyl Council is asking the B.B.C. to erect a North Wales broadcasting station in that town.

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THE "LISTENERS' HALL."

Under the auspices of the B.B.C. a "Listeners' Hall" has been installed at the *Daily Mail* Ideal Home Exhibition, which was opened yesterday at Olympia, London. Demonstrations are given of "perfect reception."

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WIRELESS IN CHANNEL FOGS.

During the recent Channel fogs the G.W.R. vessels on the Weymouth-Channel Islands route have derived the utmost benefit from their new wireless D.F. apparatus.

The ship crossing the Channel keeps in constant touch with the sister ship in harbour, and last week (says a *Times* correspondent) the "Reindeer" and the "St. Julien" were virtually steered for 70 miles by wireless.

INTERNATIONAL EXHIBITION.

An International Wireless Exhibition is to be held at Liége, Belgium, from March 26th to April 5th.

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CHEAPER LISTENING IN DENMARK.

A reduction of 50 per cent. in the cost of wireless receiving licences was recently brought into effect in Denmark. Crystal sets are now licensed at 5 crowns per annum, while valve set licences cost 7.5 crowns.

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ILLICIT TRANSMITTER FINED.

At the Manchester City Police Court on February 17th, a fine of £10 was imposed on Eustace John Dennes, of Sandy Lane, Chorlton-cum-Hardy, for installing and operating a wireless transmitter without a licence.

The defendant admitted the offence, but pleaded that he did not think a licence would have been granted to him, even if he applied, as he was still a minor.

TWO OPINIONS.

"I do not think television will ever become more than a stunt."—Mr. Thomas A. Edison.

"Mr. Edison is probably not aware of the recent developments in television."—Mr. John L. Baird.

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THE BROADCAST BALLOT.

It is estimated that the Broadcasting Ballot instituted by our contemporary, the *Daily Mail*, has drawn 1,500,000 entries. The Ballot was organised, it will be recalled, for the purpose of gauging the popular taste in regard to various types of broadcast programmes.

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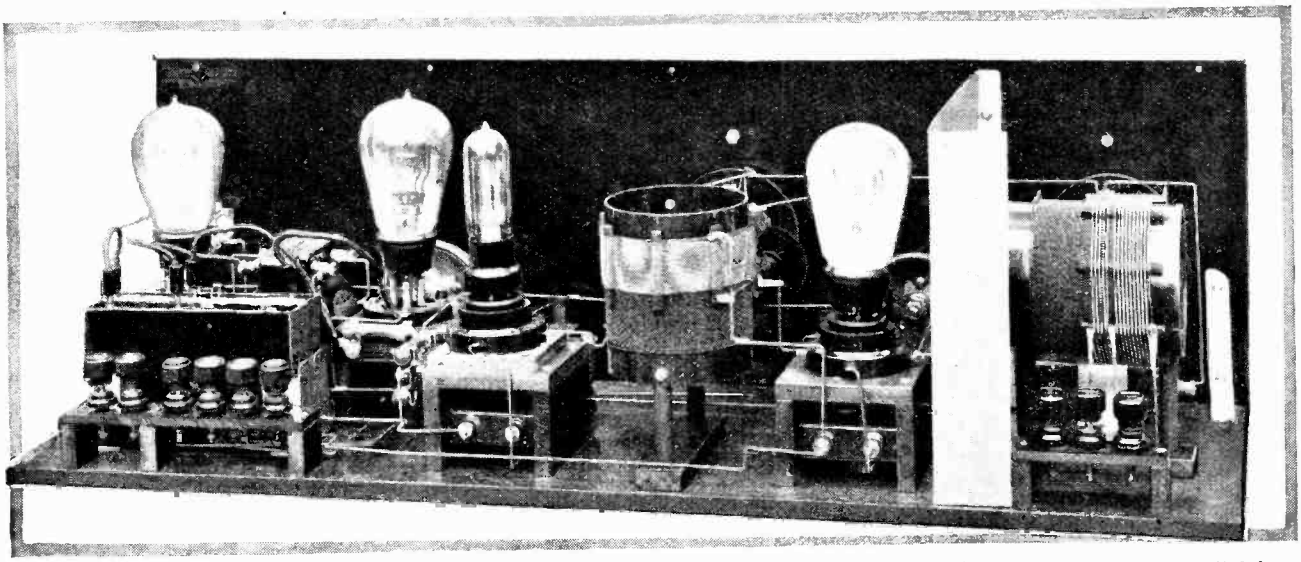
THE "EVERYMAN'S FOUR."

The set illustrated on this page was constructed by an enthusiastic reader, Mr. T. J. Pearson, to the design given in recent issues. In the receiver shown a few minor modifications have been made, however, which perhaps further simplify the construction.

Wooden platforms are used to elevate the valve-holders, at the same time pro-



A FAMOUS RECEIVER. An interesting example of the "Everyman's Four" as built by a reader. The construction has been slightly simplified, perhaps, by the introduction of the few minor modifications referred to above. For the benefit of constructors "Everyman's Four" sets are now on view in London and Birmingham. Particulars will be found on the next page.

viding a housing for the H.T. battery bridging condensers. The detector valve is carried on a "Sorbo" cushion, the grid and anode resistances being attached to the sides of the valve platforms.

(*As a result of the widespread popularity which this receiver has achieved, and to meet the increasing demand for full constructional and operating details, a booklet has now been issued, and is obtainable from the Publishers, Iliffe and Sons Ltd., Dorset House, Tudor Street, London, E.C.4, 1s. 2d. post free.*)

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THE "EVERYMAN'S FOUR" ON VIEW.

As a keen desire has been expressed by very many of our readers to have the opportunity of seeing the "Everyman's Four" set before commencing to construct, we have made arrangements to exhibit sets so that they can be inspected in detail.

In London a set is on view, between the hours of 10 a.m. and 5 p.m. (Saturdays between 10 a.m. and 12 noon), at No. 24, Tudor Street, E.C.4.

In Birmingham a set can be seen on application, at the same hours, at our Birmingham offices, Guildhall Buildings, Navigation Street.

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CLEARING THE U.S. ETHER.

The U.S. Radio Bill, referred to in these columns last week, has been passed by the Senate, and is expected to receive the approval of the President in the course of a few days.

The Bill sets up a Federal Wireless Commission of five members, whose duty will be to clear up the chaos now prevailing in the American broadcast wavelength band.

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A DANISH QUERY.

According to an official report recently published, Denmark has at present 106,400 wireless listeners, as compared with 95,374 on October 1st, 1926. Of the above-mentioned number 54,743 are using crystal apparatus, while the balance, 51,759, use valve sets. These figures have been arrived at through the amount of licence money paid in to the Danish Government. Unofficial sources in Sweden place the number of Danish listeners at somewhat above 150,000.

Is it possible that there are "pirates" in Denmark?

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"YOU SAID A MOUTHFUL."

A headline in an American paper runs: "Simple Eliminator Cuts Out Most Man-Made Static."

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WREXHAM WIRELESS EXHIBITION.

The third annual wireless exhibition in the Wrexham district under the auspices of the *Wrexham Leader* and the local Wireless Society will be opened on Friday next, March 4th, at the Church House, Wrexham, at 2 p.m. Both amateur and professional work will be on view, and numerous prizes are being offered for the best amateur-built sets. The exhibition closes at 10.30 p.m. on Saturday.

TRANSATLANTIC TELEPHONY SERVICE COMPLETE.

With the extensions last week to the fourth and fifth American zones, the Post Office Transatlantic telephony service becomes available from any place in Great Britain to any place in the United States.

The charge for calls to the fourth zone is £16 16s. for the first three minutes and £5 12s. per additional minute. Calls to the fifth zone are charged at £17 8s. for the first three minutes and £5 16s. for each additional minute.

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TRANSATLANTIC TELEPHONY FROM THE CONTINENT?

No official confirmation is given to the report, published in London last week, that telephone conversations have taken place between Frankfort and New York via the Post Office Transatlantic Telephony system. On enquiry at the General Post Office a *Wireless World* representative was informed that the Post Office had not yet entered into experiments of this kind, and that such an undertaking was unlikely until the Transatlantic service is fully developed.

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PHILIPPINES GET BUSY.

A new radio bill has been passed in the Philippine Islands under which listeners will be required to subscribe to their local broadcasting station. The principal station, at Manila Heights, has just been reorganised, a new transmitter and new studio having been installed.

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NEW B.B.C. APPOINTMENT.

Captain Daly, M.C., has succeeded Mr. Leslie B. Page as director of the Hull relay station of the B.B.C. Mr. Page is leaving for India to take up the position of director of the Bombay broadcasting station.

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WIRELESS AND A MUSHROOM TOWNSHIP.

A new town, Aldansk, has sprung up in the wilds of Siberia, as a result of the recent development of the Aldan gold mines, says a Berlin correspondent. Caravans of camels plod through the Siberian wastes to bring food to the 17,000 workers who inhabit this mushroom township, which has no rail communication with the outside world. It is not altogether isolated from civilisation, however, for the Aldan Gold Trust has installed a wireless station which keeps the gold diggers informed regarding important news of the day.

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NEW RADIO IBERICA STATION.

As we go to press we learn that the new Radio Iberica broadcasting station in Madrid (EAJ 6) began regular transmissions yesterday (Tuesday) on a wavelength of 272.7 metres. The station is independent of the Union Radio group, and the owners, the Sociedad National de Radio Diffusion Espanola, will welcome reports from British listeners. It is understood that EAJ 6 works on a power of about 2kW.

PROGRESS IN NEW ZEALAND.

The installation of broadcasting stations at Auckland and Christchurch has just been completed by the Radio Broadcasting Co. of New Zealand Ltd. It is estimated, says *Commerce Reports*, that 8,000 receiving licences were issued in New Zealand in 1926. Practically all the wireless apparatus used in the country is American.

WIRELESS AT WESTMINSTER.

BY OUR PARLIAMENTARY CORRESPONDENT.

The Washington Conference.

In the House of Commons last week Sir W. de Frece asked whether the Government proposed to be officially represented in respect of broadcasting at the Washington Wireless Telegraph Conference in the autumn.

Sir W. Mitchell-Thomson, the Postmaster-General, said that the Government's representatives at the Radiotelegraph Conference to be held at Washington in October next had not yet been selected. It rested with the United States Government to invite representatives from bodies which might be concerned in the subjects under discussion. So far as he was aware, that Government had reached no decision on the matter.

Licence Prosecutions.

Viscount Wolmer, the Assistant Postmaster-General, said that the number of persons prosecuted for the use of unlicensed wireless apparatus during the period between the passage of the Wireless Telegraphy (Explanation) Act in the autumn of 1925 and the 31st January, 1927, was 583. The number of convictions obtained was 579. The penalties ranged from a fine of 2s. 6d. to a fine of £10, in addition to £10 costs.

Captain Fraser asked if the Prime Minister would give time for a discussion on the advisability of permitting certain specially selected front bench speeches to be broadcast by arrangement between the parties at rare intervals when the importance and general interest of the subject was unquestionable; or if he would set up the Select Committee of both Houses which he told the House he was considering on March 25th, 1925?

Mr. Baldwin replied: "No, Sir. I cannot give time for such discussion under the rules of the House; many opportunities are afforded to honourable members to bring forward a motion dealing with this question on a night set apart for private members' business. As regards the last part of the question, I am not prepared to set up a Select Committee, as I am unaware of any change of opinion."

Licence Figures in Various Countries.

Sir W. Mitchell-Thomson informed Mr. Day that on December 1st the number of licensed wireless listeners in various countries was as follows: Great Britain and Northern Ireland, 2,130,000; Germany, 1,337,122; Sweden, 238,000; Denmark, 114,492; Hungary, 53,070; and Switzerland, 51,759.

BROADCASTING STATION KODR.

The Outcome of Amateur Activity.

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

THE Kiev broadcasting station was, according to reports received by that station, first heard in England in July, 1925, and since then has been heard with fair regularity.

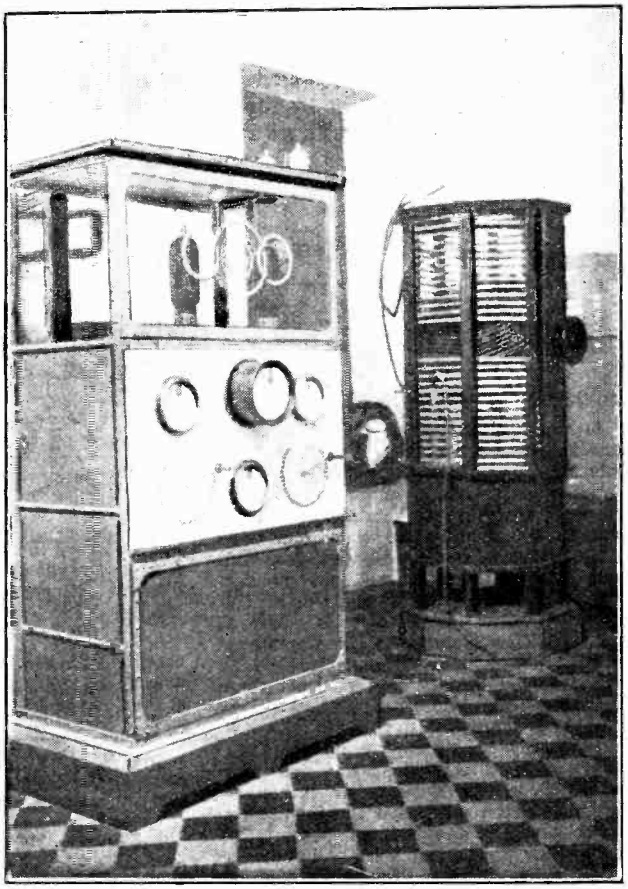
Known as the Radioperedacha station with the call sign KODR, the transmitter was set up at Kiev under licence of the Soviet Government, in one of the buildings of the spark station RAG (2,500 metres, 8 kW.), and in its earliest form was constructed solely by radio amateurs, members of the "O.D.R.," with the exception of the valves, which were constructed in the Radio Research Laboratory at Nijni Novgorod.

Early Methods of Modulation.

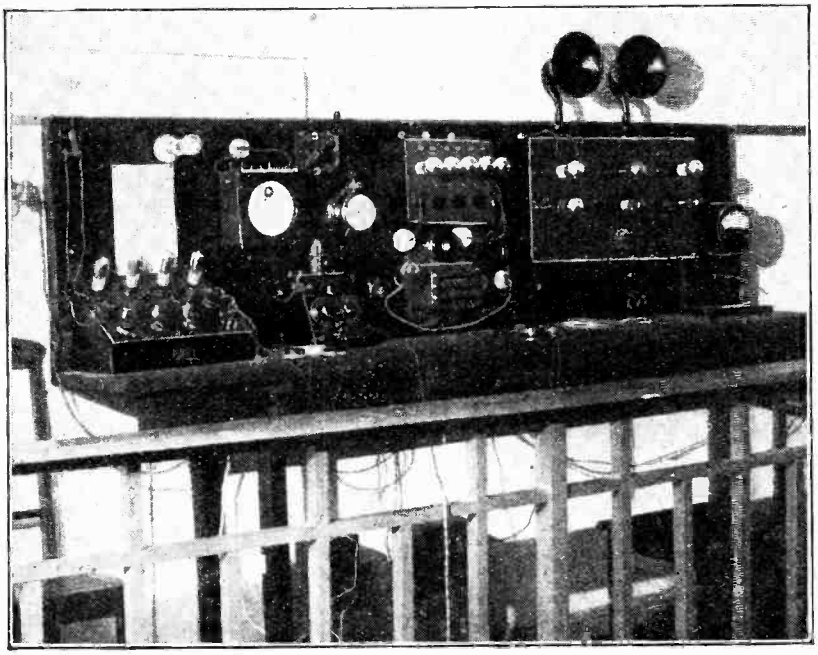
At first an undamped form of magnetic modulator was used with fair success, but the tuning was somewhat flat and spread over 850-950 metres. In December, 1925, extensive modifications were completed, including improved mounting of the aerial and large valves more liberally rated.

An interior view of the station as it is to-day is reproduced on the right, and shows one of the two enclosed switchboards and the tuning inductances with their tapped connections.

The Radio Society ("O.D.R.") have recently added a comprehensive "translation board" or exchange for outside broadcasts. Land lines connecting microphones permanently placed in the concert hall in the centre of the town, the clock tower of the town hall, the theatre, etc., are brought to the plug board, seen in the centre of the photograph on the left, and in conjunction with the change-over switches, seen to the left above, permit of very rapid changes. On the left is seen a four-valve receiver used for the reception, prior to re-broadcasting, of foreign stations and also of Moscow Radioperedacha.



Valve panel and tuning inductances of the 800-metre transmitter.



Control panel and amplifiers for outside broadcasts.

The rectified current is amplified by the five-valve amplifier (seen in the centre) before being passed to the modulator in the broadcasting station. The six-valve amplifier, to be seen at the extreme right, together with a bank of four power valves (not shown) supply the loud-speakers situated in certain of the main streets, open squares, and exhibition (trade) hall. The single-valve receiver shown is used as a monitor to the transmitter, which is in the suburbs some distance away from this exchange.

It will be appreciated that this exchange compares very favourably with Western progress, when it is remembered that it was constructed principally by amateurs.

Broadcasting Station KODR—

As a further modification, experiments are being made with a system of communication between the exchange and its permanent microphone posts, using superimposed high-frequency speech modulated currents on the land lines used simultaneously for conveying the ordinary speech currents to the main microphone of the transmitter.

A further increase in the transmitting power at KODR is contemplated, and reports of reception on 800 metres will be appreciated. Reports should be addressed to Injenioro P. Naumov, Radioperedacha, Kiev, Ukrainia, S.S.S.R., and preferably in the international language (not to be confused with Esperanto), when they will be acknowledged in that language. It will probably be of considerable assistance in identifying the station to give the words actually spoken in the international language both at the commencement and termination of transmissions: "Parolas Kieva Radiofona Staciono dil Uniono di Radio Amiki, en la Internaciona Linguo." Local announcements are in the Ukranian language.

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.

Plotting Valve Curves at Home.

Although most wireless amateurs are familiar with "characteristic curves" of valves as published by valve manufacturers and others, comparatively few people are able to make such use of the information contained in those curves as to enable them to operate their receiving apparatus in the most efficient manner.

At the last meeting of the North Middlesex Wireless Club, Mr. R. Kirlew, A.M.I.M.E., a member of the Committee of the club, gave a lantern lecture which was designed to elucidate at least some of the mysteries connected with "Valves and their Characteristics."

Mr. Kirlew's main contention was that, to get the best results, it was necessary for all those who were really interested in the subject to prepare for themselves curves showing the performance of the valves they themselves were using, under actual operating conditions. The lecturer's curves had all been obtained while signals were being received.

The difference between the characteristic curve of a valve thus obtained, and that given by the makers, was illustrated by one of the slides, and, generally speaking, quite an appreciable difference was noted when the valve was "loaded" with telephones or transformer, from that obtained with only a milliammeter in the anode circuit.

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Captain Round Demonstrates "Stereophonic" Reception.

Captain H. J. Round, M.C., A.M.I.E.E., gave an interesting demonstration on "Stereophonic" reception before the Muswell Hill and District Radio Society, of which he is president, on February 9th. He demonstrated with two Marconi-Reisz microphones which were connected to two separate amplifiers of identical design. Three pairs of phones were connected, one ear-piece of each being joined to No. 1 amplifier and the other ear-piece of each being joined to No. 2 amplifier. Results were astonishingly stereophonic; performing artists (school members who gave an impromptu community singing concert) could be accurately "placed" to the right or left of the platform, and could even be followed by the ear when crossing over from right to left or vice versa. No sounds, however, could be heard in the front centre of the platform; this Capt. Round attributed to the fact that microphones lack certain of those characteristics which make the human ear so adaptable.

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FORTHCOMING EVENTS.

WEDNESDAY, MARCH 2nd.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Lecture by Mr. J. H. A. Whitehouse, of the B.B.C.

Barnsley and District Wireless Association. At 8 p.m. At 22, Market Street. Lecture: "Simple Principles of Television," by Mr G. W. Wigglesworth.

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

Tottenham Wireless Society.—At 8 p.m. At 10, Bruce Grove. Business meeting, followed by a discussion.

North Middlesex Wireless Club.—At 8.30 p.m. At Shaftesbury Hall, Bowes Park, N.11. Practical demonstration of making valve curves, by Mr. R. Kirlew, A.M.I.M.E.

THURSDAY, MARCH 3rd.

Golders Green and Hendon Radio Society. —Discussion on Circuits opened by Mr. J. C. Bird, B.Sc.

FRIDAY, MARCH 4th.

Radio Experimental Society of Manchester. —Experimental Evening.

Sheffield and District Wireless Society.—At the Department of Applied Science, St. George's Square. Receiver Demonstration, by Mr. G. Bagshaw.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Lecture: "The Production of H.F. Current," by Mr. L. Harvey, Engineer-in-Charge, 2LS.

MONDAY, MARCH 7th.

Ipswich and District Radio Society.—At 8 p.m. At 55, Fonnereau Road. Lecture: "Valve Manufacture," by Dr. Haitt, of the Ediswan Electric Co., Ltd.

Northampton and District Amateur Radio Society. Lecture: "Amplification," by Mr. J. A. Cooper, A.M.I.E.E., of the Birmingham Broadcasting Station.

Southport and District Radio Society.—At 8 p.m. At 20, Scarisbrick Street. Lantern Lecture: "Wireless Valves," by Mr. Pratt, of the Mullard Co.

Public Address Surprises.

An interesting account of the progress of public address systems was given by Mr. F. Youle, of the Marconiphone Co., at the last meeting of the Southend and District Radio Society. Many lantern slides were shown and an entertaining demonstration was given with the actual public address equipment. After dealing with the different types of microphones employed, the lecturer turned attention to loud-speakers, making special reference to the Round instrument. This loud speaker had been heard for a distance of four miles, and it had been found that measurements taken on the diaphragm when working at low frequencies had shown an annular movement of a quarter of an inch! A similar type of much larger dimensions was shown on the screen, and it had been estimated that the necessary input of current for such an instrument would be as much as two kilowatts. Such an instrument has not yet been tried out!

Hon. Secretary, Mr. Fred Waller, Eastwood House, Rochford, Essex.

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An Efficient Neutrodyne.

At a crowded meeting of the Swansea Radio Society on Monday, February 7th at the Y.M.C.A., Mr. Herbert Morgan demonstrated an interesting 4-valve neutrodyne receiver of his own construction. The design provided for instant switching from the local station to Daventry, and the lecturer showed how even Radio Paris and Hamburg could be brought in at a moment's notice without changing any coils. The H.T. supply was obtained from the electric mains.

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Changes in Impedance.

Other slides indicated the change in the impedance of a valve according to

the conditions under which it was operated, the difference between grid and anode rectification, and so on.

Amplification curves for a complete receiver were also exhibited, and these illustrated how much less distortion there is in a set which is scientifically designed and constructed than in one where the constructor is working in the dark, and simply builds up a receiver of apparently suitable parts.

In conclusion, Mr. Kirlew remarked that all the curves he had shown, and others equally informative, could be plotted from data which could easily be obtained by the use of instruments belonging to the club, and at the disposal of members.

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

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A Transformer Demonstration.

"Steps towards true radio reproduction" was the intriguing title of a lecture given by Mr. Hall, of the Ferranti Co., at the last meeting of the Preston and District Radio Research Society, which was attended by 191 persons.

The lecturer traced the history of low-frequency amplification from the earliest experiments, and gave an interesting demonstration with a special combination amplifier. In this instrument the H.F. output could be plugged into a detector and amplifying unit incorporating no fewer than six different types of L.F. amplification. Demonstrations were given with the new type of Ferranti loud-speaker, and with the Rice-Kellogg, members being agreeably surprised at the high quality given by the Rice-Kellogg instrument using transformer-coupled amplifiers.

Particulars of membership can be obtained from the Hon. Sec., Mr. John B. Cookson (2BDA), 14, Lune Street, Preston.

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Variation on the Hale.

A demonstration of a receiver employing a novel circuit was given at the last meeting of the North Middlesex Wireless Club.

The lecturer was Mr. W. Gartland, and the apparatus was constructed by Mr. H. A. Crowch. Two valves and a crystal were employed, the principle of the set being similar to the well-known Hale circuit.

Although some of the audience were prejudiced against any receiver incorporating a crystal, on the score of unreliability, no trouble was experienced on this account in the demonstration; perhaps the fact that a Perikon detector was used was partly responsible.

Mr. Gartland proceeded to describe, with the aid of blackboard diagrams, some other modifications of the circuit, one employing a frame aerial, and also a high-frequency amplifier which could be applied to any existing receiver, and of which the lecturer had had personal experience.

Many questions were asked as to details of construction, and some alternative arrangements were suggested by members of the audience.

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Super-Hets on Trial.

A "super-het." demonstration by Mr. O. H. Patterson (G 2YY) aroused considerable interest at the Muswell Hill and District Radio Society's meeting on February 16th. The set, which was of Mr. Patterson's own construction, embodied eight valves and employed screened coils. High-tension current was derived from the mains.

A number of stations were reproduced on the loud-speaker with freedom from interference, and the quality on the local station was good for this class of set.

By way of contrast a commercial super-heterodyne set was demonstrated by Mr. L. C. Hill. The quality of reception was exceptionally good owing to the fact that the second rectifier was a crystal.

Wireless World readers in the Muswell Hill district are strongly urged to join the Society. Full particulars of membership can be obtained from the Hon. Sec., Mr. Gerald S. Sessions, 20, Grasmere Road, N.10.

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Crystal Research.

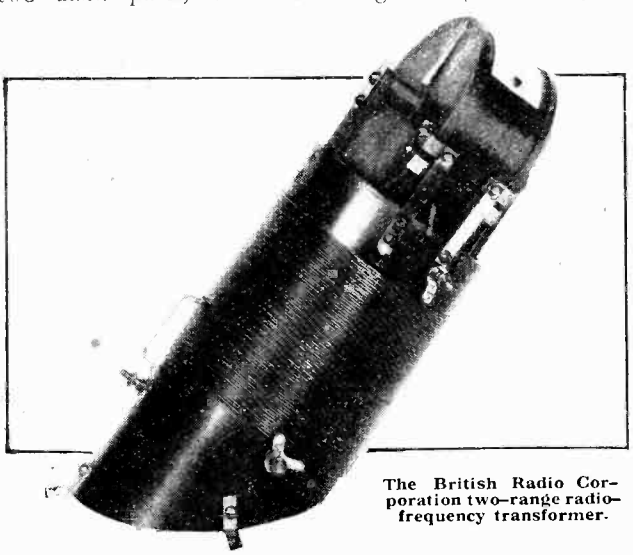
In connection with the Individual Research Scheme organised by the Radio Experimental Society of Manchester, the secretary, Mr. J. Levy, gave a talk before the Society on February 18th dealing with research work on crystals.

After outlining the work carried out over many months, Mr. Levy gave valuable data regarding galena, zincite, bornite, iron and copper pyrites, carborundum, manganese, molybdenite, ferrous silicon and tellurium. He then dealt with oscillating crystals, and demonstrated how, in addition to zincite, other crystals which could be included in this group were bornite, hertzite, tellurium and ferrous silicon. The speaker concluded by demonstrating the application of the oscillating crystal to various circuits.

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

TWO-RANGE RADIO-FREQUENCY TRANSFORMER.

A RADIO-FREQUENCY transformer of sound construction is being marketed by the British Radio Corporation, Weybridge, Surrey. The transformer has two main parts, the first being the pair of cylinders carrying windings for 200-700 metres, and the second, the coils mounted at the top of the unit for 700-2,000 metres. For the 200-700 metres wavelength range, single-layer windings of heavy gauge copper wire are used, a tap being taken from the secondary—that is, the outer—winding, for balancing. The primary winding associated with this coil consists of a few turns wound on a cylinder fitted to the lower end of the secondary. At the upper end of the tube are fitted four contacts, which press on further contacts screwed to the long-wave transformer. This transformer has its windings completely enclosed in an ebonite former, and its ends are connected to the contacts mounted on the former. The change from the short wavelength band to the longer wavelengths is effected by turning the long-wave unit which transfers the connections by means of the switches. All end connections are terminated at contacts provided with numbered tags. It is, therefore, very easy to connect it with the assistance of the diagram provided.



The British Radio Corporation two-range radio-frequency transformer.

A set comprises three units, one for the aerial-grid coupling and the other two for intervalve couplings. Magnetic coupling between stages is avoided by the angle at which the units are mounted and the distance between them. Tuning condensers of 0.0005 mfd. are used with the transformers

A NEW RELAY FOR MORSE RECORDING.

Utilising a Well-known Property of the Neon Lamp.

At the assembly of the Association of German Scientists and Doctors at Düsseldorf a short time ago, Dr. Richter and Dr. Geffcken, of Leipzig, disclosed details of an interesting relay which is remarkable on account of its high sensitivity for the reception of wireless signals. The glow-discharge relay shown in Fig. 1 is a tube filled with neon and enclosing three plate-electrodes. Between the two outer plates, which serve as anode and cathode and are connected to the lower socket, a plate is placed as an intermediate "igniting electrode," to which connection is made by means of a terminal fixed to the upper end of the tube. If such a tube is connected as in Fig. 2, where P is the anode, K the cathode, and Z the igniting electrode, and if the electrode Z is neglected for the moment, a glow discharge will be set up between P and K at a perfectly definite potential. At a slightly lower potential this discharge will not start by itself, but it can be started by a certain potential on the auxiliary electrode Z. Quantitative measurement shows that there are two different limiting values for the potential V_z at which the discharge commences.

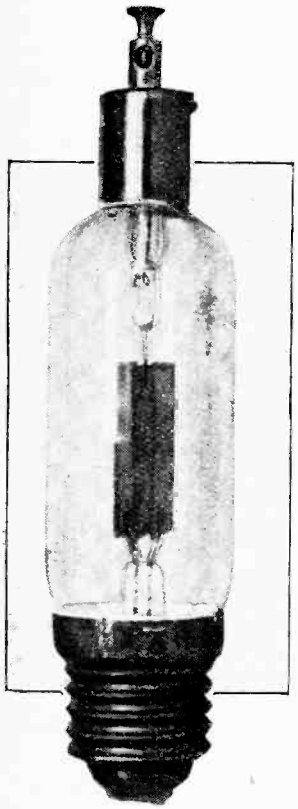


Fig. 1.—Glow-discharge relay. The "ignition electrode" is connected to the terminal at the top.

The discharge current through the tube attains a value of 30-50 milliamps., according to the size of the electrodes, while the current necessary to charge up the electrode Z can be extraordinarily small. On an average a current of 10^{-10} ampere fully suffices for this purpose. Thus by application of the glow-discharge relay such small currents may be made to actuate relatively heavy mechanical relays for which a current of 10 milliamps. is quite sufficient. The discharge, once started by the igniting action, does not extinguish itself again, so an interrupter is connected somewhere in the lead to the anode by means of which the relay is rendered self-restoring.

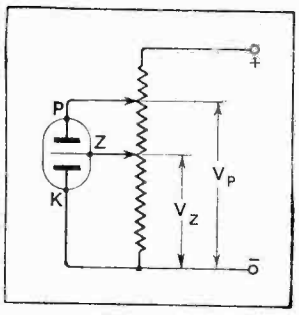


Fig. 2.—Circuit diagram illustrating adjustment of electrode potentials.

A circuit showing how this relay can be adapted for the reception of wireless signals is given in Fig. 3. In the anode circuit of the thermionic valve is a resistance W_1, while there is a resistance W_2 in the lead to the igniting cathode and a condenser C between igniting electrode and cathode. The resistances must be so chosen that the tube does not ignite as long as there are no radio signals arriving, but that relatively weak signals suffice to cause response. The procedure here is such that incoming signals cause the grid of the thermionic valve to become negatively charged. The anode current of the valve is thereby reduced, and the potential drop across the resistance W_1 is reduced, while the drop across the valve is increased. The potential of the igniting electrode is thereby correspondingly changed so that the discharge through the glow-discharge tube starts. In this manner one obtains a very simple recording receiver. It has been found possible, with the arrangement given in Fig. 3, and using only one thermionic valve, to receive the time signals from Nauen at Leipzig with an accuracy, as established by the Leipzig observatory, of $\frac{1}{100}$ of a second.

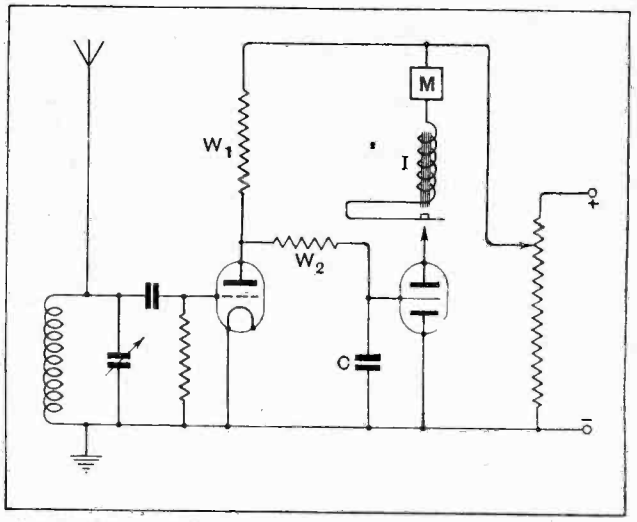


Fig. 3.—Schematic diagram of the method of connecting the relay in a receiving circuit.

It appears likely that the glow-discharge relay will find further applications in other directions for radio reception—for instance, as a simple call-device.

H. K.

BOOK RECEIVED.

Wireless Without Worry, describing how to obtain the best results from a radio set; on buying the complete outfit, assembling the parts or making them at home; the why and wherefore of faults and how they may be avoided or corrected. By Ronald F. Tiltman, with an introduction by Prof. A. M. Low. Pp. 186, with 7 illustrations. Published by Seeley, Service and Co., Ltd., London, price 5s. net

Constructional Details and Operation Notes.

By W. JAMES.

(*Continued from page 220 of previous issue.*)

IN the first part of this article we considered in detail the design of the circuit, discussing the various parts which are employed in the receiver. We also described the arrangement of the parts on the front panel and the terminal strip and gave details for making the tuning coil for the lower wavelengths.

We now have to turn our attention to the arrangement of the parts on the baseboard. Reference to the illustrations will show that such things as by-pass condensers, chokes, and the tapped resistance are mounted on the under side of the baseboard, while the tuning coils for the long and short broadcast band of wavelengths, the valve-holders, transformer, grid bias batteries, and the filament resistance are fixed to the upper surface. This arrangement of parts was adopted first in order that the space available should be used to the best advantage, and secondly for the sake of neatness and convenience in wiring. The illustrations show that the wiring is particularly neat and orderly, that it is not likely to be moved when inserting valves or making other adjustments, and that the important wires, such as those carrying high-frequency currents or connected to grids, are run in short, clear paths. Notice also that the wires are all covered, this being because experience has shown that there is less risk of damage to valves and components, while the high-frequency circuits are not in any way affected. This

1 S.L.F. friction vernier condenser, 0.0005 mfd. (Jackson Bros. Poland Street, W.1).
1 S.L.F. friction vernier condenser, 0.00025 mfd. (Jackson Bros., Poland Street, W.1).
1 Non-pong valve holder (Sterling).
2 Valve holders, W.B. (Whiteley, Boneham & Co., Duke Street Mansfield, Notts).
1 8-contact switch (General Electric Co., Ltd.).
1 H. and L.T. "on" and "off" switch (Marconiphone Co.).
1 3-pole change-over switch (Burndept Wireless, Ltd.).
1 Fixed condenser, No. 610 type, 0.0002 mfd. (Dubilier).
1 Fixed condenser, 5 mfd. (T.C.C.).
2 Fixed condensers, 2 mfd. (T.C.C.).
1 Fixed condenser, 0.1 mfd. (mica), (T.C.C.).
2 Grid leaks, 0.25 megohm (Edison Swan Elec. Co.. Ltd.).
1 Grid leak, 1 megohm (Edison Swan Elec. Co., Ltd.).
3 Dumetohm grid leak holders (Dubilier Condenser Co., Ltd.).
1 H.F. choke (Varley Magnet Co.).
1 60,000-ohm anode resistance, tapped in six places (Varley Magnet Co.).
1 32-henry choke (Pye).
1 Transformer, A.F.3, 3½ to 1 (Ferranti).
2 9-volt grid bias batteries (Ever Ready).
9 Ebonite shrouded terminals (Belling & Lee).
2 Dial indicators.
1 Paxolin tube, 3in.×3½in. (Micanite & Insulators Co. Ltd., Blackhorse Lane, Walthamstow, E.17).
20 yds. Litzen wire (P. Ormiston & Sons, Ltd., 79, Clerkenwell Road, E.C.1).
1 6-ohm "Preset" resistor (Igranic Pacent).
Ebonite panel, 18in.×9in.×¼in. (The British Ebonite Co., Ltd., Hanwell, W.7).
Ebonite terminal strip, 18in.×3½in.×⅛in. (The British Ebonite Co., Ltd., Hanwell, W.7).
Wood base, 18in.×9¾in.×¾in., and strips.
1 "Camco" cabinet (Carrington Man. Co., Ltd., 18/20, Norman's Bldgs., Central Street, E.C.1).
3 "Wearite" low loss coil mounts: 1, LL_3; 2, L_3 (Wright & Weaire, Ltd., 740, High Road, Tottenham, N.17).
1 Set Eddystone absorbos (Stratton & Co., Ltd., Balmoral Works, Bromsgrove Street, Birmingham).
Sistoflex (Spicers, Ltd., New Bridge Street, E.C.4).
Flex—4 wander plugs—screws, etc.

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.

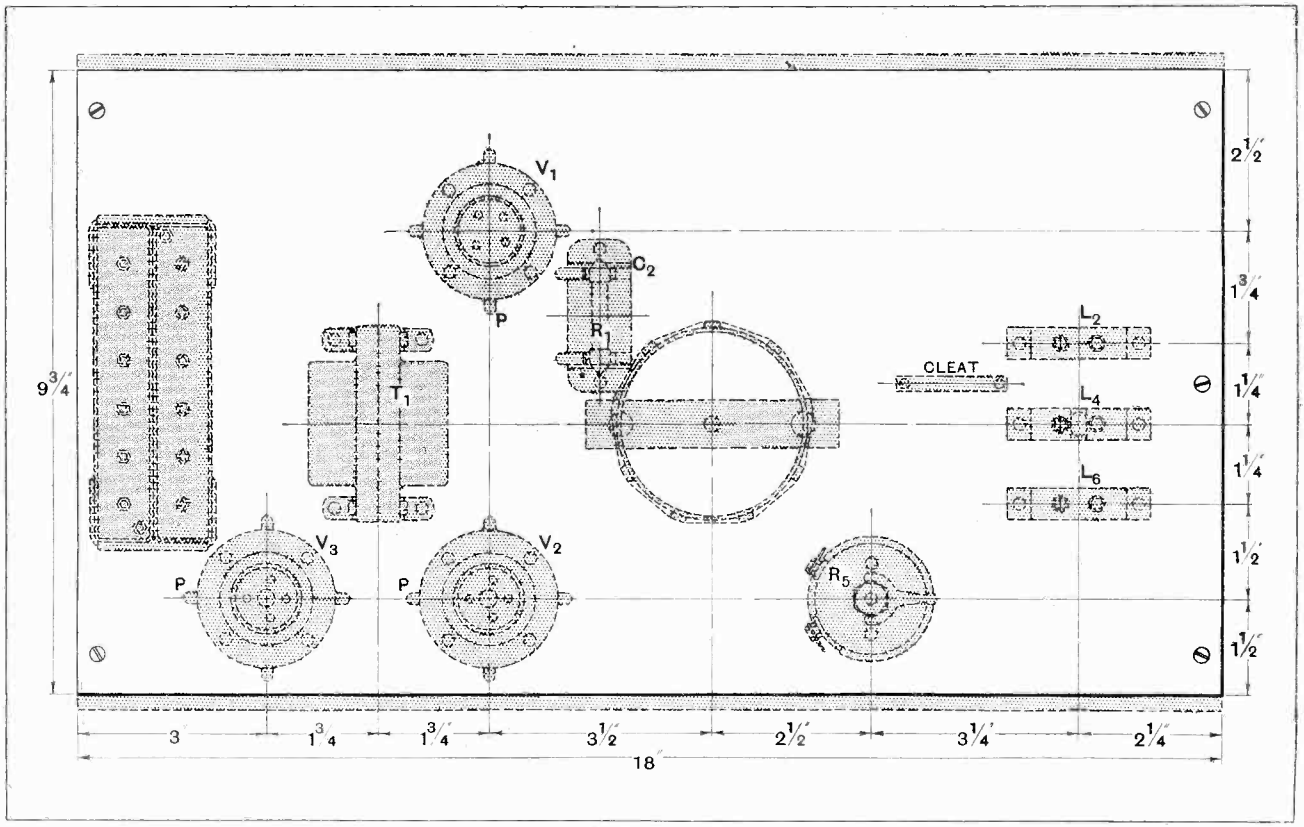
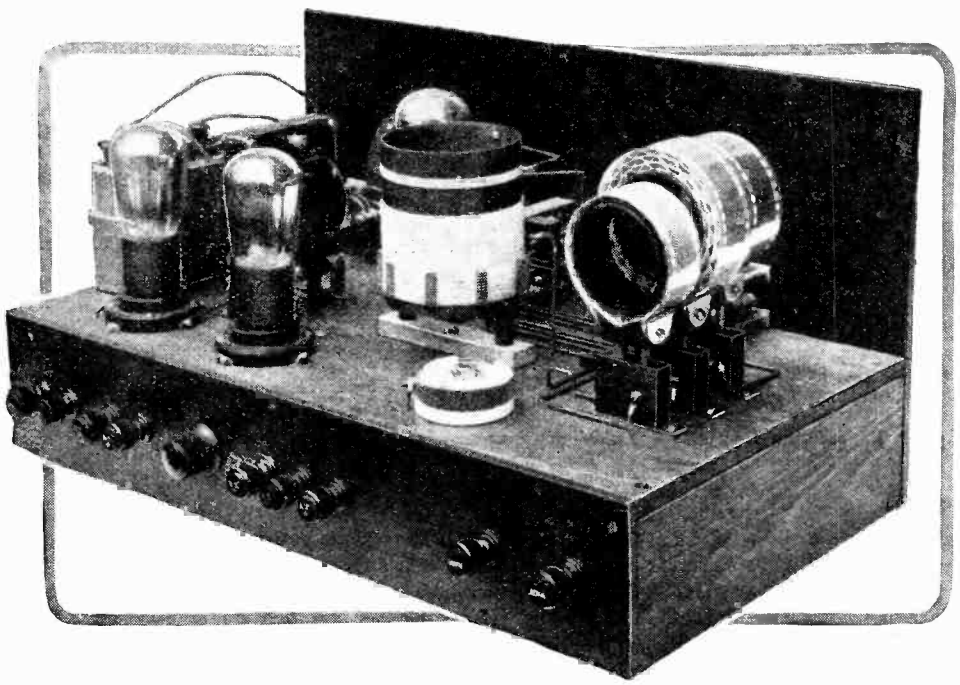


Fig. 6.—Arrangement of parts on the top side of the baseboard.

method of construction has been used by the writer several times and has proved to possess many advantages.

Continuing with the construction of the receiver, we have in Fig. 6 the arrangement of the parts on the upper surface of the baseboard, which measures 18in. × 9¾in. × ⅜in., and is supported on two strips of wood, 9¾in. × 2⅝in. × ⅝in. Fig. 6, with the illustration below it, shows the exact position of the parts. It will be noticed that the Sterling valve-holder is used in the detector position.



Rear view of the completed receiver.

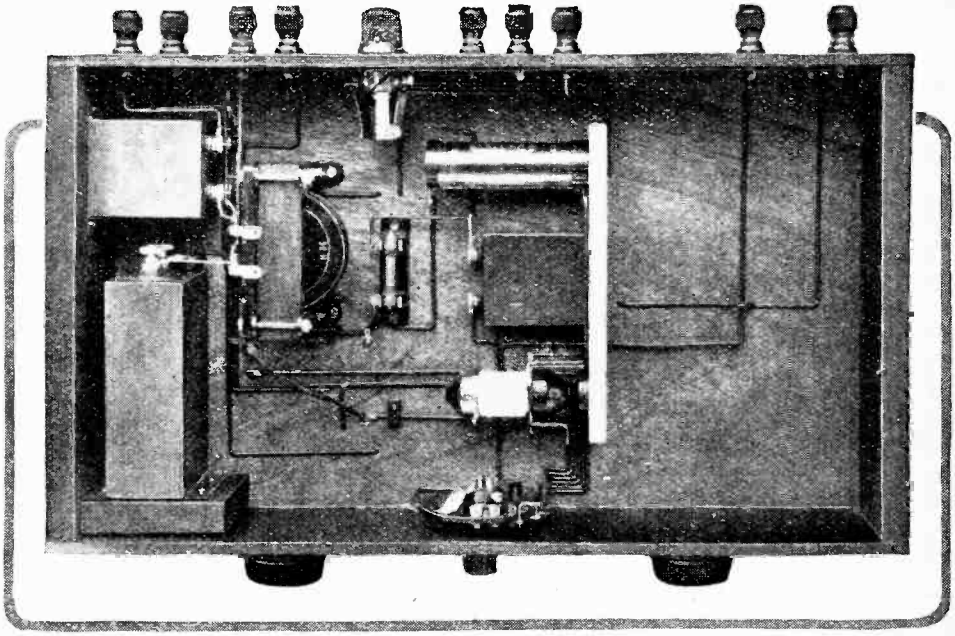
On the under side of the baseboard two wooden strips, 6¾in. × 1¾in. × ⅜in. and 3in. × 2⅝in. × ⅝in. respectively, are screwed. Three parts, viz., the tapped anode resistance, 0.1 mfd. mica coupling condenser and high-frequency choke are fastened to the larger piece of wood, while the 5 mfd. condenser is screwed to the short piece.

Grid leak holders R_3, R_4, and choke L_7 are fastened direct to the baseboard, while the 2 mfd. condenser, C_7, is screwed to one of the end supports. On the back edge is fastened the terminal strip. It will be noticed that the illustration of the under side of the set shows one grid leak only, while two are used in the receiver

Quality Three.—

as indicated in Fig. 7. This is because the photograph happened to have been taken during a time when the grid leak, R_4, was removed from the set in an endeavour to find whether it was absolutely essential. It was found that occasionally when using critical reaction the set was more stable with the grid leak, R_4, connected.

When the parts have been assembled and the base fitted to the panel, the position of the holes to be drilled in the baseboard to take the connecting wires should be marked. Many of these holes can be seen in the illustrations. Wires connecting the filament circuit and the rheostat, for instance, are run beneath the baseboard and passed through holes to the contacts of the valve-holders and rheostat. Positive H.T. wires and several others are run from contacts above the baseboard to contacts below.



View of the under side of the receiver.

A good deal of the wiring can be done with the panel removed from the baseboard and several wires, such as those for the tapped resistance, can be run and cut to length before the panel is finally fixed. The last two studs of the tapping switch are connected together and to stud 6, as an "off" position is not required.

Particular attention will have to be given to the wiring

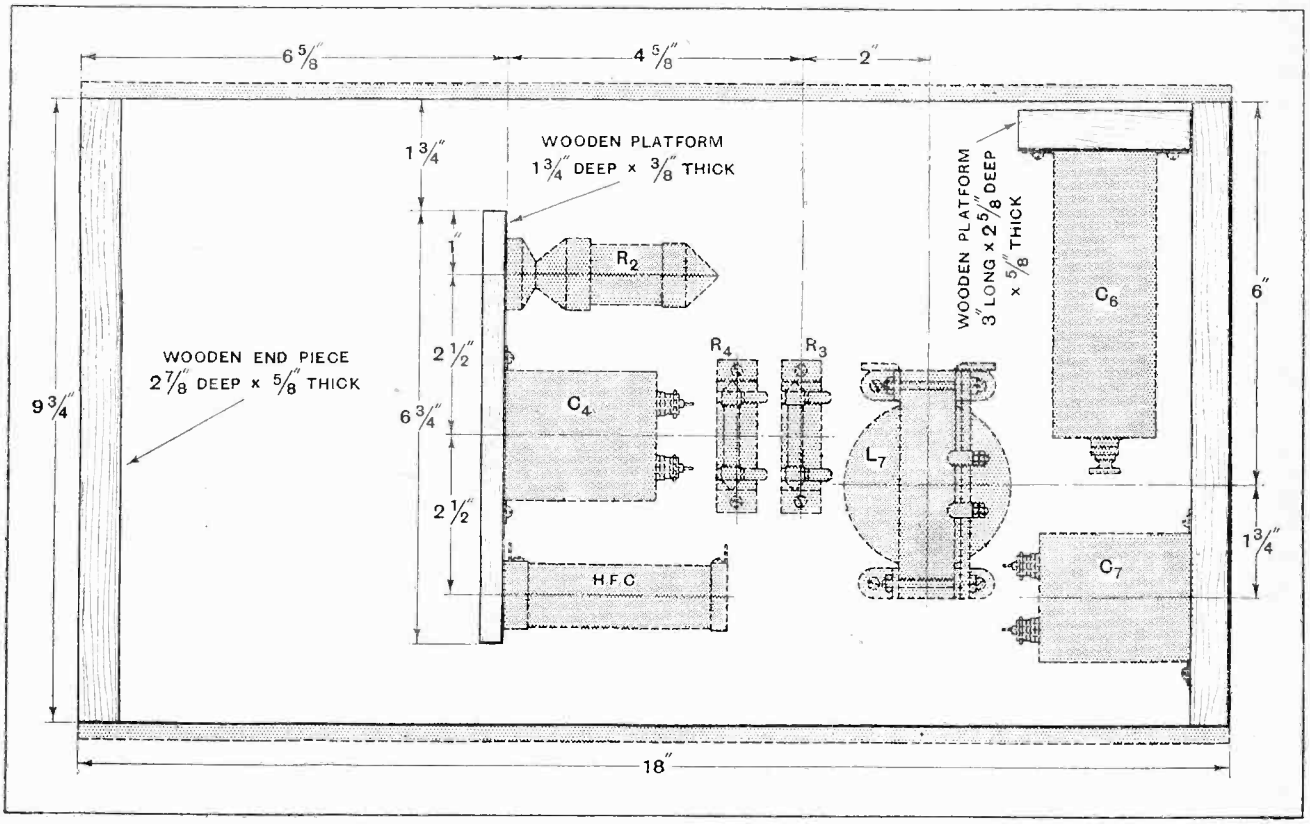


Fig. 7.—Arrangement of parts on the under side of the baseboard.

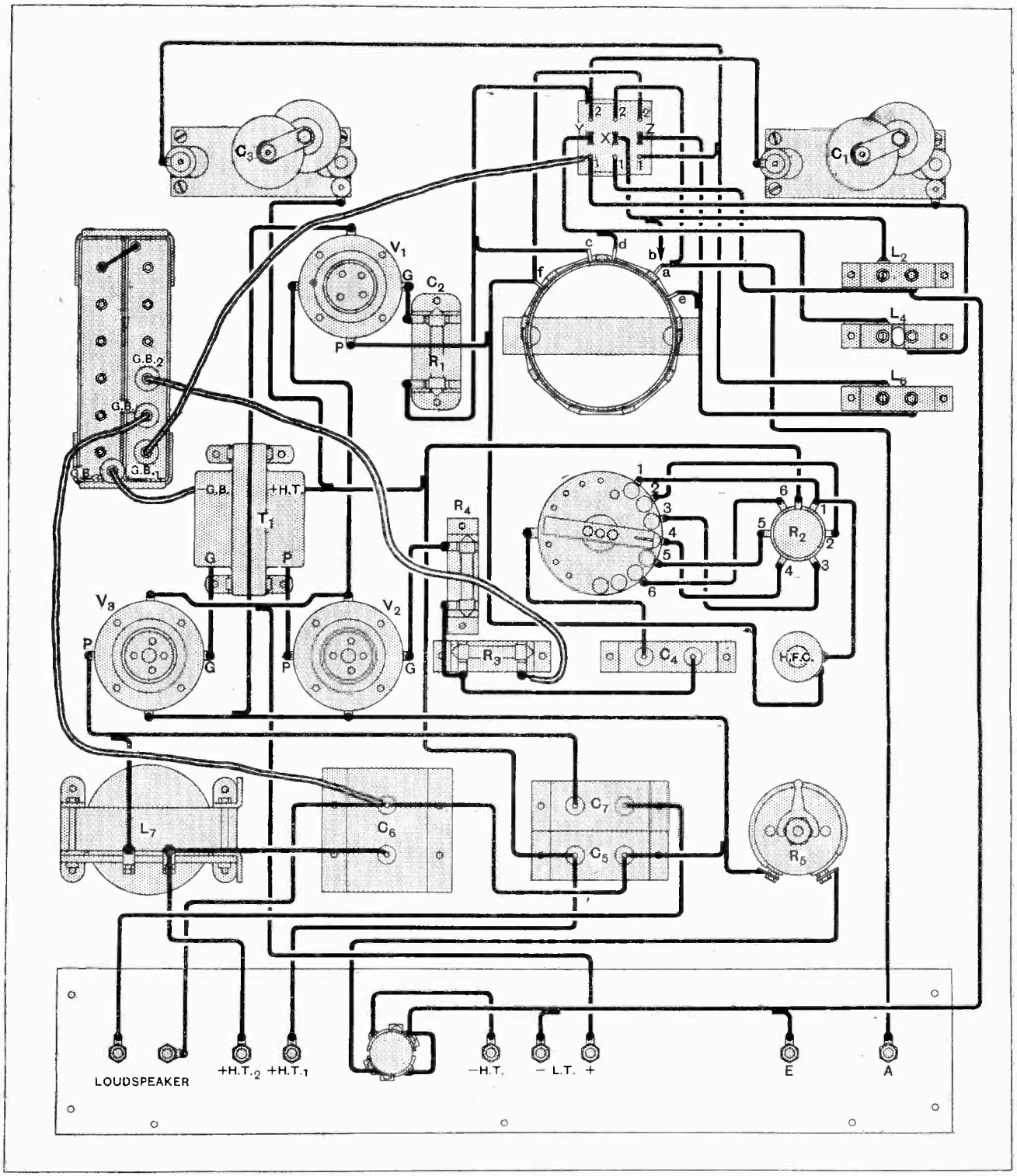


Fig. 8.—Wiring diagram. Many of the wires can be run before the panel is fastened to the baseboard.

of the coils and the change-over switch. Those wires connected to the lower row of contacts, marked 1, should be put on first; then those marked X, Y, Z, and finally, the wires marked 2. The letters against the coil contacts are the same as those in Fig. 1, *a* being the aerial end of the primary, and *b* the earth end; *c*, the grid end of the secondary, and *d* the filament end; *e*, the end of the reaction coil connected to the reaction condenser (marked

Quality Three.—

R Fig. 2); and *f*, the end of the reaction coil connected to the anode of the valve (R (P) Fig. 2).

For wiring No. 18 or 20-gauge tinned copper wire, with sleeving to suit, should be used.

With the wiring finished, put a high voltage factor valve in the detector circuit, a valve with a moderate A.C. resistance in the first L.F. position, and a valve of the so-called "Super Power" type in the output stage.

Adjust the grid bias according to the valves used; plug GB_1, which is connected to the return wire of the detector circuit, should be put into the positive end of the grid battery; for a 6-volt valve plug GB should be connected to a point 3 volts negative with respect to GB_1. For a 2-volt valve, GB may be 1½ volts negative, that is, connected to the next cell of the grid battery to GB_1. GB_2 applies grid bias through resistances R_3, R_4, to the grid of the first amplifying valve V_2. Probably a grid bias of negative 1½ to 3 volts would be sufficient; therefore GB_2 should be connected to the first or second cell away from plug GB, plug GB being considered as having zero potential.

For the last valve a much bigger grid bias will have to be used, and if a high anode voltage, such as 150, is employed, the full voltage available, that is, 18 less 3, will have to be used.

In the long-wave circuit three coils are required; Lewcos plug-in coils are recommended. A No. 100 will be required for the aerial circuit L_2. No. 250 for the secondary circuit L_4, and No. 100 for reaction, L_6.

The next thing to be done is to set the resistance R_5.

Most valves of the 6-volt type work quite well with a voltage of 5 across the filaments; resistance R_5 should therefore be adjusted when listening to the local station, with condenser C_3, which is the reaction condenser, set at zero. Before distant stations can be tuned in the reaction coil provided on the lower wavelength unit will have to be adjusted. To do this, set the reaction condenser C_3 at maximum; probably the valve will oscillate violently; now switch off the set and remove one or two turns from the reaction coil until it is found that reaction is smooth over the whole tuning range of the lower wavelength coil. It is possible so to adjust this circuit that the receiver will not oscillate, it being necessary only to remove a few more turns from the reaction coil. The coils employed in the long-wave circuit have been found satisfactory and should not require adjusting under usual conditions.

VALVE TABLE.

Position.	Maker and Type.	Anode Volts.	Grid Bias.
Detector. 2-volt	Cossor 210H, Red Band	120	+ 1.5
	ST21	120	+ 1.5
	PM1 H.F.	120	+ 1.5
4-volt	Cossor 410H, Red Band	120	+ 3
	ST41	120	+ 3
	PM3	120	+ 3
6-volt	Cossor 610H, Red Band	120	+ 3
	ST61	120	+ 3
	PM5	120	+ 3
	Marconi or Osram:		
	DE5b	120	+ 3
	DE8 H.F.	120	+ 3
1st L.F. 2-volt	Cossor 210D, Black Band	120	— 1.5
	ST22	120	— 3
	PM1 L.F.	120	— 3
4-volt	Cossor 410D, Black Band	120	— 3
	ST41	120	— 3
	PM3	120	— 3
6-volt	Cossor 610H, Red Band	120	— 3
	ST61	120	— 3
	PM5	120	— 3
	Marconi or Osram:		
	DE5	120	— 7.5
	DE8 L.F.	120	— 6
2nd L.F. 2-volt	Cossor 215P	150	—12
	ST23	120	— 9
	PM2	120	— 9
	Marconi or Osram DEP215	120	—12
4-volt	Cossor 410P	120	—15
	ST43	120	—15
	Mullard DP425	120	—15
6-volt	Cossor 610P	150	—15
	ST63	150	—15
	Mullard DP625	150	—15
	Marconi or Osram DE5a	150	—15

Catalogues Received.

S. G. Brown, Ltd., Western Avenue, North Acton, W.3. The "Brown Budget" for February, 1927, containing articles on wireless, window dressing, high velocity service, new instruments, etc.

Fuller Accumulator Co. (1926), Ltd., Woodland Works, Chadwell Heath, Essex. List No. 265, dealing with the R.H.G. 20-volt high-tension battery with rubber insulated cells and "outside" terminals.

The Electron Co., Ltd., Triumph House, 189, Regent Street, London, W.1. Illustrated leaflet dealing with the "Six-Sixty" range of receiving valves.

E. K. Cole, Ltd., 513, London Road, Westcliff-on-Sea. Leaflet descriptive of the "Ekco" high-tension units for A.C. and D.C. mains.

Formo (Arthur Preen & Co., Ltd.), Crown Works, Cricklewood Lane, London, N.W.2. Catalogue of "Formo" transformers, coupling units, condensers, and other accessories.

Watmel Wireless Co., Ltd., 332a, Goswell Road, London, E.C.1. Catalogue of "Watmel" fixed condensers, grid leaks and anode resistances, and other accessories.

Wright & Weaire, Ltd., 740, High Road, Tottenham, N.17. Illustrated leaflet describing "Wearite" components, including low loss coils and stands, anode resistances, valve holders, etc., etc.

Philips Lamps, Limited, 145, Charing Cross Road, London, W.C.2. Leaflets 77 and 78, giving particulars of the Philips type 450 rectifier and high-tension supply unit respectively.

"Pelapone," 41, Baker Street, London, W. Booklet 150, containing illustrated particulars of "Pelapone" electric generating plants.

British Thomson-Houston Co., Ltd., Crown House, Aldwych, London, W.C.2. Leaflet R7335-2, dealing with B.T.H. radio receivers and amplifiers. Leaflet R7432-2, dealing with B.T.H. low-frequency transformers.

General Electric Co., Ltd., Magnet House, Kingsway, London, W.C.2. Illustrated folder giving details of the "Gecophone" H.T. battery eliminators.

Weston Electrical Instrument Co., Ltd., 15, Gt. Saffron Hill, London, E.C.1. Illustrated folder describing Weston voltmeters, with instructions for testing circuits under working conditions.

A.E.G. Machinery and Apparatus Co., Ltd., 76, Victoria Street, Westminster, S.W.1. Leaflet describing the A.E.G. automatic circuit-breaker fuse substitute.

TRANSMITTERS' NOTES AND QUERIES

International Amateur Prefixes.

It becomes daily more evident that the list of International Prefixes devised by the I.A.R.U. at Hartford, Conn., was drawn up hastily, and without due consultation with other countries interested. It has already led to considerable confusion, some European countries having adopted the American prefixes, while others retain those to which they are accustomed, either, as in the case of Great Britain, because they have been officially sanctioned after due consideration and by agreement between the Governments concerned, or because comparatively long use has rendered them familiar to European transmitters. We hope, however, that the laudable efforts of the I.A.R.U. to bring about a generally established and systematic arrangement of Amateur Nationality Prefixes will eventually result in the regular and official apportionment of suitable and agreed prefixes among all countries concerned.

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Amateur transmitters in the Irish Free State are also in disagreement with the proposed new prefixes, if we may judge by the following outspoken remarks of GW 14C in our contemporary, the *Irish Radio and Musical Review*:—"Apart from the fact that we amateurs were not consulted in this, our Government was not, so far as we know, asked if they agreed with the change. The Government authorities of each country are, of course, the only people in a position to change intermediates. The "Yankee," in his usual high-handed manner, pushed the new intermediates on us and gave us no time to discuss or make provision for them, but we are glad to see that for once he has not succeeded in "putting one over" on us, as the Government has not adopted them here nor has the British P.M.G. allowed their use in England. Incidentally, the intermediate that GW stations were "granted" by our American friends was EO, and the fact that E was the easiest letter to get lost in atmospherics was altogether ignored by the devisor of these intermediates."

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General Notes.

Mr. W. K. Alford (G 2DX), Rosedene, Camberley, was sucessful in working two-way speech with Hong Kong on Sunday, January 30th, on a wavelength of 44.8 metres. He was transmitting with an input of 42 watts to Osram L.S.5B and DET1 valves, crystal controlled, the receiver being fitted with Osram V.24 and L.S.5 valves.

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Mr. F. Mayer (G 2LZ), Stilemans, Wickford, Essex, tells us that he was in communication with ARDI, the Norwegian whaler, s.s. *Larson*, when that vessel was in the Ross Sea, Antarctic. The wavelength used by ARDI was 35 metres, and his signals were very good. Communication was maintained from 9.0 to 10.30 a.m., G.M.T.

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Mr. R. H. Harris (G 6TG), Long Crichel Rectory, Wimborne, Dorset, states that at 1920 G.M.T. on February 18th, he was in two-way communication with a Danish vessel between Iceland and Greenland, which gave OFT as her call-sign. He was working with 5 watts input to an Osram D.E.5B valve on a wavelength of 45 metres, and his signals were reported as R8. According to the "Berne List" the call-sign OFT belongs to the British s.s. *Airedale*.

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M. Louis Era (B B1), 46, Avenue Van Put, Antwerp, gives us the following particulars of steamers fitted with short-wave transmitters:—SJB, s.s. *Lapponia*, which at the time of writing (February 6th) was bound from Narvik, Norway, to Boston, Cuba, and back; SFX, s.s. *Louisa*; SKA, M/S *Axel Johnson*; SGT, M/S *Suecia*, and several other vessels owned by the Axel Johnson Company, of Stockholm. He states that Göteberg station, SAB, calls CQ at 1200 and 2300 G.M.T. for 5 minutes for Swedish vessels fitted with shortwave sets. The Swedish Government has fitted several vessels with experimental sets to see if the 35-45 metre waveband is suitable for regular working.

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Spanish Amateurs.

We are indebted to Señor Miguel Moya, Madrid (EAR 1), for the following list of amateur transmitters in Spain.

EAR 1	M. Moya, Mejia Lequerica, 4. Madrid.
EAR 2	F. Castaño, Fernández de los Rios, 25. Madrid.
EAR 3	I. H. Gasque, San Miguel, 8. Zaragoza.
EAR 4	E. Valor, Jorge Juan, 17. Valencia.
EAR 5	J. D. Galcerán, Centro de Lectura. Reus.
EAR 6	J. R. de Arcaute, Ibai Gain, Tolosa (Guipúzcoa).
EAR 7	A. Prieto, Garcia de Paredes, 31. Madrid.
EAR 8	R. Montoro, Guillén de Castro, 47. Valencia.
EAR 9	C. S. Peguero, Paseo de Pamplona, 11. Zaragoza.
EAR 10	F. Roldán, Garcia de Paredes, 47. Madrid.
EAR 11	L. G. López, Oficinas de Telégrafos, Guadalajara.
EAR 12	A. Uriarte, Alberto Aguilera, 29. Madrid.
EAR 13	E. Butrón, Alameda de Urquijo, 22. Bilbao.
EAR 15	J. Illera, Velázquez, 8. Madrid.
EAR 16	J. Borrás, Rosellón, 556. Barcelona.
EAR 17	J. Soler, Hernán Cortés, 8. Santander.
EAR 18	J. de la Fuente, Sol, 14. Santander.
EAR 19	F. Delgado, Instituto, 5. Teruel.
EAR 20	P. Careaga, Ondategui, 9. Las Arenas (Vizcaya).
EAR 21	R. de L. Galdames, Estación, 5. Bilbao.
EAR 22	A. Escauriaza, Avenida de los Aliados. Bilbao.
EAR 23	J. Portela, Cervantes, 14. Cádiz.
EAR 24	L. Garay, Toki Eder. Oñate (Guipúzcoa).
EAR 25	Radio Club Cataluña, Plaza de Santa Ana, 4. Barcelona.
EAR 26	E. Estalella, Avenida del Puerto, 65. Valencia.
EAR 27	A. Merino y Ballesteros, Plaza Mayor, 14 al 20. Palencia.
EAR 28	J. B. Novo, Patio de Madres, 13. Santiago (Coruña).
EAR 29	A. Lagoma. Jovellanos, 9. Barcelona.
EAR 30	J. Castell, San Antonio, 44. Sans (Barcelona)
EAR 31	A. Estublier, Jaime I, 9. Barcelona.
EAR 32	J. M. Bayarri, Gonzalo Barrachina, [illegible]
EAR 33	V. Guiñau, Angel Guimerá, Sarriá ([illegible] lona).
EAR 34	F. Sucarana, Asturias, 13. Barcelona.
EAR 35	F. Baque, Paseo de Gracia, 103. Barcelona.
EAR 36	C. Salvador, Nueva, 7. Almansa (Albacete).
EAR 37	M. M. Morante, Camino Nuevo, 17. Santiago de Compostela.
EAR 38	L. Navarro, Matemático Marzal, 21. Valencia.
EAR 39	F. Hervera, Jesús del Valle, 23 y 25. Madrid.
EAR 40	V. Ayuso, Valencia, 360. Barcelona.
EAR 41	J. Golf. Chapa, 11. Valencia.
EAR 42	J. Arrillaga, Hotel Vega. Marquina (Vizcaya).
EAR 43	J. G. Civera, Paz, 44. Valencia.
EAR 44	J. R. Balmás, Paseo del Principe, 10. Almeria.
EAR 45	J. G. Aybar, Mendizábal, 7. Madrid.
EAR 46	L. Sanjuán, Rios Rosas, 14. Madrid.
EAR 47	L. Ferrer, Reina Maria Cristina, 6. Palma de Mallorca.
EAR 48	L. Varela, Juana de Vega, 15. La Coruña.
EAR 49	M. Corella, Salmerón, 45. Barcelona.
EAR 50	F. Llinás, Moncada, 16. Játiva.
EAR 51	A. Escudero, Plaza de Aragón, 8. Zaragoza.
EAR 52	J. R. Cuevas, Plaza Mayor. Aguilarde Campóo (Palencai).
EAR 53	I. I. de la Puente, Cinco de Marzo, 7. Zaragoza.
EAR 54	I. B. Elias, Cortes, 564. Barcelona.
EAR 55	A. G. Banús, Plaza Trilla, 4. Barcelona.

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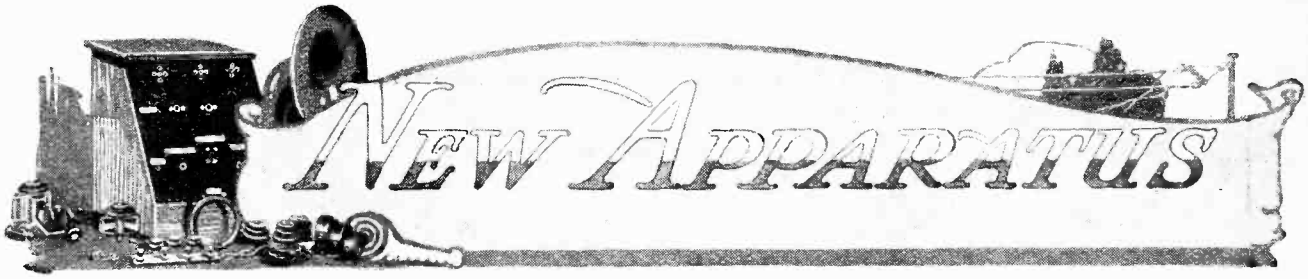
New Call-signs Allotted and Stations Identified.

G 5BD	A. C. Simons, Lynwood, Mablethorpe, Lincs. (Change of address.) Transmits on 45 metres.
G 5KJ	(Ex 2AZS) O. B. Kellett, 11, Allerton Rd., Southport, Lancs. Transmits on 45 metres.
G 6FW	(Ex 2AGR) S. Fallows, 68, Warbreck Rd., Orrell Pk., Liverpool.
R 19RA	(Ex R 1KA) Karl Abolin, Zwezdinka 23, app. 1, Nijni Novgorod.
G 6XS	John Monckton, Jnr., 15, Berkeley Road, Bishopston, Bristol; transmits on 8, 23 and 45 metres.
2 ADA	A. F. C. Adye, 3, Vale Avenue, Tunbridge Wells.
P 1AF	A. Faria Praca, Marques Pombal 3, Lisbon.
TP AJ	P. Leon Góralski, 1, pulk Strz. Konnych, Garwolin, Poland.
FM 8AFA	— Frémont, Aviation, Ajadir, South Morocco.
R HB5	M. Cardeñosa, Caseros 960, Cordoba, Argentina.
Y 2ZX	— Perkins, 25, Bodyguard Lines, Raisina, Delhi, India.
NL 1P	(ex SM 1P) P. J. Frigerio, St. Martin Island, West Indies.
FM 1TZ	J. Bardin, Sergt. Aviation, Rabat, Morocco. (This call-sign was formerly used by M. Truxler, Taza.)
SH BZL	A. Gagan, The Wireless Station, Demerara, British Guiana. (Transmits on 44 metres and will welcome reports.)

We are indebted to correspondents for the following, of which, however, we have not yet been able to obtain formal confirmation:—

NH HVW	F. H. Harvey, Vila Radio, New Hebrides Islands.
BAM	G. Bambridge, Papeete, Tahiti.
SH 6BR	M. Solomon, 125, Carmichael St., Georgetown, British Guiana.
C 2AX	W. G. Southam, 15, Grove Park, Westmount, Quebec.
AI ACS	L. E. P. Jones, "A" Corps Signals, Karachi, India.
M 1DA	C. W. Liversedge, Radio 1DA, Kirkuk, Iraq.
Ö OHK	Radio Austria, Ltd., Rengasse 14, Vienna I.
I 1UU	A. Criscuoli, Via Legni 52, Turin, Italy.

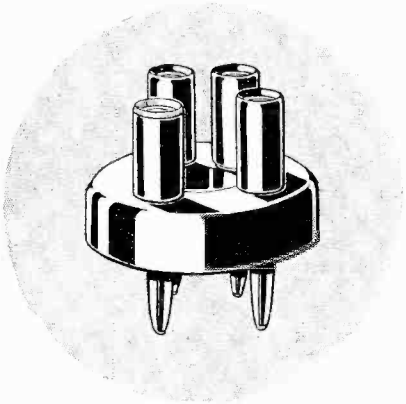


A Review of the Latest Products of the Manufacturers.

ANTI-PHONIC ADAPTER.

To prevent the passing on of microphonic vibration from the baseboard of a receiver to the valve in cases where a suitable sprung valve holder is not employed, an antiphonic adapter is now available.

It consists of four pin connectors, which terminate on an indiarubber pad, the latter giving support to four valve holder sockets. By inserting the adapter in an unsprung valve holder and transferring the valve, an antiphonic mounting is obtained. Spring-sided pin connectors are employed in the construction of the adapter, while the top is hollow on the underside to serve as a cover for the holder to which it is fitted.



An adapter fitted with an indiarubber pad for interposing between valve and valveholder to prevent the transference of microphonic vibration.

This adapter is a product of Harlie Bros., 36, Wilton Road, Dalston, London, E.8.

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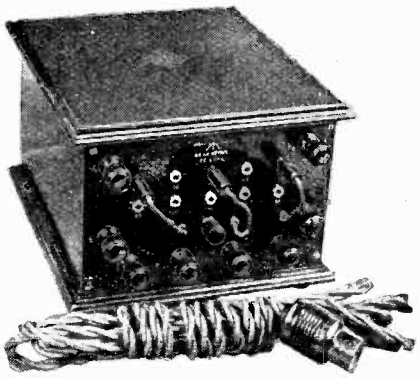
D.C. BATTERY ELIMINATOR.

As a substitute for the H.T. battery the Regent Radio Supply Co., 45, Fleet Street, London, E.C.4, have produced a D.C. mains battery eliminator of liberal dimensions. Practically all apparatus of this type follows a common design, differences existing as regards minor practical details in the dimensions of the smoothing chokes and condensers.

An interesting feature in this instance is that both the aerial and earth terminals are connected through terminals on the eliminator, and a two-position plunger switch makes provision for the use of the eliminator on supplies where either the positive or the negative is earth connected. The various output voltages are obtained by means of a potential divider connected across the supply after smoothing, three wander plugs being fitted to give three different output potentials.



The Regentone battery eliminator for use with D.C. supply.

The eliminator is well finished externally, being enclosed in a polished mahogany case with a Mahoganite front panel and gilded engraving.

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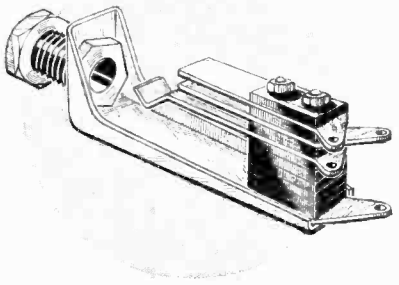
THE BOWYER-LOWE JACK.

A new form of construction has been adopted in the new break-jack produced by the Bowyer-Lowe Co., Ltd., Radio Works, Letchworth, Herts. Jacks are usually assembled on a brass casting or a substantial bent piece of metal. In the Bowyer-Lowe jack, however, a light pressing is employed, which, although only made from thin sheet metal, is of ample strength owing to the provision of the stiffening pieces at the sides.

The contacts are carried on good stout springs, the connecting tags being spread out to facilitate the making of connections. The fixing nut has a smooth, rounded face giving a more pleasing appearance on the front of the panel than the usual sharp-edged nut. The frame is nickel-plated and the bronze springs plated with zinc to prevent corrosion and to facilitate soldering. Although of light construction the jack is thoroughly durable.



The new Bowyer-Lowe break-jack

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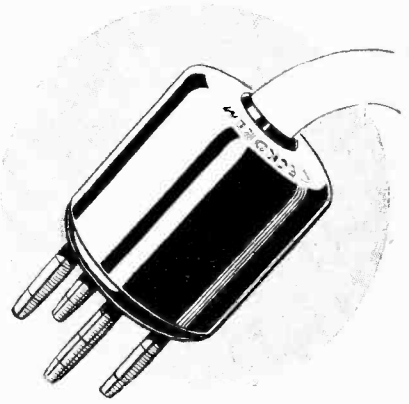
BATTERY CABLE PLUG.

The making of battery connections is very much simplified by using a plug connector.

In the design adopted by A. F. Bulgin and Co., 9-11, Cursitor Street, Chancery Lane, London, E.C.4, in their Deckorem plug the spacing of the connecting pins is the same as that of the pins of a valve, so that the socket is, of course, an ordinary valve holder. A four-pin connector of this sort can be used when joining the two L.T. battery leads as well as three leads from the H.T. battery. Thus five wires are passed to the plug from the batteries, the two negatives being common, so that the pins become



The Deckorem four-plug connector is suitable for connecting the L.T. as well as three H.T. leads, one pin connector being common to the negative connections. The spacing of the connectors is the same as that used for the pins of a valve.

H.T.– and L.T.–, L.T.+, H.T.+ low voltage, and H.T.+ high voltage.

The connector is well made, and is taken apart by means of a screw joint, so that no metal screws are to be seen. The pin connectors are hollow, cross slotted, and expanded in the middle so that they make a smooth and reliable contact suitable for passing a heavy current such as may be required for the many valves of a superheterodyne.

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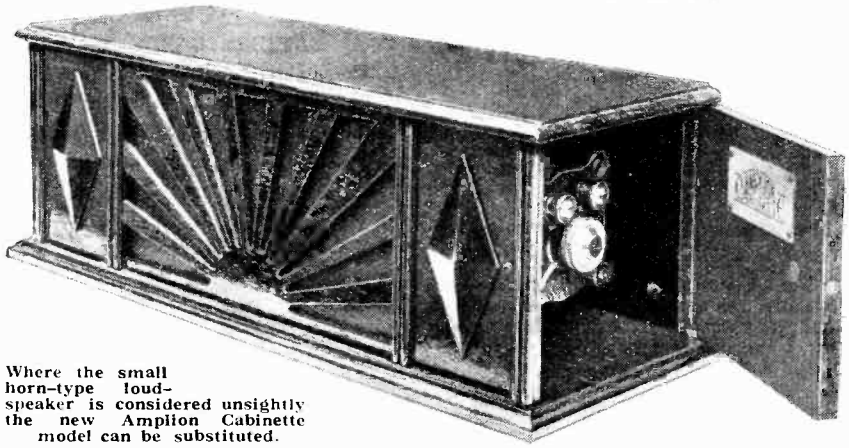
THE CABINETTE AMPLION.

To meet the demand of listeners who are not prepared to purchase one of the rather more costly "Radiovox" Amplion loud-speakers, Graham Amplion, Ltd., 25, Saville Row, London, W.1, have recently produced a less expensive loud-speaker though designed on somewhat similar lines.

A standard Amplion movement is provided of the floating diaphragm Amplion type, which is accessible through a door on the right-hand end of the cabinet. The sound is taken by a short tube to a cavity behind an ornamental grille.

The aim in design has been to produce a loud-speaker of pleasing appearance with the object of superseding the unsightly horn type of loud-speaker. Good reproduction is obtainable with this instrument, and one need not hesitate to change an existing small horn type for this new model.

The cabinet is of dark fumed oak and of japanned style and measures $16\frac{1}{2} \times 5\frac{1}{2} \times 6$in. deep.



Where the small horn-type loud-speaker is considered unsightly the new Amplion Cabinette model can be substituted.

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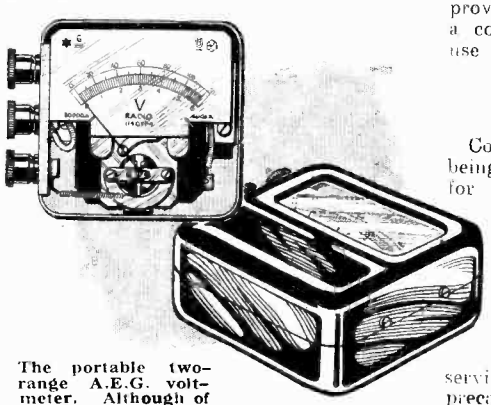
POCKET MOVING-COIL VOLTMETER.

It is becoming more generally realised that unless a voltmeter is available for verifying the correctness of filament, grid, and anode potentials, a receiving set cannot be adjusted to give the best performance either as to range or quality of reception. Voltmeters are therefore in more general demand, and in consequence several useful instruments have become available.

A new and compact form of voltmeter has recently been introduced by the A.E.G. Machinery and Apparatus Co., Ltd., 131, Victoria Street, Westminster, London, S.W.1, with a double scale reading to 6 and 120 volts. Fitted with a moving coil movement, this meter imposes an exceedingly small load on the battery under test, and therefore gives a true reading when measuring the potential across the terminals of a battery of high internal resistance. So high is the resistance of the meter, in fact, on the 120-volt scale that it is suitable for giving reliable indication of the voltage output of a battery eliminator and is one of the very few instruments available in any way suitable for this purpose. If a current of only a few milliamperes is passed by the testing voltmeter a false reading is invariably obtained owing to the voltage drop produced in the rectifying potential dividing equipment. This meter has a resistance of 80,000 ohms when reading to 120 volts, so that a full scale reading is obtained with a current of only 1.5 milliamperes. Similarly, on the 6-volt scale the resistance is 4,000 ohms.



The portable two-range A.E.G. voltmeter. Although of compact design, it is fitted with a high-grade movement giving a full-scale reading with a current of 1.5 milliamperes.

In spite of the small overall dimensions a substantial permanent magnet is fitted and the moving coil action is exceedingly well constructed, while the pointer is probably of aluminium tube about No. 26 S.W.G. gauge flattened at the end to form a fine knife edge. The movement is particularly dead beat and the readings accurate to within a very small limit throughout the whole scale.

The outer case is of brass and forms a screening box and measures overall $2\frac{5}{8} \times 2\frac{5}{8} \times 1\frac{3}{8}$in., all corners and edges being rounded, rendering the instrument robust and suitable for pocket use. The case, too, is entirely dust and damp proof, and has a black japanned finish. The three terminals are ebonite shrouded.

It is not intended that the instrument in its present form should be built into a receiving set, and the three terminals providing the two ranges therefore have a common positive in preference to the use of a common negative terminal.

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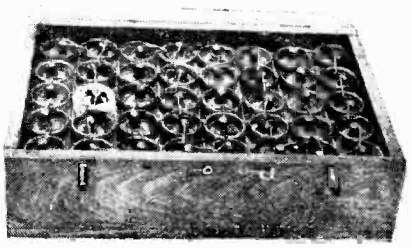
WET H.T. BATTERIES.

Considerable keenness is at present being shown in the adoption of wet cells for constructing high tension batteries, the principal reason being that the battery can be recharged at small cost.

Batteries of this type sometimes fail owing to the corrosion which arises through the "creeping" of the electrolyte and in order that a wet cell battery may give reliable service it is essential to take every precaution to prevent corrosion taking place around the joints, terminals, and connections between the cells. It is in this respect that the Hartel H.T. battery, manufactured by the Yorkshire Ignition Co., Ltd., 1 and 3, Broomhall Street, Sheffield, is well constructed, for not only are the tops of the glass containers liberally treated with beeswax, but the entire top of each of the positive elements as well as the sack containers and the connecting leads are well covered with a black wax compound through which the electrolyte does not percolate and to which crystals produced by creeping do not adhere.

In order that the action of the depolariser may be uniform throughout the material contained in the sack surrounding the carbon rod, a piece of waxed card is secured to the outside of the sack immediately facing the zinc so as to prevent the action taking place across the shortest path between the zinc and carbon. The battery presents a somewhat rough appearance, but it is, of course, unnecessary to increase the cost of the production by devoting attention to a good finish. The inside of the box is treated with damp-resisting paint, though the box itself is of rough construction



The Hartel 60-volt wet high-tension battery.

Broadcast Brevities

NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Keston "Tours" Spain—"Mañana!"—Our Blasé Announcers—Pianoforte Transmissions—A Guide for "Pirates"—B.B.C. at Olympia.

The Beethoven Centenary.

A grand Beethoven Centenary concert is being arranged by the B.B.C. for March 26th. An outside hall will be engaged for the purpose, and in view of the success which Herman Scherchen met with when he conducted the national concert for the B.B.C. at the Albert Hall on February 3rd, it is hoped that he may be available to direct the Beethoven programme.

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An Experimenters' Paradise.

The engineers at Keston will probably resent the suggestion I am about to make, viz., that the Keston receiving station is an experimenters' paradise. They will, I know, insist that the job of roping in and amplifying unconscionably distant and anæmic signals for the sake of an ungrateful public is the very deuce, with elements about it which are the exact opposite of paradisaical. For all this weariness of the flesh, however, there are definite compensations.

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"Touring" Europe.

For instance, Keston possesses a standard Geneva wavemeter, a useful little adjunct which adds flavour to the enjoyable task of exploring the European ether. During the past two or three weeks Keston has been "touring" Spain, with results that are scarcely flattering to that country in the light of its association with the Bureau International de Radiophonie. The Spanish authorities have themselves declared, with an air of utmost gravity, that the Spanish representative was a notable absentee from the last meeting of the International Committee, but this lamentable *contretemps* hardly justifies the present attitude of the Spanish stations towards the Geneva scheme.

FUTURE FEATURES.

Sunday, March 6th.

BIRMINGHAM.—Fifth Concert of the Beethoven Centenary Series.
MANCHESTER.—Special Service from Manchester Cathedral.

Monday, March 7th.

LONDON.—Request Programme of Fox-trots.
CARDIFF.—"Four Hats," a Duologue by John H. Bennett.

Tuesday, March 8th.

LONDON.—Sheffield University Concert S.B. from Sheffield.
BELFAST.—The Death of Cuchulainn, a Tragedy of the Gael.

Wednesday, March 9th.

LONDON.—Military Band Programme.
BIRMINGHAM.—"The Evolution of Syncopated Music."
NEWCASTLE.—"Dinner for Two," Comedy in one act.
GLASGOW.—Two Playlets by A. F. Hyslop.
ABERDEEN.—Scottish Concert.

Thursday, March 10th.

LONDON.—"Our Mr. Lohengrin." Burlesque Sketch by Fred Bowyer.
BELFAST.—The Round Table Singers.

Friday, March 11th.

LONDON.—"My Programme," by Capt. Harry Graham.
BOURNEMOUTH.—Programme of music by Bournemouth Residents.
CARDIFF.—A Bristol Programme.
BELFAST.—Oratorio, "Elijah."

Saturday, March 12th.

LONDON.—"Irene," musical comedy in two acts.

What the Wavemeter Showed.

The results of Keston's investigations are best shown in tabular form. Six stations were calibrated against the standard wavemeter, which gave the following readings:—

	Geneva Wavelength.	Actual Wavelength.
Madrid, EAJ7	375	374.5
Bilbao, EAJ11	294.1	420.25
Cadiz, EAJ3	297.7	362.25
Cartagena, EAJ16	277.8	297
Salamanca, EAJ22	400	402.5
Barcelona, EAJ1	344.3	325-331

There are a good many more stations in the Unione Radio Group, but in view of the above readings one can hardly blame Keston for giving up the search as a bad job!

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Mañana!

The suggestion has been made that the Spanish Unione Radio openly defies the Bureau International, but I am inclined to think that their extraordinary attitude is summed in the country's watchword—Mañana!

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A Keston Coup.

In successfully relaying the major portion of President Coolidge's speech last week, Keston deserves every congratulation. The success of the attempt was the more remarkable in view of the fact that almost complete failure attended the specially arranged test between Keston and Schenectady on the previous day.

The President's speech was picked up from Schenectady on 22 metres at a time when practically the whole of the Atlantic was in daylight.

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The Blasé Announcer.

Many listeners must have been struck by the calm matter-of-fact manner in

which the announcer said, at the conclusion of the speech, "We have now finished the transmission of President Coolidge's speech, and are back again in the London studio for the London Radio Dance Band."

Are our announcers becoming too blasé? Shall we hear, not far hence: "You will now listen to the Grand Lama of Tibet," followed by a half-stifled yawn?

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An Elusive Effect.

I understand from Capt. West that the elusive "hall effect" is still absent in the new Savoy Hill studio, despite its abnormal height. Consequently no musical combination larger than an octette is likely to make use of it in the near future, and large orchestras will continue to use studios which rely on an "echo room."

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Suspending the Microphone.

The suspended microphone is coming into favour at Savoy Hill; indeed, there are indications that the four-legged microphone stand, which has held the studio floor for four years, may disappear entirely. In No. 1 studio, where big orchestral works are performed, the microphone is now suspended about 9ft. from the floor, and this arrangement is said to result in clearer definition.

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Pianoforte Quality.

The question of whether the quality of B.B.C. pianoforte transmissions is constant under all conditions was raised by a correspondent whose letter appeared in *The Wireless World* of February 16th. This letter came under the eye of the authorities at Savoy Hill, from whom I have received the interesting avowal that pianoforte quality is *not* constant and that in this respect the receiver is not to blame.

Following upon recent investigations, it is explained, certain of the Savoy Hill studios have been found to be unsuitable for pianoforte transmissions. The obvious course will be to remove the pianos from those studios.

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From the Shaftesbury.

An excerpt from "My Son John" will be relayed by the B.B.C. from the Shaftesbury Theatre, London, on March 16th. The artists taking part are Billy Merson, Reginald Sharland, Henry Latimer, Betty Chester, and Annie Croft.

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The Actor at the Microphone.

I wonder whether the next few weeks will see the inception of a new era in broadcast dramatic art? Just a hint that such may be the case is contained in the news that the Royal Academy of Dramatic Art is about to conclude its first half-yearly term, during which an interesting experiment has been tried.

Readers may remember that in August last a Committee which included Mr. Kenneth Barnes, of the R.A.D.A., and Mr. R. E. Jeffrey, of the B.B.C., offered prizes in connection with special classes in broadcast acting. The tuition afforded to dramatic students has given them every opportunity of making the most of the studio atmosphere, a "studio" with a microphone having been installed at the Academy. The lessons aim principally at improving enunciation, but the students also learn how to obtain effects by methods which are not available on the ordinary stage.

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Reproducing Broadcast Conditions.

The results are judged, not in the studio, but on a loud-speaker in another part of the building, consequently the students learn to appreciate from the very beginning the peculiar conditions in which the broadcast listener is placed.

I hear that the first term's work has aroused great enthusiasm; let us hope that this will be reflected in an influx of new and original broadcast talent.

TANK WIRELESS. One of the latest whippet tanks equipped with a wireless transmitter and receiver. The use of wireless promises to revolutionise tank tactics in warfare, particularly in securing co-ordination between sections.

"Blue Vinny."

How many listeners outside the confines of Dorset experience a responsive thrill at the mere mention of Blue Vinny? Miss A. Bolch is to talk to farmers on the subject from the Bournemouth station on March 15th, and in case any reader may be uncertain as to what Blue Vinny is I would mention that Miss Bolch describes it as a beautiful, crumbly cheese made in Dorset.

Perhaps Miss Bolch will place a specimen before the microphone so that we may hear its "note"?

Some cheeses give a raw A.C. note, but toasting might rectify this.

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The Poor Pirate.

The ladies and gentlemen who obtain broadcast entertainment without securing licences are having rather a bad time, if we may judge from the newspaper reports of recent prosecutions. The pirates' great trouble at the moment seems to be a distressing shortage of excuses. Time was when a courageous pirate could clear himself by exclaiming between sobs: "Believe me, Your Honour, I never, never knew that a licence was required!"

Nowadays magistrates are growing stern, and the old excuses *simply won't do.*

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The Pirate's Guide.

Rather than desert the poor pirate in his hour of need I propose setting forth, in homely and understandable language, a few new excuses. They should, of course, be used sparingly and only at times when the pirate is unwilling to shoot himself and no other avenue of escape seems handy.

(*a*) I'm stone deaf.

(*b*) I was waiting for the collector to call.

(*c*) I thought that the Wireless Telegraphy Act was repealed by Mr. Gladstone in 1893.

(*d*) I didn't know a licence was needed.*

(*e*) I'm only an ordinary human being/wireless expert (strike out as required).

(*f*) I'm only 14, 25, 37, 43, 59, 72 (strike out age not required).

(*g*) It's a blinkin' shime.

* Inserted by error; this excuse secures double fine.

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B.B.C. at Olympia.

This year's exhibit of the B.B.C. at the Ideal Home Exhibition now being held at Olympia is devoted mainly to the question of broadcast reception, a matter of greater interest to the average listener than the transmission service, to which more space has been given in previous years. The exhibits show by means of three different types of receivers what the B.B.C. considers the quality of loud-speaker reception should be within the ordinary range of B.B.C. stations. By listening to these sets, which have been built by the B.B.C., listeners will be able to form comparisons. Models, complete in every detail, of Daventry station and of a studio and the control room at Savoy Hill will be on view.

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How Programmes Are Built Up.

Another exhibit of particular interest now that broadcast programmes provide so much controversy is a printed description with specimen programmes showing the stages through which programmes pass from the time of the Programme Board meeting up to the actual broadcast. There is also a display of valves, from the largest to the smallest, as used by the B.B.C. both for transmission and reception. Visitors will also find an exhibit of microphones showing those used in the early days and those in use to-day.

This year the B.B.C. is dispensing with the full-sized studio installed at previous exhibitions. Broadcast artists will no doubt relish this omission.

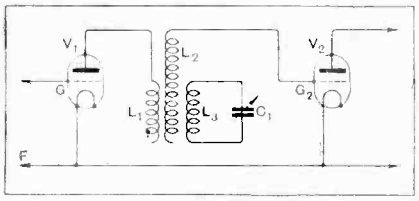
RECENT INVENTIONS

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.

High-frequency Amplifier. (No. 261,088.)

Application Date: August 12th, 1925.

A high-frequency amplifier is described in the above British patent by Radio Patents Corporation and W. Dubilier, one arrangement being shown in the accompanying illustration. Incoming signal voltages are applied between the grid G and the filament F of a valve V_1, the anode circuit of which contains an inductance L_1, comprising the primary winding of a high-frequency transformer, the usual anode battery being omitted for the sake of clearness. The secondary winding comprises an inductance L_2, having a very much larger number of turns than the primary winding L_1, and is connected between the grid G_2 and the common filament lead F, or a grid



System of H.F. coupling. (No. 261,088.)

bias battery if desired. Coupled to L_1 and L_2 is another inductance L_3, tuned by a condenser C_1, the tuned circuit L_3 C_1 being tuned to the same frequency as the incoming signals. The specification states that this arrangement gives amplification which is sometimes 50 per cent. greater than that obtained with the more normal form of high-frequency transformer.

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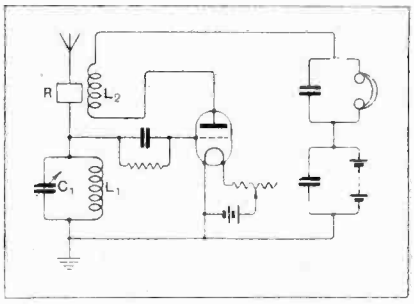
Constant Reaction. (No. 263,560.)

Application date: October 6th, 1925.

A receiver employing constant reaction control is described in the above British patent by M. A. Robinson. The idea of the invention is to include a resistance in series with the aerial lead and suitably arrange the circuit so that the reaction is fairly constant over the whole condenser range. In the illustration the receiver comprises an ordinary tuned input circuit, consisting of an inductance L_1 tuned by a variable condenser C_1, connected between the grid and filament of the valve, the usual grid condenser being provided for rectification purposes. The anode circuit contains a reaction coil L_2, which is coupled in fixed relationship to the inductance L_1. The aerial is not connected directly to the end of the grid coil, but is joined through a resistance R. Readers will be aware, of course, that the aerial system, which consists of an



Series aerial resistance for stabilising reaction. (263,560.)

inductance, capacity, and resistance connected, of course, to the tuned circuit L_1 C_1, will materially affect it, but the inclusion of the resistance greatly reduces the effect upon the tuned circuit. By suitably adjusting the remainder of the resistance it is possible to obtain a value of reaction coupling such that the receiver will not oscillate over the whole range of the tuning condenser. The inclusion of the resistance, however, will tend to reduce the signal strength.

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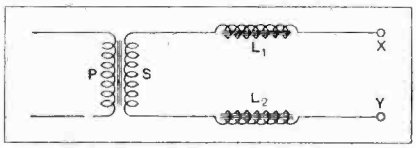
Eliminating Hum. (No. 262,979.)

Application date: October 6th, 1925.

Although most of the hum or ripple in rectified A.C. current should be eliminated before it is applied to a receiver, it frequently happens that a certain amount



Chokes included in telephone leads to eliminate A.C. hum. (No. 262,979.)

is still audible in the telephones. W. E. H. Humphreys describes in the above British patent a method of eliminating hum from the telephone receivers by including chokes in series. The diagram shows a method of carrying the invention into effect, where the output transformer from the receiver comprises a primary winding P and a secondary winding S. The telephones or loudspeakers are connected across the secondary of the transformer in the normal manner at XY, but in series, of course, with two chokes L_1 and L_2, which offer considerable impedance to currents of frequencies of the order of those of the ripple.

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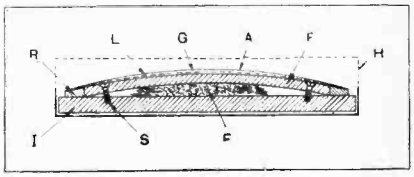
Condenser Microphone. (No. 263,300.)

Application date: December 21st, 1925.

An interesting form of condenser microphone is described by P. G. A. H. Voight in the above British patent. The microphone consists of two electrodes, one in the form of a rigid plate and the other an area of thin metal foil. In the accompanying illustration the rigid electrode consists of a metal plate P, which is damped with felt or similar material F, the plate being secured to another in-



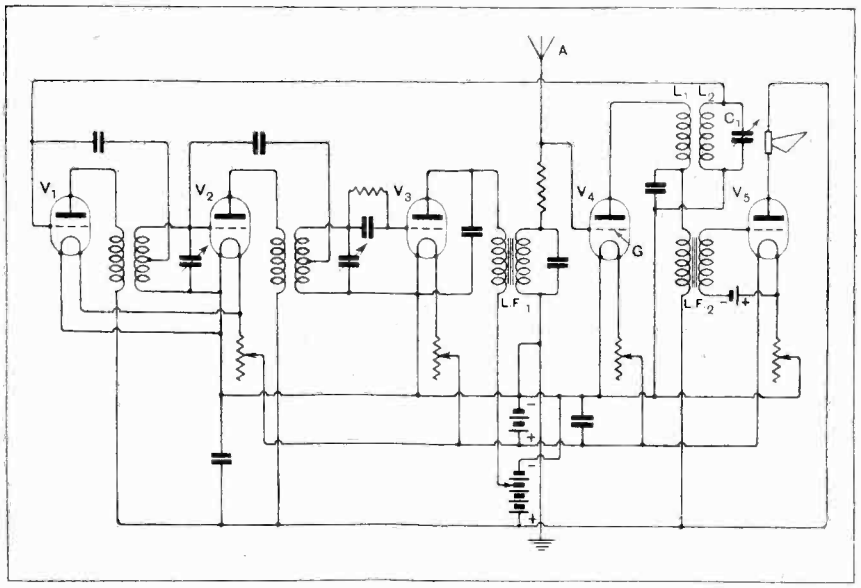
Condenser microphone. (No. 263,300.)

sulating plate I by means of screws S. The other electrode comprises a sheet of aluminium foil A about 1-2,000th inch thick, and is separated from the back electrode P by an air cushion, *i.e.*, a layer of air G about $\frac{1}{32}$in. thick. Some very thin silk L is interposed between the foil and the back plate to prevent the two becoming short-circuited. It is stated in the specification that the natural frequency of the system is about 16,000 cycles. The foil shown in the accompanying diagram is attached to a ring R, which, in turn, is fixed to the insulating plate I. In order to protect the microphone from stray capacity effects a metal screen H is used, and is arranged as shown. It is mentioned that it is important for the air to be dry, and means may be provided for removing the moisture from the air between the back electrode and the foil. The specification is very detailed, and gives several alternative forms of construction

Non-radiating Receiver. (No. 252,691.)

Con. date (U.S.A.): May 26th, 1925.

A rather unusual form of receiver is described in the above British patent by the Hazeltine Corporation and W. A. MacDonald. The main feature of the invention, which is illustrated by the diagram below, lies in the use of a valve connected directly to the aerial without any tuned input circuit. It will be seen that the aerial A is connected to the grid G of the valve V_4, which is the supply valve referred to. The anode circuit of this valve contains the primary winding of a transformer L_1 L_2 the secondary of which is tuned by a condenser C_1. This secondary circuit is connected to the grid of the first ordinary amplifying valve V_1 on the left of the illustration. The valve V_2 acts as an ordinary neutralised high-frequency amplifier, while the valve V_3 acts as a detector, this portion of the circuit, of course, being quite straightforward. The output of the detector valve contains the primary winding of a low-frequency transformer LF_1, the secondary of which is connected to earth and also the grid of the valve V_4, which thus acts as a low-frequency amplifier, the output of this valve being coupled by another low-frequency transformer LF_2 to the grid-filament circuit of the last valve V_5, which operates the loud-speaker. With the arrangement shown the high-frequency potentials derived from the aerial would normally be by-passed to earth through the condenser across the secondary winding of the first low-frequency transformer. However, a resistance is connected in series with this grid circuit. While this will not have any appreciable effect upon the magnitude of the low-frequency potentials applied to the grid of the valve V_4 it will offer a very high impedance to any high-frequency voltages occurring at the aerial terminal. It is claimed that even if the circuit oscillates the radiation will be small, since the oscillations have to pass to the aerial through the inter-electrode capacity of the valve V_4, and, since the aerial circuit is untuned, the radiation will be practically nil.



Non-radiating five-valve receiver. (No. 252,691.)

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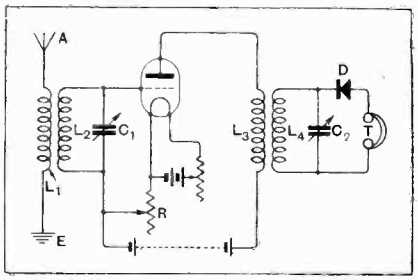
A Stable High-frequency Amplifier. (No. 241,185.)

Convention date (U.S.A.): October 12th, 1924.

R. E. Manufacturing Co. and B. Phelps describe in the above British patent a form of stable high-frequency amplifier which is stabilised by coupling back a certain proportion of the potentials produced in the anode circuit into the grid circuit by means of a resistance. The inductance L_1 is coupled to a closed grid circuit comprising an inductance L_2 tuned by a variable condenser C_1. The anode circuit contains the primary winding of a high-frequency transformer L_3, L_4 the secondary being tuned by a condenser C_2. The amplified potentials produced across this circuit are shown to be rectified by a crystal detector D in series with the usual telephones T. Instead of connecting the negative pole of the high-tension battery and the lower end of the grid circuit directly to the filament, connection is made through a resistance R. Since this resistance is included in the anode circuit a portion of the potentials occurring in the anode circuit will be produced across it. But as this resistance is in the grid circuit of the valve the same potential will be applied to the grid of the valve. But it must be remembered that the voltages occurring in the anode circuit are of opposite phase to those in the grid circuit, which causes the production of the potentials in the anode circuit. Hence the function of the resistance will be materially to lower the overall amplification of the valve. Thus, supposing there is sufficient stray inter-electrode coupling, or stray magnetic coupling to cause the valve normally to generate continuous oscillations, by suitably adjusting the value of this resistance it is possible to introduce voltages into the grid circuit, which will counteract those tending to maintain the generation of oscillations.



Stabilising with a resistance common to the grid and anode circuits. (No. 241,185.)

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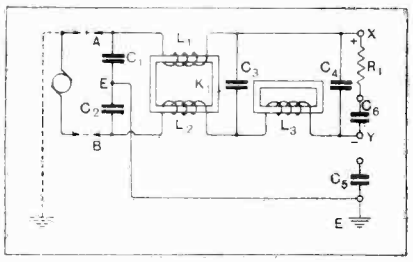
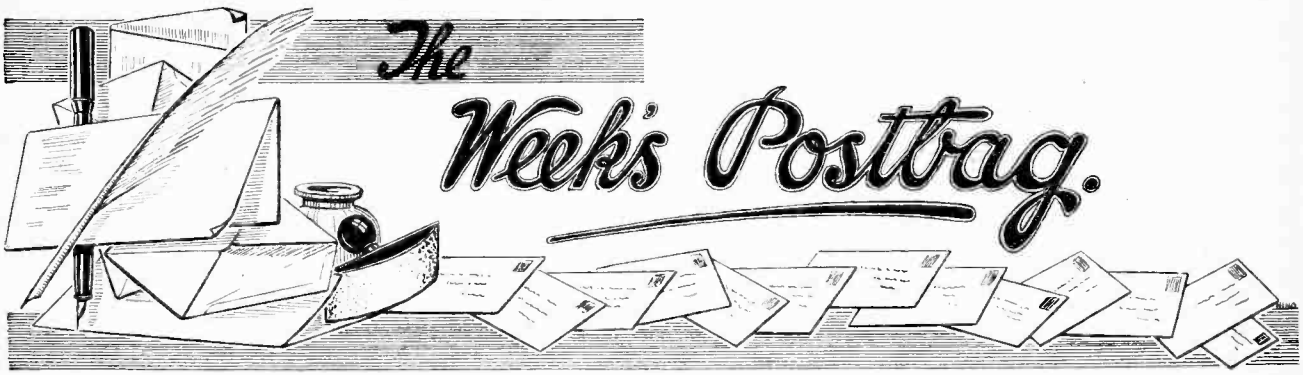
Smoothing Direct-current Supply. (No. 241,944.)

Con. Date (U.S.A.): October 24th, 1924.

The Dubilier Condenser Co. (1925), Ltd., and H. W. Houck claim in the above patent a smoothing circuit suitable for use with direct-current supply mains. The smoothing circuit is shown in the accompanying illustration, where the direct current mains are introduced at A and B, which are positive and negative respectively. Across the mains are two condensers C_1 and C_2 connected in series, the centre point being earthed at E. The current is next passed through two chokes L_1 and L_2 arranged on a common core K_1. The two chokes are shunted by a third condenser C_3. Another choke L_3 is then included in the negative lead, and another condenser C_4 is placed on the other side. The earth connection to the set is taken through a safety condenser C_5. The highest voltage smoothing supply is taken across X and Y, these representing respectively the positive and negative terminals. A lower voltage for working, perhaps, a detector valve of a receiving system is derived through a series resistance R_1, which, of course, is shunted by a by-pass condenser C_6.



Smoothing circuit for D.C. mains. (No. 241,944.)



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

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

THE "EVERYMAN FOUR."

Sir,—For some considerable time I have been experimenting with the above remarkable four-valve set, and can certainly say it is easily the best I have tested from amongst hundreds of others I have tried, especially as regards volume and selectivity.

I should be glad if you will kindly insert the following notes in your paper, so as to enable other enthusiasts to get the very best results from this circuit.

Practically every make of valve, of any note, has been used and compared as regards selectivity, volume, and purity, also many combinations.

In the first instance I obtained very good results with Marconi D.E.5b in valve No. 1, Cosmos S.P.18 Green Spot valve No. 2, D.E.5b in valve No. 3, and D.E.5 in valve No. 4. Subsequently I have experimented with other makes of valves, and during the month I have used the following valves with splendid results; in fact, far beyond my expectations, viz. :—Valve No. 1, Mullard P.M.5X; valve No. 2, P.M.5X; valve No. 3, Mullard P.M.6; and valve No. 4, Mullard P.M.256. The H.T. should be 120 volts H.T. 1 and 3, and 60 to 90 volts H.T. 2. G.B.2 is 1½ to 4½ volts, and G.B.3 is 15 to 24 volts. Resistor R_3 is 1 ohm, and R_4 7 ohms. To short-circuit R_3 is not so good as having a small resistance. Rheostat R_1 should be 6 ohms, and R_2, 35 ohms; this will save a considerable amount of L.T. current and give a greater amount of control.

The tuning of L_1 (200 coil) is much sharpened by placing a fixed condenser of 0.0003 mfd. in series with the Daventry terminal.

The set when used with these valves is quite silent and no humming or microphonic noises can be heard, no matter how the cabinet is shaken.

I have given this information to many friends, who are delighted with the results they have obtained. Over forty stations can easily be had at full loud-speaker strength after 8 p.m. any day.

I have no interests with the Mullard Company whatever, and am only giving this information for the benefit of others.

Bournville. S. LAMBERT.

February 11th, 1927.

WET BATTERIES FOR H.T. SUPPLY.

Sir,—Having read of the experiences of various users of Leclanche type H.T. batteries, I am prompted to give the results of my own tests with this type of battery.

It is not generally understood that the wet battery is similar to the dry type, the difference being that the latter is sealed in, with precautions taken against the electrolyte becoming dry. The wet battery, therefore, in many respects is identical with the dry battery.

The output of the wet battery can be greater (using the same size depolariser or sack) than the dry battery, but this advantage depends on two things. First, the depolariser or sack element must be made from the right proportions and best quality manganese dioxide and graphite, etc., and it should be compressed hard. Secondly, and this is important, the electrolyte should be made from the right chemicals, and there must be sufficient of it. With the above two requirements satisfactorily met, the wet battery will give 30 to 50 per cent. more output than a dry battery of the best quality using the identical size depolariser. The reason for the increased output of the wet battery is due to the ample quantity of electrolyte provided in the usual size container for this class of cell.

Wet batteries have the further advantage that used up parts can be replaced instead of having to throw the whole battery away. Wet batteries are therefore cheaper in the long run, and if properly constructed give reception with a perfectly silent background.

Now to explain the causes of the short life that some of your correspondents complain of. This, I think, is chiefly due to using the wrong electrolyte. The best electrolyte is a solution of ammonium chloride (sal-ammoniac), 6 oz., and zinc chloride, 4 oz., to 20 oz. of boiled water. The electrolyte when dissolved should be strained through fine muslin or linen, and, of course, be used cold. The usual size of container, 2½in. high by 1½in. square, using the flash-lamp size of sack element, will require just under one ounce of electrolyte, which is ample for the whole life of the sack element. Using the larger size sack element (about ⅞in. in diameter) in the same size container, the electrolyte should be renewed when the voltage of the cells drops to 1.1 volts.

It is advisable to use rubber bands to prevent any possibility of a short-circuit between the zinc and the sack element. Elements taken from dry batteries are usually half used up and in some cases quite useless. If the voltage drops as low as 0.7 per cell the sacks should be thrown away.

Evaporation is best reduced by having a layer of liquid paraffin or thin machine oil on the top of electrolyte, and any evaporation that does take place should be made good by adding boiled water cold. The jars should be well waxed to stop creeping, and the connections and the brass cap on sack element shellac varnished and smeared with vaseline as a double precaution to prevent corrosion.

It must not be assumed that the Leclanche type battery will last for ever, nor will they give a greater current than a similar size dry battery, although the total output can be considerably greater. It is probable that a number of your correspondents are taking an excessive current from cells which will naturally give satisfactory results.

I am at present using a battery of 70 cells with the small sack element on a four-valve (neutrodyne) set taking 4½ milliamps., and after four months' service it is giving excellent results, the voltage being now 85. RESEARCH.

London, S.E.5.

February 22nd, 1927.

RECEPTION OF MOSCOW (RDW).

Sir,—It is an extraordinary fact that Moscow (Central) RDW on 1,450 metres is receivable here at any time of the day it is working, always provided, in this neighbourhood, that 5XX is not transmitting.

You can receive this station very well on Sundays any time after 10.30 a.m., G.M.T., and I should imagine, in view of amount of anode current by an anode bend rectifier being greater here than some German stations, it would be easily receivable on a straight 1 H.F. and detector set. I have not, however, tried, as I use a larger amplification set with a frame aerial (loaded and therefore inefficient) loosely coupled to a tuned aerial.

The power this Moscow station uses must be very great indeed. Identification is certain from the station call of "Moskwa Peredacha" and wavelength. Needless to say, that it is this daylight reception which astonishes me. Using low-frequency amplification one can blow the house out on a loud-speaker with it.

Market Harborough. CECIL R. BATES.
February 17th, 1927.

B.B.C. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—I can thoroughly endorse the remarks of Mr. E. C. Richardson in reference to the quality of pianoforte tone in the B.B.C. transmissions. Judging by the results, the technique of such transmissions receives the minimum attention by the B.B.C. engineers, or on the other hand, the problems in connection with it are unusually difficult.

It should be stated at once that there is a corresponding difficulty in realistic loud-speaker reproduction of this type of music, and I am aware that the performance of most receivers leaves much to be desired. Even a poor receiver does moderate justice to stringed instruments of the violin type, but with a poor receiver piano tone is a parody of the real thing.

Having a preference for pianoforte music I have taken all ordinary steps on my side to ensure that my receiver does justice to the transmission. The receiver has two resistance coupled L.F. stages (with alternative transformer coupling—2.7 : 1 ratio for the second stage). Accumulators are used for supplying filament and anode current, and valves are operated at their optimum potentials for filament, grid, and anode. The speaker is a coil driven cone, and is connected to the anode circuit of the last valve through a filter circuit. The last valve is of 4,000 ohms impedance, and two can be connected in parallel when necessary for full volume. An improvement would possibly be effected by using anode bend rectification instead of the cumulative grid method adopted in the receiver, but distance from the transmitter (Daventry) precludes this. Such a receiving equipment should and does give good reproduction with bass-drums and organ pedal notes which can be *felt*.

Possibly I am situated too far away from Daventry to obtain consistently good reception. But it is curious that quality should vary so much in one evening or even in the same half-hour. And, curiously enough, it is often a piano solo, for which one would think there would be a specially adapted studio, that comes through worst. One can often hear, say, a Chopin "Etude" come through with dull woolly tone, to be followed immediately by a variety programme in which the piano tone is brilliant and full.

The usual form the distortion takes is a lack of brilliancy in the middle and lower registers of the piano with a disagreeable blurring effect from about middle C to two octaves below; further down in the bass tone is rather better. The B.B.C. can transmit the piano well if they will, for I have listened with real enjoyment to some of the pianoforte transmissions, but good quality transmissions are the exception.

Teignmouth, G. F. ROSSITER.
February 18th, 1927.

Sir,—I read with interest the letter from Mr. E. C. Richardson on the quality of the piano transmissions now being put out by the B.B.C., as I have recently been in communication with them on the subject.

My complaint is that for some months past there has been a deterioration in quality compared with that previously sent out, the principal fault being blasting on bass notes. The effect is similar to that produced by silent-point oscillation in a neighbouring aerial.

The replies I have received from the B.B.C. are most unsatisfactory, for, while admitting that complaints from other listeners are being received, they persist in the suggestion that the fault is at my end. Naturally, I took great care to ascertain that this was not the case before writing them.

Cambridge, W. K. ISLIP.
February 17th, 1927.

HOW TO TUNE-IN AMERICA!

Sir,—Recently I received a letter in which the writer gave an account of the methods he employs and the precautions he finds it necessary to take when receiving American broadcasting on very low wavelengths under considerable difficulties caused mainly by the fact that the receiving set used was never intended for reception below 200 metres at the lowest, and further aggravated by other circumstances such as locality, and the impossibility of erecting a decent aerial and making any sort of a direct "earth" connection at all.

As many of your readers may have to contend with similar difficulties perhaps the following extract from the letter referred to may prove helpful :—

"Tuning is accomplished thus : Fix S—— on couch with phones on and book to read. Rest of household must be in bed. Kittens locked in kitchen. No flies in room. Policeman asleep on beat outside. Find a howl. Let it howl. Then move away from set until silent point reached. Regardless of howls or vanishing of signals, back-off reaction until, when leaning back, the station is 'in.' The great trick is so to arrange that when station is tuned-in one has just arrived at a reclining position (or as one might say, a recumbent posture) in chair. Final deft touches may be given to the tuning by wrinkling the nose or elevating the eyebrows."

London, S.W.5. J. H. S. FILDES.
February 14th, 1927.

RETAIL SALE SERVICE.

Sir,—I should like to bring to your notice the extremely poor service offered by the retailers in wireless accessories and equipment. Living as I do in London, and being desirous of purchasing the ordinary accessories from time to time, I find it extremely difficult to find *any* shop where I can be sure of having my wants supplied without a latent period varying from days to weeks or a salesman whose intelligence is measureable. I believe that it would be quite impossible to find a shop in England where one would be supplied from stock with an S.P. 55B valve, a Hellison grid battery, a Dubilier grid leak clip, and a Tye 32H choke, to take but an example. As a potential buyer of a "Kone" loud-speaker I have been through the horror of hearing it attached to a one-valve set anchored to a 36-volt H.T. battery.

I have been informed in the showrooms of a great retailing company that the inductance of the primary of a certain transformer was ten ohms, and that another customer had used a D.E.5b in the last stage of a power amplifier with great success (sic).

I am informed that there is little money in the wireless retailing business, which I cannot believe to be true. There must be many desirous of buying if they knew but where. London and the provinces need first-class, well-stocked wireless shops, attended by salesmen of intelligence and some knowledge, and not associated with cameras, bicycles, gramophones or vegetables. I, for one, would support them.

London, S.W.3. E. J. H. ROTH.
February 17th, 1927.

AMATEUR INTERNATIONAL PREFIXES.

Sir,—To me the suggested scheme for International Prefixes appears one of the most "muddleheaded" ideas going, from whatever point of view it is looked at. In the first place, as Mr. Hinderlich points out, they have been chosen without "rhyme or reason," and in the second place, as is shown by Mr. Fergus, who has been consulted about it? Thirdly, the latter E, which, it has been proposed, will be allotted to all Europe, in the Morse code would never be recognised, if even R3, amid the usual QRN and QSS of a DX signal; everyone knows that the Post Office never allots the call 2EE or 5EI owing, presumably, to the obvious difficulty in reading it among

interferences. For instance, if someone listens to EO 2XX (which would be the Irish Free State) and hears only the O 2XX how is he to know where the signal is coming from? In the present system Rhodesia is the answer. Again, OE sent badly from Melanesia might be quite easily mistaken by a misguided Austrian for one of his own countrymen (— — — .).

I foresee innumerable mistakes occurring, for how easy will it be to introduce these new prefixes! It will be like relearning the Morse code again!

Mr. Hinderlich is most decidedly right over the political point of view, and for myself I see no difference between trying to compel all the governments of every place in the world to change the amateur prefixes and asking them to change the commercial ones! Until now I always held a high opinion of the I.A.R.U., but I regret to say that I consider that they have overstepped the mark this time.

I sincerely trust that all effort will be made to do away with the absurd idea; perhaps it will answer in the U.S.A., where amateurs are no longer "amateurs" but private telegraph establishments, with a power that would make the foundations of the G.P.O. tremble. America may be a go-ahead country, but nobody tolerates direct interference.

Pau, France. A. E. LIVESEY (G 2BZT).
January 31st. 1927.

Extracts from Readers Logs.

Zaria, Nigeria

October-December, 1926.

U.S.A.:—U 1AIR, 1AJ, 1AG, 1AGN, 1AXX, 1BF, 1CH, 1CKP, 1CMX, 1IM, 1LU, 1XU, 1AXA, 2AKZ, 2APA, 2APV, 2ATU, 2BO, 2BX, 2KW, 2XG, 2RA, 2TY, 3ATN, 3GP, 3LD, 3ZM, 4FT, 4IT, 8AB, 8ADG, 8AMD, 8BF, 8BPL, 8BZ, 8BTH, 8BYT, 8FA, 8FO, 8BZQ, 8PD, 8PL, 8TTL, 9EBJ, 2XAD. Great Britain:—G 2XY, 8AD, GBJ, 2DO, 5UW. France:—F 8CA, 8CX, 8JJ, 8QRT. Argentine:—R DB2, BA1, AA7. Uruguay:—X 1BU. Germany:—AGB, POF. Brazil:—BZ 2AG, 1AX. Dutch East Indies:—AND, ANE, ANF, PKH. South Africa:—O A4Z, A5Z, 1SR. Egypt:—SUC. Chile:—CH 2AB, 2AS. Australia:—A 5HG. Canada:—C 2GZ. Switzerland:—H 6Y. Miscellaneous:—ABI, LPI, UNB, VNB, KEL, SPI, PUA, PWX, CHILE, MCHT, ISL, SPR, HIK, K44, FC6, YAE4. G. C. Wilmot

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

Friern Barnet, London, N.11.

Jan. 1st to 18th, 1927.

U.S.A.:—U 1 AMD, BHS, RD, BEZ, AVL, CJC, BES, BNW, ASA, KL, CH, UZ, 2 CTN, YM, AGM, AK, DH, MM, AAS, AYJ, CVJ, BUM, GPK, MK, AGP, CJB, FO, AGN, BQH, FO, CUQ, AOC, 3 CAH, CKL, AY, KR, AFQ, GP, ARV, 4 CV, LG, RM, 8 DRJ, BTH, ADK, RH, 9DR. Brazil:—BZ 1AD. Czecho-Slovakia:—CS 2YD. Canada:—C 1CX, 1AK. Costa Rica:—CR 10. Portugal:—P 1AF, 1AO. Spain:—EAR 44, 38, 42, 30. French Algeria:—FA 8VX, 8RIT, 8JO. Austria:—Ö PY. Poland:—TPAV. Italy:—I 1MT, 1PN, 1DM, 1DO, 1CN, 1BD. Finland:—S 5NB. Denmark:—D 7YO, 7NI. Lithuania:—TL 2XA. Yugo-Slavia:—YS 7KK. Africa:—O A5X. Miscellaneous:—W AA, S KTR, LPRV.

J. Clarricoats (G 6CL).

Bangor, Co. Down.

Dec. 15th, 1926, to Jan. 29th, 1927.

Gt. Britain and Ireland:—G 5GQ, 5BY, 5UP, 2VQ, 5AD, 5TD, 2BI, 6IW, 6DA, 5VL, 2RG, 6VP, 6BD, 2BM, 6BQ, 2UN, 2XY, 5MS, 5UW, 6IA, 5SK, 6PA, 6HT, 6KK, 2DB, 6TG, 6GQ, 5YK, 2YD, 2HW, 5AQ, 2NM, 5DC, 6NI, 6RL, 5TZ, 2VJ, 2GS, 6UP, 5XY, 5FQ, 6TA, 5GW, 5XK, 6HS, 5HS, 2US, 5US, 6CL, 5HX, 6KS, 2CB, 5QG, 6FT, 5TD, 5KZ, 5YK, 5XN, 2VS, 6YQ, 5RU, 6PA, 6LR, 6CP, 6RY, 2AK, 2WL, 6YC, 6BT, 2AG, 2PZ, 2IH, 6ZZ, GI 5MO, 5WD, 5NJ, 6YW, 6MU, 6WG, 5ZY, 2II, 2BX, GW 18B, 11B, 11Z, 14C, GC 6KO, 5NW, 6NX. France:—F 8FFR, 8FY, 8VAA, 8TIS, 8UT, 8DGU, 8HLL, 8NOX, 8DGS, 8VVL, 8CL, 8UEL, 8IH, 8AKL, 8ZET, 8GOB, 8WEL, 8HU, 8OLU, 8DX, 8ER, 8EAR, 8OL, 8PJ, 8SST, FA 8VX. Germany:—K 4YA, 4YAE, 4YF, 4XU, 4GO, 4MCA, 4ENX, AGC, ABC. Sweden:—SMWF, SMVJ, SMVR, SMSV, SMTO, SMUR, SMON, SMUA. Belgium:—B 4AA, 85, H4, H5, 4VT, 4ZZ, 3CV, 84, 08, A2, AR6. Denmark:—D 7FP, 7ZG, 7MT, 7FJ, 7VK, 7JO. U.S.A.:—U 1CKI, 2XAF, 1DH, 1JK, 3ACM, 9PY, 1AW, 1ADM, 2OR, 1BB, 1AWE, 1GA, 2MK, 1BEZ, WIZ, KDKA. Others:—J 59, NI OWG, P 1AO, 1CO, NI OWR, SPM, SPR, H 2AT, TPAJ, I 1BD, LIAS, R 1NX, PCMM, PCRR, PCPP, B P7, EAR44.

A. Jameson (GI 6JA).

London, N.16.

England and Wales.—G 2AU, 2AQ, 2AV, 2BM, 2BO, 2BZ, 2 DA, 2 DU, 2DY, 2GO, 2FQ, 2JJ, 2KT, 2LJ, 2LU, 2LZ, 2MI, 2NH, 2NJ, 2NM, 2OD, 2OM, 2ON, 2OO, 2OT, 2OU, 2OY, 2OZ, 2PU 2PX, 2PZ, 2QN, 2RD, 2RK, 2SH, 2SQ, 2UD, 2VJ, 2VS, 2VR, 2XO, 2XP, 2XR, 2XY, 2YY, 2YZ, 2ZB, 2ZK, 5AD, 5AQ, 5BG, 5BY, 5BD, 5CF, 5CT, 5DC, 5DT, 5DY, 5FQ, 5GO, 5GV, 5IS, 5IY, 5JN, 5LI, 5MS, 5LU, 5PU, 5QP, 5PW, 5PZ, 5QK, 5QV, 5RW, 5RD, 5SI, 5SL, 5TR, 5TZ, 5UL, 5US, 5VG, 5VR, 5ZA, 5VY, 5YM, 5XW, 5ZY, 5ZG, 6AO, 6AT, 6BO, 6BT, 6CL, 6HY, 6KA, 6KC, 6LB, 6LL, 6LY, 6OH, 6OO, 6OU, 6OZ, 6PD, 6PU, 6QH, 6QO, 6QY, 6TA, 6UZ, 6UT, 6OT, 6WF, 6XF, 6YG, 6ZA, 6ZY, 6QL, 2PA, 2HQ, 5JM. Scotland:—GC 6VO, 6GY, 6GU, 5JK. Northern Ireland:—GI 2AFD, 2PLR, 6MU, 6NJ. Irish Free State:—GW 11B, 13C, 17B. France:—F 8OF, 8EZ, 8BJ, 8XJT, 8LA, 8LC, 8ALG, 8IE, 8JD, 8HT, 8JVX. Italy:—I 1BD, 1RR, 1NO, 3AM, 1AZ, 3TR. Various:—Z 4AS, U 2XAV, U 1JEU, U 7JF, Z IAA, FC 8GG, P6PE, BN SKI, Z 1AO, MIXAY, U 2XG, K V8, SMRG, SMUI, A 2LR, A 3KB, A 6SR, R QA5, RUA7, CHIER, BZ 5AB, K AYY, K 4ABF, DF 7JO, K 4ZZ, KY 1VP, O JA1, R BH9

(0-v-2 Reinartz.) On 15 to 180 metres.

F. C. Mason (G 2BXM).

London, N.10.

Australia:—A 2AA, 2BK, 2CM, 3XO, 5JA, 6BL, 7CW, 7LA. Brazil:—BZ 1AA, 1AE, 2AA, 2BG, 5AA, 6QA. Canada:—C 1EL, 1FG, 2AR, 3BY, 3XI. Denmark:—D 7GN, OHK, ONC. Italy:—I 1AM, 1BW, 1CX, 1ER. Japan:—J 1PP, 3KK, FMW. Scandinavia:—SMXR, S 2NM, SBM, SAE. United States:—U 1ADM, 1PL, 1QL, 1ZB, 2AYU, 2GP, 2TP, 3BY, 6ADB, 6CAE, 6DDO, 6OI, 6ZAT, 7EK, 8ADE. Miscellaneous:—WIK, PCLL, GBK, AGB, Z 2XA.

J. Hum (2AJH).

(0-v-1) On 20 to 26 metres.

Streatham, S.W.2.

Great Britain:—G 2AJC, 2IT, 5BY, 5LI, 5MA, 5MF, 5TZ, 5WD, 5WH, 6AL, 6DN, 6FA, 6FD, 6JS, 6LR, 6NX, 6RD, 6WG. Belgium:—B E4, 4AR. France:—F 8BP, 8BRI, 8FK, 8WMA, 8WY, 8YPM, 8ZB. Holland:—N OWW, OHB. Norway:—LA 1A. Sweden:—SMSH, SMZV. Spain:—EAR18, EAR26. Various:—SUC.

D. H. C. Rudd (2BWR).

(0-v-0) On 39-46 metres.

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.

Inductance of Single-layer Coils.

I wish to calculate the inductance of a single-layer coil. Would you mind giving me a formula and working out an example? W. W.

The inductance of a single-layer coil can be calculated from the following formula :—

$L = \pi^2 n^2 D^2 l K$ where

L = the inductance in centimetres.

(For inductance in microhenries divide the above result by 1,000.)

$\pi = 3.1416$ and $\pi^2 = 9.87$,

n = number of turns of wire per centimetre length of coil,

D = the mean diameter of the coil in centimetres,

l = the total length of the winding in centimetres,

K = a factor (Nagaoka's) which depends upon the ratio of diameter to the length of the coil.

If the ratio $\frac{D}{l}$ is one, the value of K is 0.6884.

A few other values are given in the table below :—

$\frac{D}{l}$	K	$\frac{D}{l}$	K
0.10	0.9588	0.85	0.7228
0.15	0.9391	0.9	0.7110
0.20	0.9201	0.95	0.6995
0.25	0.9016	1.0	0.6884
0.30	0.8838	1.1	0.6675
0.35	0.8665	1.2	0.6475
0.4	0.8499	1.3	0.6290
0.45	0.8337	1.4	0.6115
0.5	0.8181	1.5	0.5950
0.55	0.8031	1.6	0.5795
0.6	0.7885	1.7	0.5649
0.65	0.7745	1.8	0.5511
0.7	0.7609	1.9	0.5379
0.75	0.7478	2.0	0.5255
0.8	0.7351		

As an example, suppose we have a coil 10 centimetres in diameter and 5 centimetres long wound with 40 turns of wire. Then, $\pi^2 = 9.87$, $n^2 = 64$, $D^2 = 100$, $l = 5$, $K = 0.5255$.

and $L = 9.87 \times 64 \times 100 \times 5 \times 0.5255 \div 1{,}000$ microhenries.

or $L = 166 \mu H$.

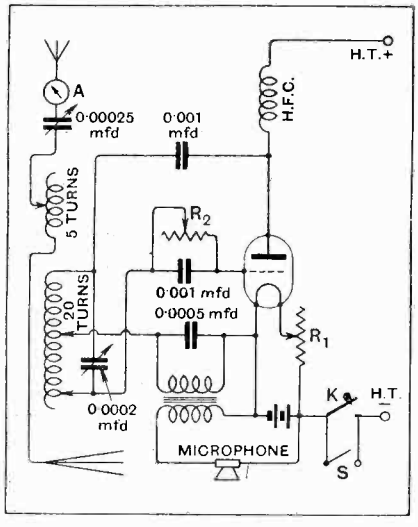
It will be seen that for a coil of certain physical dimensions the inductance depends upon the number of turns per centimetre squared. Thus, if one coil has 10 turns per centimetre and the second coil has 20 turns per centimetre, both coils having the same physical dimensions, the inductance of the second coil is 4 times that of the first. The formula also shows that the inductance of the coil depends upon the square of the diameter, while it is directly proportional to the length, allowance having to be made, of course, for the factor K.

o o o o

A Low-power Transmitter.

I would like to have a circuit for a small transmitter for telephony and C.W. Efficiency is not of primary importance and a receiving valve of the power type will be used as the oscillator. D. P.

A circuit diagram of a single valve transmitter working on the shorter wavelengths, such as 50 metres, is given below. In the aerial circuit is included



Circuit arrangement for low-power transmitter working on short wavelengths.

a tuning condenser of 0.00025 mfd. suitably insulated, and a tapped coil of 5 turns of No. 16 copper wire 4 in. in diameter.

The valve has a filament resistance R_1, and in its grid circuit is included a 0.001 mfd. grid condenser, an adjustable grid leak R_2 having a fairly low maximum value such as 50,000 ohms, and a 0.0005 mfd. condenser shunting the secondary of the microphone transformer.

The amount of the grid circuit included between the grid and filament can be varied by the taps provided. This circuit is tuned by a 0.0002 mfd. variable condenser and the coil has 20 turns 4 in. in diameter, the number of turns included in the circuit being adjustable by means of tapping clips. The key K is connected in the negative H.T. wire to the valve and this can be short-circuited by switch S when the set is used for telephony. The H.F. choke should have a low capacity and may consist of 100-200 turns of No. 36 D.S.C. wire, wound on a former $1\frac{1}{2}$ in. in diameter. The coil should be of the single-layer type.

It is important to use a microphone transformer which is suited to the microphone, and if a volume control is found necessary a variable high resistance may be used across the secondary winding of the transformer. Tests with a small transmitter of this type are much more interesting and instructive if meters are included in the various circuits.

As the valve to be used is of the ordinary receiving power type, the H.T. voltage required will be of the order of 150-200 volts, and may conveniently be obtained from accumulators. This is a very simple transmitter, but it can be made to work quite nicely.

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THE SILENT PERIOD.

ON many occasions since broadcasting started in this country the question of the desirability of providing an occasional silent period during the evening has been discussed. The desire for a silent period arose from the fact that those living in the vicinity of one of our broadcasting stations found it very difficult to eliminate that station in order to be able to listen to programmes of the other British stations or stations on the Continent working at the same time. With very selective sets, even if one is, so to speak, under the shadow of the local station, it is still possible to have a wide choice of programmes, but there are many users of sets not designed for extreme selectivity, but which, nevertheless, would be capable of receiving other British and Continental programmes if it were not for the presence of the swamping effect of the local station.

Why the Demand Arose.

Originally it was only the experimenters who urged that the B.B.C. should close down every station in turn for, say, half an hour each week during the regular broadcasting hours, and because these experimenters were in the minority the B.B.C. did not respond to the request, on the grounds that they had to cater for the requirements of the majority, who would prefer that their local programme should not be interrupted; but the position has changed since the early days, and now we believe that the great majority of users of valve sets would gladly avail themselves of an opportunity for listening to other programmes if their local station closed down for a short period, say, once a week. The hours of working of the British broadcasting stations overlap the transmitting times of practically all of the Continental stations, so that there is no opportunity for hearing these stations except for those comparatively few fortunate owners of selective sets.

A Contradictory Attitude.

The B.B.C. itself obviously recognises the considerable interest in reception of programmes other than those from the local station, otherwise they would not publish a weekly paper devoted to those programmes.

A Reasonable Demand.

What is asked for is surely no unreasonable request; it is merely required that each of the British stations in turn on different nights at predetermined times should arrange an interval long enough for us to get a taste of distant transmissions. Silent periods have been adopted by certain stations on the Continent for the benefit of their local listeners, and it seems unreasonable that advantages should be granted so readily to some of our Continental friends whilst they are denied us. The idea of a silent period could quite well be introduced by the B.B.C. as an experiment, to be continued or abandoned depending upon the extent of the popularity of the innovation which we imagine would be readily expressed. The views and suggestions of our readers would be welcomed.

CONTENTS.

FOUR-ELECTRODE AMPLIFIER

A New and Inexpensive Scheme for Loud-speaker Working.

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

THERE comes a time when the owner of a crystal set gets rather tired of always having to use the earphones, and would like sometimes to be able to use a loud-speaker.

Perhaps the simplest way to do this is to use a microphone amplifier, which requires only two or three large size dry cells as battery power, but unless a good and well-designed type of microphone amplifier is used—and these are relatively expensive—the quality of reproduction is not likely to be nearly so good as that to which the crystal user is accustomed.

Another, and more usual, way of obtaining amplification is by means of a valve, and this method can be relied on to give good quality reproduction provided that good components and correct battery values are used. The long-wave two-station crystal set described by the writer in last week's *Wireless World* is a suitable set to which to add a valve amplifier, both for working a loud-speaker from the local station and Daventry and for obtaining louder signals in the telephones from the distant Continental stations. Constructional details given in this article refer to the above-mentioned crystal set, but of course the arrangement, using the same components, may be applied to any crystal set.

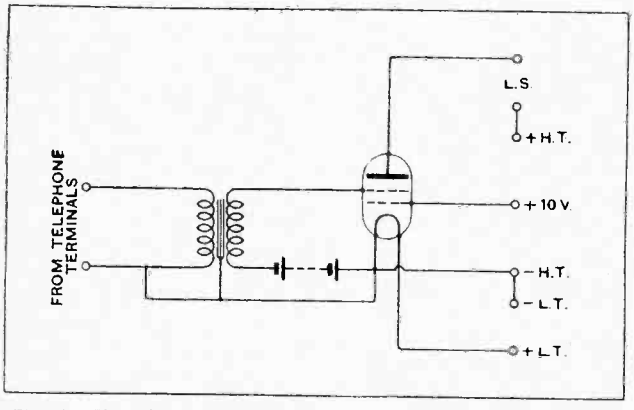


Fig. 1.—The theoretical circuit diagram of the four-electrode amplifier.

The Cost of Adding a Valve.

One of the most important considerations to the average crystal user is the question of cost, so that it is desirable to keep the cost both of installing *and running* an amplifier as low as possible consistent with good quality reproduction. For good quality reproduction it is essential to use good components, and with the usual type of valve the voltage of the high-tension battery must be at the very least 100, and probably a minimum value of 120 volts would be nearer the mark. Also, the normal plate current of an L.F. valve is fairly large—5 milliamperes or more—so that the small type of high-tension battery using the very smallest cells will not last very long—and, as the writer has elsewhere[1] pointed out, the quality of reproduction is likely to suffer long before the battery voltage drops right down.

The High Tension Supply.

For this reason, it is advisable to use either high-tension accumulators, which are expensive, or the large size dry-cell high-tension batteries, which are more expensive in first cost than the small size, but are much cheaper in the long run—or the short run, either—since they last so very much longer. The small size battery usually gets hopelessly overrun and its life is correspondingly short, while the large cells take the load comfortably and quietly and last much longer than the difference in size would seem to indicate.

From the foregoing remarks it will be seen that in the

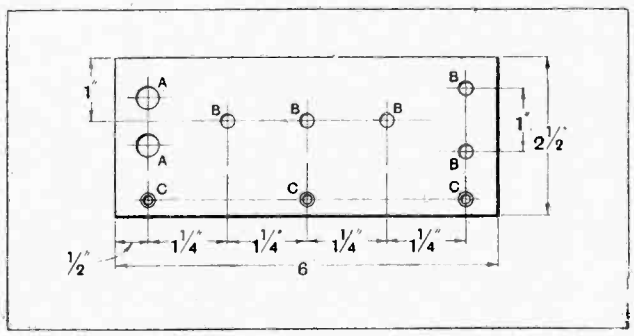


Fig. 2.—Showing the dimensions of the terminal strip A=3/8in. dia. holes; B=7/32in. dia. holes; C=1/8in. dia. holes, countersunk for No. 4 wood screws.

[1] *The Wireless World*, Sept. 9th, 1925.

Four-Electrode Amplifier.

matter of H.T., at any rate, it simply does not pay to economise in first cost by buying a small-cell battery—but there is another way of economising in battery power which is a real saving and does not involve a high maintenance cost.

This way consists in the use of a new type of valve—or rather in an improved version of an old friend of the experimenter—the four-electrode or two-grid valve.

The writer pointed out some time ago[2] a few of the possibilities of the two-grid valve, especially from the point of view of high-tension economy, and showed the essential points required in a two-grid valve for satisfactorily dealing with comparatively large input voltages such as are met with in low-frequency amplifiers—in other words, he showed what the essential features of a two-grid *power* valve should be.

As a result of these suggestions, a two-grid power valve is now obtainable from Messrs. Ancloy Products, Ltd., at the same price as the corresponding ordinary power valve, and in operation it is perfectly successful in dealing with quite large loud-speaker volumes without distortion and with much lower high-tension voltages than the usual three-electrode valve.

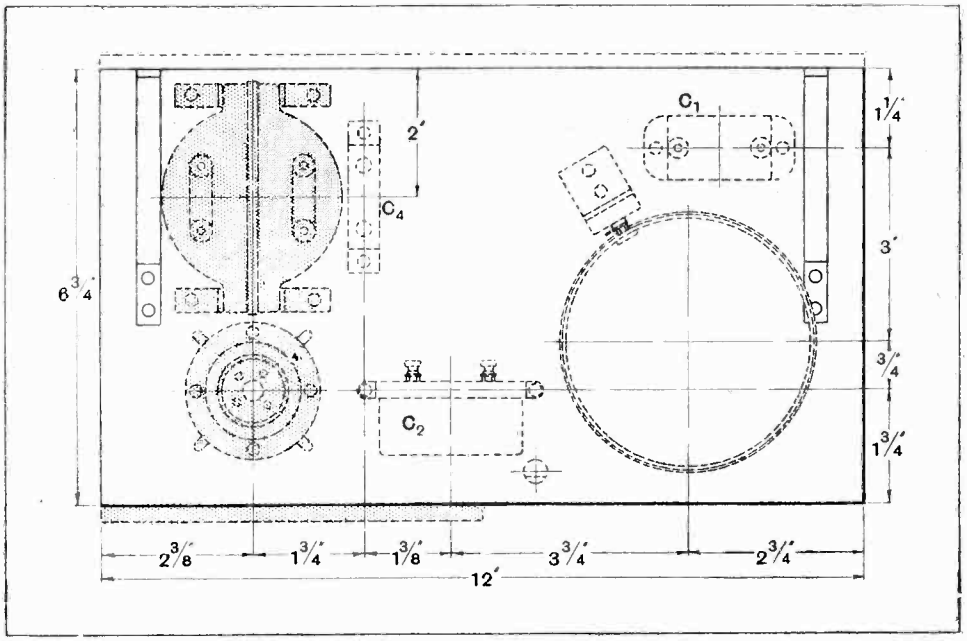
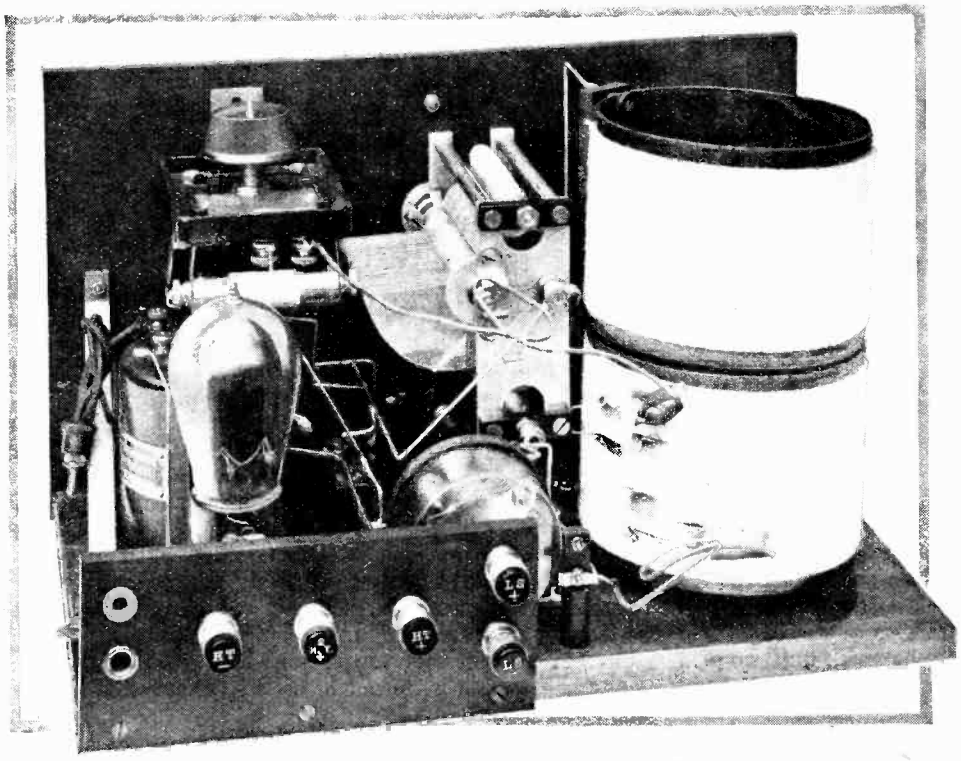


Fig. 3.—Showing the lay-out of the additional components on the baseboard of the crystal set

Perhaps the experimenter who has used four-electrode valves will rather wonder at the plate voltages specified for the two-grid power valve, but it must be remembered that this valve has to handle large input voltages and to give large current fluctuations in its plate circuit in order to operate the loud-speaker. The ordinary type of loud-speaker required at least twenty volts (peak value) for normal operation, so that the minimum plate voltage must be twice this value, or 40 volts. The writer does not intend to elaborate this point or the theory of the two-grid valve in the present article, but will go very fully into theoretical considerations and practical applications of two-grid valves in a future series of articles.

The main point that is of interest to the crystal user is that the two-grid power valve will give as good loud-speaker results on 40-50

[2] *The Wireless World*, July 21st, 1926.



A rear view of the set, showing the valve and transformer in position

Four-Electrode Amplifier.—

volts as the usual type on 100-120 volts high-tension—and, incidentally, the power efficiency is much greater, since the total current taken from the H.T. battery is actually less than that taken by a three-electrode valve dealing with the same grid swing (*i.e.*, input volts).

As the name implies, the two-grid valve has an extra grid, and this is brought out to a terminal on the base of the valve. The two-grid power valve is designed for medium power work (like the P.M.4 or the S.T.42 valves), and the extra or "inner" grid is used with a positive potential of from 10 to 15 volts. The plate voltage should be from 40 to 60 volts—when very near the local broadcast station, so that loud telephone signals are received with the crystal only, it is advisable to use 50 to 60 volts. Apart from the connection of the inner grid to a tapping point on the H.T. battery, the two-grid power valve is used exactly as an ordinary valve, the grid bias for the outer, or "working," grid being – 6 volts for 40 v. H.T., – 7½ v. for 50 v. H.T., and – 9 v. for 60 v. H.T.

The circuit is shown in Fig. 1, which gives the components and their connections for the complete amplifier to add to any crystal set. The transformer used should be of the *high* ratio type, since the resistance of the average crystal, especially on loud signals, is very low compared to the input resistance of a valve, so that a Marconiphone 8—1 transformer is used in the amplifier described. The additions required to the crystal set described last week consist of this transformer, an ordinary baseboard mounting valve-holder, an ebonite terminal block, and the necessary battery terminals, and the arrangement of the components is shown in the accompanying figures. There is plenty of room on the baseboard of the crystal set described last week to incorporate the extra components without altering the positions of any of the others.

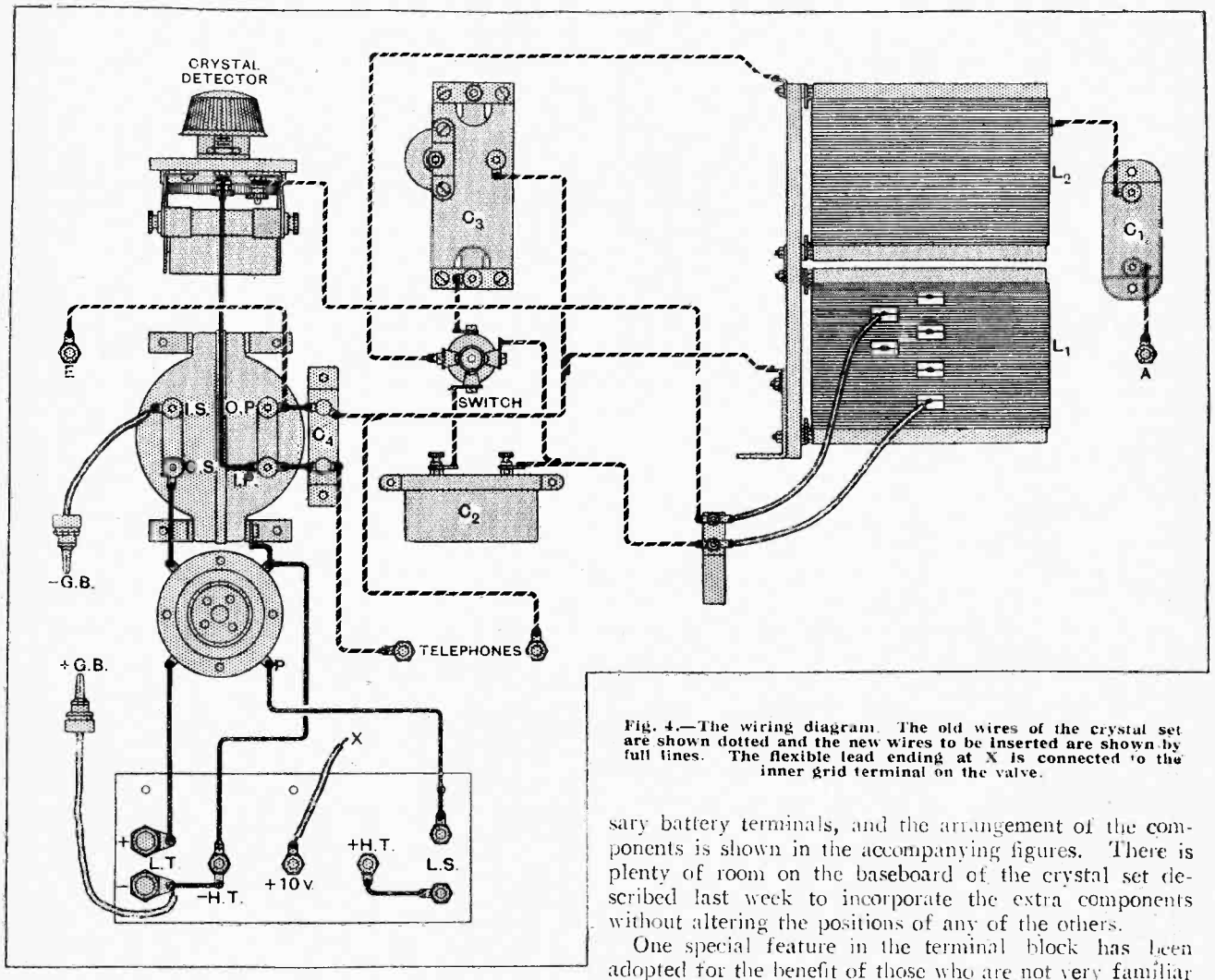


Fig. 4.—The wiring diagram. The old wires of the crystal set are shown dotted and the new wires to be inserted are shown by full lines. The flexible lead ending at X is connected to the inner grid terminal on the valve.

One special feature in the terminal block has been adopted for the benefit of those who are not very familiar with valves, namely, the provision of a different arrangement for connection of the L.T. or filament battery to that for the H.T. battery, so that there will be no chance of blowing up the filament of the valve when first connecting up. The arrangement used, namely, a Burndept standard telephone plug, not only ensures that the L.T. battery is connected the right way round in virtue of the different sizes of its plugs, but also may be used to switch off the set when not in use by being pulled out of the sockets.

The high-tension battery used may consist of one 48- or 60-volt *large* size dry-cell type and should last at least

LIST OF PARTS.

1 Ideal transformer, 8–1 (Marconiphone Co., Ltd.).
1 W.B. valve holder (Whiteley, Boneham & Co., Ltd., Mansfield, Notts).
3 Terminals (Belling-Lee).
1 Two-grid, 425, power valve (Ancloy Products, Eton Works, Dulwich, S.E 22)
1 Telephone plug and sockets (Burndept).
1 Ebonite strip, 2½in. × 6in.

Approximate cost, inclusive of valve, but exclusive of batteries - £2 10 0

nine months of normal operation, while the low-tension battery should be a 4-volt of about 15 to 20 ampere hours' actual capacity

The values of the various voltages—H.T., inner grid and grid bias—as given in this article should be used in order to ensure good quality of reproduction.

The saving effected by using a two-grid power valve in place of an ordinary power valve is in first cost for H.T. batteries as well as in H.T. maintenance, one of the prime costs of broadcast reception, and since it gives equally good results it is certainly well worth while to use such a valve.

TRANSMITTERS' NOTES AND QUERIES.

Transmissions from Iceland.

Mr. Arthur Gook (IC 3PF), Akureyri, Iceland, is transmitting on 175-200 metres with an output of 1½ Kw, and will welcome reports, which may be sent via Mr. L. A. C. Lawler (G 6LR), 67, Lucien Road, S.W.17.

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Norwegian Amateurs.

We are asked by Mr. J. Diesen (LA 1A) to state that QSL cards for Norwegian amateurs should be sent to Norsk Radioforbund, QRA and QSL Section, Oslo, instead of to LA 1A. He also states that the prefix LA will in future be incorporated in their call-signs (*e.g.*, LA1A) in the same manner as SM is incorporated in the Swedish call-signs, and that they propose using the intermediate EL suggested by the I.A.R.U. of America.

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A Japanese Station.

J KZB, the station of the Tokyo Electric Co., Kawasaki, Kanagawaken, Japan, is transmitting regularly on 38 metres on Tuesdays, Thursdays and Fridays, between 0800 and 1300 G.M.T., sending CQ for three minutes every 20 minutes, and will welcome reports from British amateurs. The operator's name is Y. Imaoka. He wishes to test also on 20 and 5 metres with an input of 500 watts, and would like to get into touch with any British amateur willing to co-operate in these tests.

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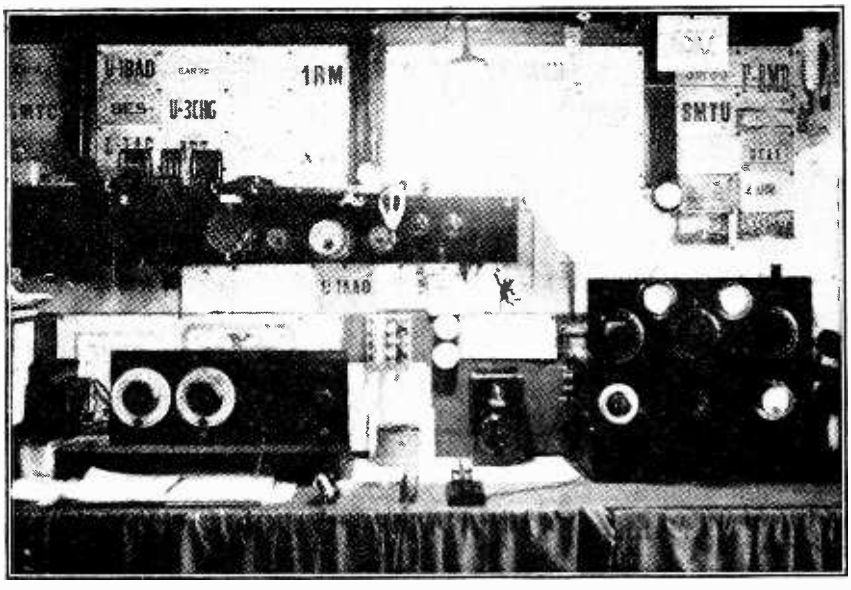
British Experimental Station.

Mr. R. Mitchell (G 5KZ) has sent us a description of his experimental station at Woodstock, View Road, Keighley, of which we are able to reproduce a photograph.

The transmitter is made up from receiving apparatus, and is the conventional coupled Hartley circuit. The input varies from 10 to 28 watts derived from the D.C. lighting mains and H.T. accumulators. An indoor aerial is used of the half-wave Hertz type. During the late low-power tests arranged by the T. and R. Section of the R.S.G.B. signals were reported as R5 in Rawalpindi when the input to the LS5 valve was only 4.8 watts.

The receiver is a Grebe CR18, using REL plug-in coils. Mr. Mitchell has worked Brazil, Palestine, districts 1, 2 and 8 in U.S.A., and ships in the Atlantic and Arctic with inputs of 18 watts or less, and has for five consecutive nights been in two-way communication with Mr. R. G. Reid (C 8RG) in St. John's, Newfoundland, with inputs varying between 15 and 20 watts. He informs us, incidentally, that 8RG is now using the prefix "NE" which, in the I.A.R.U. list, is marked "unassigned," instead of the "C" to which transmitters have grown accustomed.



G 5KZ, the amateur transmitting station owned and operated by Mr. R. Mitchell at Woodstock, View Road, Keighley, Yorkshire.

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QSL Forwarding Bureau.

We are asked to state that the Radio Association has established a Forwarding Bureau for QSL cards, which may be addressed c/o BM/DAFL, London, W.C.1. All cards must be sent under cover, with forwarding fee. The forwarding fee, charged to cover expenses, is 1½d. for each card, this being the actual postage on cards for abroad. The fee should be sent in stamps and not attached to the cards.

Cards are forwarded to the Continent of Europe on Tuesday and Friday of each week, and to other parts of the world as mails permit.

Cards received from abroad for British stations are forwarded once a week, no charge being made for this service

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New Call-signs Allotted and Stations Identified.

G 2AY W. H. Morris-Airey, 16, Villiers Road Southsea, Hants.

G 5BV H. N. Ryan, 22, Woodhaves Road, Wimbledon Common, S.W. (Change of address.)

G 6JH J. Hartley, Jnr., 10, Kingsmere Ave., Levenshulme, Manchester. (Change of address.)

G 6WS S. T. G. Weston, 38, Folkestone Road, Copnor, Portsmouth. (Change of address.)

GI 6YW T. P. Allen, 59, Marlborough Park North Belfast. (Change of address.)

NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

BASEBOARD HINT.

When building a new receiver to replace an obsolete one in an existing cabinet it is convenient to be able to make use of the old panel and baseboard.

Many suggestions have been put forward in these pages for treating panels in order to obscure the holes left by previous components, and there is no reason why baseboards should not be treated in the same way. Before screwing down the new components, it is a good plan to cover the surface of the baseboard with a sheet of fairly thick presspahn. This will lie perfectly flat, and, besides having a better surface insulation than wood, will improve the interior appearance of the set. W. A. G.

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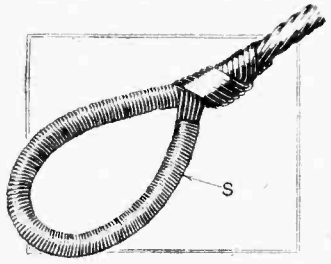
GUY WIRE PROTECTION.

Failure of guy wires generally occurs at the ends where a loop is formed for attachment to the ground anchorage. The usual method of preventing fraying of the stranded wire at this point is to insert a steel rope "thimble" when making the loop, but an equally effective protection is afforded by a short length of closely



Spring covering for guy wire loops.

wound steel spring, as shown in the sketch. Springs of this type are obtainable from dealers in cycle and motor accessories, Bowden wire casing being suitable for small diameters and spring belting for speedometers or cooling fans for wire of large diameter. The spring is cut to the required length, and passed over the end of the wire before making the loop. E. E. L.

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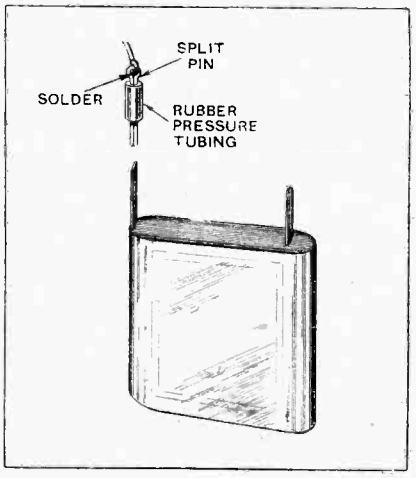
BATTERY CONNECTOR.

The diagram shows a convenient and cheap method of making contact with the brass terminal strips of



An inexpensive battery connector.

flash-lamp batteries, which are frequently used for high-tension and grid batteries. The clip consists of an ordinary split pin, and the connecting wire is soldered to the loop.

To prevent the pin from opening through continued use a rubber sleeve is fitted as shown. This consists of a short length of chemical pressure tubing which is thick-walled and has a small bore. It serves, in addition, as an insulator which will prevent shocks when handling, and also reduce the possibility of a short circuit should the connector accidentally fall on another part of the circuit. M. R. W.

WOOD STAIN AND POLISH.

Dissolve a teaspoonful of permanganate of potash in a teacupful of warm water, and apply with a soft brush to the cabinet, which should be first rubbed down with glass-paper. Permit to dry after applying each coat. Three or four coats will give a mid-brown oak colour, but it is necessary to give six coats to obtain a rich old oak tone.

On completing the staining, rub in a fairly liberal application of brown boot polish. Finally polish vigorously for some minutes, when a pleasing old oak effect will be obtained. J. E.

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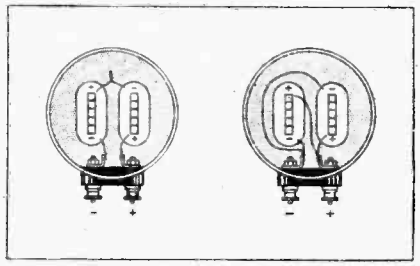
PHONE CONNECTIONS.

For use with modern low-impedance valves the impedance of 4,000-ohm phones is on the high side, and an improvement in power output will be obtained by connecting the windings in parallel, as shown in the right-hand diagram.

This method of connection will halve the current through each coil of the winding, which is an additional advantage, since the anode cur-



Telephone windings (left) in series and (right) in parallel to lower impedance.

rent of a low-impedance valve is generally higher than that of the general-purpose type of valve for which the windings were originally designed. C. G. C.

BROADCASTING SPORTING EVENTS

A Regular Feature of American Programmes Now Gaining Popularity in This Country.

By H. de A. DONISTHORPE.

THE broadcasting of running commentaries of football matches by the new B.B.C. cannot but be considered as having been responsible for considerably increasing the public interest in broadcasting.

Until 1927, owing to certain arrangements made with the Press, the old B.B.C. were unable to give any running description of sporting events, and consequently the public had to be satisfied with such "stunts" as the broadcasting of the sound of the horses' hoofs as they came round Tattenham Corner on Derby Day.

Possibly we have to thank sport for giving us broadcasting at all, as America's first effort was the broadcasting of a great fight, and from this commencement broadcasting has flourished all over the world beyond the dreams of the original promoters of that first event.

On my return from America twelve months ago I was very astonished to find that the broadcasting of sporting events was prohibited in this country, as during my three years on the other side of the Atlantic I had the opportunity of listening to many different kinds of sporting events being broadcast. All these events were most interesting, and I found myself taking a wholesome interest in those sports of which hitherto I knew little or nothing, such as baseball and the American football game.

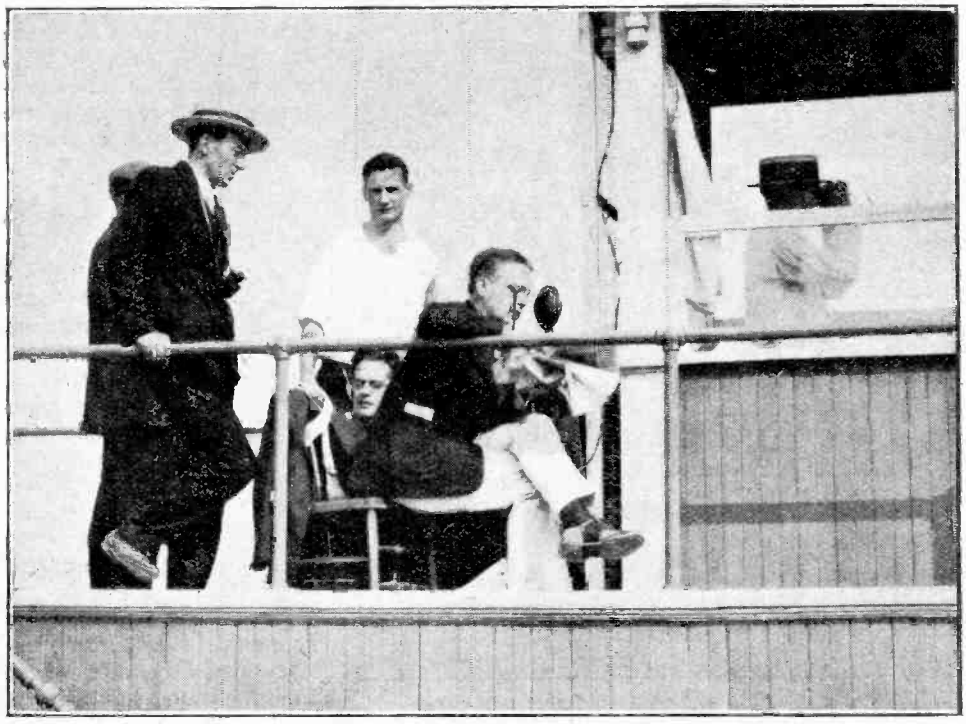


Fig. 1.—Broadcasting Epinard's first American race from the timekeeper's stand. The photograph was taken during the preliminary announcements.

Broadcasting and the Press.

I believe that in the past the newspapers here were afraid that this type of broadcasting would sorely affect their sales and that potential readers, having heard the running commentary of an event "over the air," would no longer purchase a paper to read its descriptive version of that event.

This did not prove to be the case in America; in fact, I believe that sales of newspapers were stimulated by the broadcasting.

There is another section of the community which still

Broadcasting Sporting Events.

views this form of broadcasting with alarm; this embodies the promoters of sporting events, who fear that their gate-money may be adversely affected. There is little fear of this, however, as at most of the bigger events there is rarely sufficient accommodation to meet the needs of all the enthusiasts that attend these affairs; they certainly will not be kept away by a mere broadcast. Broadcasting is, therefore, a help to the less fortunate public who are unable to attend these events personally, as it enables them to obtain at least a "wireless glimpse" of the proceedings, and produces potential enthusiasts of the future.

Fig. 2.—Broadcasting the "Gold Cup" boat races in Long Island Sound, New York, through a relay station located on a motor launch.

Notable American Events.

In my humble opinion the broadcasting of the running commentaries of sporting events in America enhanced the public interest in broadcasting on a scale comparable with that brought about by the broadcasting of the better concerts with well-known artists.

I myself was associated with the broadcasting of the international horse races held in New York, and perhaps my experiences in connection with them may be of interest to my readers.

The first such international race was that between the Derby winner Papyrus and Zev, which ended so disastrously for our candidate. In this instance arrangements were made to broadcast only wireless telegraph signals relating to the race, which were addressed to ships at sea.

Fig. 3.—A contrast in weather conditions! Mr. L. M. Magee broadcasting through 2RN a running commentary on the International Rugby match between Ireland and Scotland on February 26th.

The race was held on a Saturday, October 20th to be exact; Saturdays in New York are the big sailing days, and most of the large liners leave for Europe on that day. It was therefore considered that the instantaneous flashing of news items regarding this race might be of interest to those passengers who had left New York that morning and had therefore been unable to attend that great race and social event.

Telegraphic arrangements were made whereby the messages could be sent direct from the course to a wireless coast station, and the start and finish were flashed out to

Broadcasting Sporting Events.—

the ships as the event took place. The next effort was of a more ambitious character, as it was arranged to broadcast a running commentary of the first Epinard race. This was a much harder task, as the number of horses competing was greater and the race was run at a greater speed owing to the better weather and the consequently faster track.

The site of the microphone in each of the Epinard races was in the timekeeper's stand, an elevated cabin located directly opposite the judge's box, from which the whole course could be plainly seen.

I cannot say that this broadcasting was an easy matter, but the results were much appreciated, and were eagerly sought after by the stay-at-home sportsmen, so that our endeavours were not wasted.

It must be appreciated that an event of this nature requires that the describer shall maintain a calm demeanour, as it is all over in such a short space of time that any hesitancy on the part of the broadcaster will cause the loss of nearly all the details.

During the first Epinard race, which was held on the American holiday—Labour Day—September 1st, 1924, the temperature was 96° in the shade, a climatic condition which did not go to help the broadcasters, especially as the broadcast was carried out from a small cabin which was subjected to the sun's scorching rays.

A glance at the photograph in the title of this article taken from this cabin gives a very fair indication of the heat, and also shows the land-line wires carrying the telephone description to the broadcasting station WJZ, which was located in New York.

The Prince of Wales was present during this race, and watched it from the judge's box, shown in the photograph. It is understood that His Royal Highness expressed considerable interest in the fact that the event was being broadcast. It is well known that he is an ardent wireless listener as well as a sportsman.

The Continent, too, seems to have taken a fancy to this type of broadcasting, as on one Sunday afternoon during a recent wireless tour of Germany I tuned into a station broadcasting a boxing contest, the running commentary of which was coupled with the sounds of the hits and applause, not to mention the "hoching" and clinking of beer mugs.

As has been stated before, we in this country have started with the broadcasting of running commentaries of the Saturday afternoon football matches. These are an excellent start, and we are further promised that all the big sporting events of this year are to be put "over the air."

The employment, however, of two people describing the football events from the microphone in my opinion is not a good feature, as frequently the two broadcasters talk at once when something exciting takes place, with the result that it is lost to the listening public. The "powers that be" here would do well to follow the example of America, and employ only one broadcaster, as this has been found to be the only possible way over there of faithfully broadcasting these events.

It is an interesting fact that well-known and efficient sporting reporters who are able to write illuminating and truly descriptive stories of such events after the event are many of them quite useless for the broadcasting of running commentaries, as they become nonplussed before the microphone. It is, therefore, essential to find people for this work who are familiar both with the sport being broadcast as well as with the microphone.

There is no doubt whatsoever that this form of broadcasting will find considerable space allotted to it in the programmes of the future, and this cannot do any harm to this new art, as much will be learnt about outdoor acoustics, and no doubt new effects will be dealt with which will make such events still more realistic to the stay-at-home sportsman.

It is to be hoped that the public will give every encouragement to this new form of broadcasting, as the present efforts are really worthy of their utmost support and help to associate broadcasting with the great outdoor life.

TRADE NOTES.

Octron Price Reduction.

Messrs. Octron, Limited, of 52, Charlotte St., Birmingham, advise us of the price reduction to 10s. of the series of Octron valves originally priced at 12s. 6d. Despite this reduction the manufacturers give every assurance that the high standard of production will be maintained. All Octron valves are fully guaranteed, the manufacturers undertaking to replace free of charge any faulty valve returned to them within a reasonable time.

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New "Camco" Address.

Owing to the increasing demand for "Camco" cabinets, Messrs. The Carrington Manufacturing Co., Ltd., have acquired larger works at Croydon which will enable them to give more efficient service than hitherto. In future vans will deliver in the London area daily. The new address of the Company is "Camco" Works, Sanderstead Road, South Croydon.

New "Cosmos" Valves.

In distributing the latest illustrated brochure describing "Cosmos" Shortpath valves, Messrs. Metro-Vick Supplies, Ltd., draw attention to a new valve in this popular range known as the S.P.16/R, which is a low-consumption general-purpose dull emitter. Two new rectifying valves are also announced, namely, the S.P.41/U and S.P.42/U.

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Wireless Telephony for the Unskilled.

An interesting wireless telephony set specially designed for use under severe service conditions by unskilled personnel has been produced by Marconi's Wireless Telegraph Co., Ltd., and is described in Leaflet No. 1,061. Known as the Marconi 500-Watt Fixed Wavelength Telephone Set, type XMCI, this instrument has already proved its efficiency under severe conditions, notably in the service of whaling vessels in the Antarctic. Conversations have been maintained between vessels over distances considerably in excess of 1,000 miles.

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Loewe Valves.

We understand that the London agency for the Loewe multiple valves referred to in *The Wireless World* of November 3rd has been secured by Mr. J. Dorn, 4, Gt. Russell St., W.C.1.

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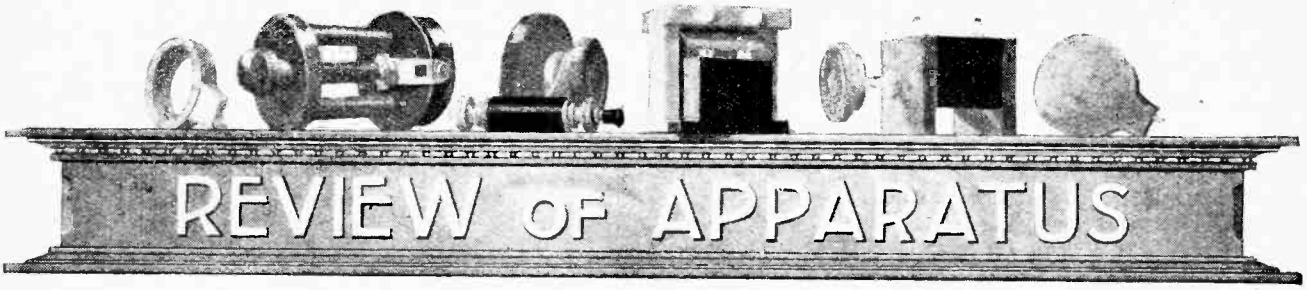
For the Trader.

Houghton's Radio News for February, published by Houghton-Butcher (Great Britain), Ltd., 88-89, High Holborn, W.C.1, contains a number of valuable suggestions of assistance to the retailer, besides useful information on wireless topics of the day. Descriptions of new apparatus together with revised prices are included.

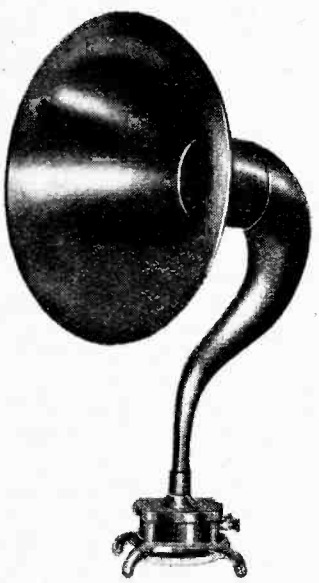


Latest Products of the Manufacturers.

ORPHEAN DE LUXE LOUD-SPEAKER.

Although much has been written recently on the design of loud-speakers in which parchment diaphragms are employed, it must not be concluded that the horn type is becoming obsolete. To suit normal home conditions it is admitted that several of the special forms of construction recommended for hornless loud-speakers are scarcely suitable, requiring very considerable input and expensive amplifiers to be operated so as to give very considerable volume.

New designs in loud-speakers of the horn type are being produced, and a model which has recently made its appearance is the Orphean De Luxe loud-speaker of the London Radio Manufacturing Co., Ltd., Station Road, Merton Abbey, London, S.W.1.



The new Orphean de luxe loud-speaker. The movement is contained in a clean Bakelite moulding. The overall height is 23in.

In general outline it is similar to many other loud-speakers, though it is obvious that the several important details that govern quality in sound reproduction have been considered. The base which houses the movement is a clean moulding resembling Bakelite in appearance, and being non-metallic it has the effect of preventing the transference of vibrations between diaphragm and horn. To avoid resonances it is necessary to prevent vibration occurring of the horn itself. The sound emitted from the horn should not cause it to vibrate, and for this reason mechanical insulation between the diaphragm and horn would seem to be desirable, and is provided in this instance by the use of moulded mounting. By using four small rubber feet, moreover, the tendency to set up vibration on the surface on which the loud-speaker stands with possible transference to the valves of the receiving set is avoided. Adjustment of the diaphragm is provided by a large-diameter milled wheel under the base, its rotation being limited to provide quick adjustment and prevent the pole pieces being forced hard against the diaphragm.

Tested with the small input obtainable from a two-valve set at a distance of five miles from 2LO, ample volume was obtained sufficient to fill an ordinary living-room, showing the loud-speaker to be sensitive. The quality was found to be good with absence of well-defined resonances and the reproduction pleasing in tone. Loud signals can be handled without the setting up of rattling noises or buzzing, and a sensitive and critical adjustment is easily obtained.

The loud-speaker is of good appearance and its weight carefully distributed so that with the aid of the four extension feet it stands firmly and is not readily overbalanced.

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RESIN CORED SOLDER.

The use of resin cored solder has been frequently advocated in constructional articles in the pages of this journal, though readers often experience difficulty in obtaining supplies. Much of the resin cored solder which is available is of poor quality, being of unsuitable gauge, the solder itself too hard and the flux not entirely non-corrosive.

W. H. Agar, 19, Whitecross Place, Wilson Street, London, E.C.2, are now supplying a small carton containing approximately a yard of resin cored solder of reliable grade. The particular merit of using cored solder is that flux is entirely safe as regards any chance of poor insulation being produced. Only the requisite quantity is applied to the joint, which remains bright and clean, and there is no need to subsequently wash the joint to remove surplus flux. The application of flux in the form of cored solder is both convenient and clean, and is the safest method that can be adopted.

The specimen of solder submitted contained a liberal content of tin, and was found to be particularly suited for making joints in wiring.

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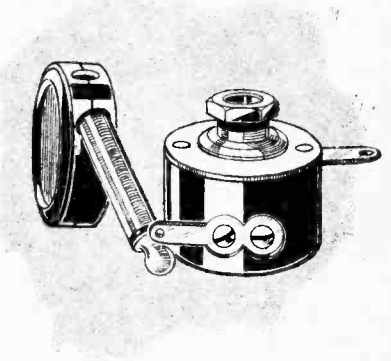
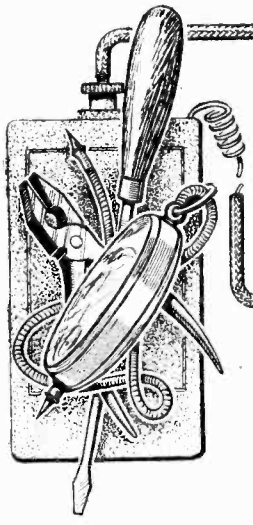
A NEW PLUG AND SOCKET.

Some useful modifications in plug and socket design are to be found in the new Tapa connector, a product of W. J. Charlesworth, 88-89, Aston Street, Birmingham.

Instead of the usual cylindrical insulating handle customarily fitted to plug connectors a circular insulator is provided which is particularly convenient for gripping between the thumb and finger when the plug is withdrawn. The socket is particularly compact, occupying a space behind the panel of about 1in. in diameter by $\frac{5}{8}$in. depth. It is, of course, only a connector and not a break jack, but the small space occupied will recommend it for set construction owing to the difficulty which usually arises in accommodating a jack behind the instrument panel. The contact is perfectly reliable, and the one-hole-fixing bush is so arranged that the adjustment of the contact is independent of the thickness of the panel.



A new form of plug-and-socket connector. It occupies much less space behind the panel than the usual form of jack.



PRACTICAL HINTS AND TIPS

A Section Mainly for the New Reader.

THE LOCAL STATION OR DAVENTRY.

Due to the central situation of the high-power station, a very considerable proportion of listeners are able to receive its signals, in addition to those from the local one, with comparatively simple and insensitive receivers. There is, however, some little difficulty in arranging for a really simple change-over from one wave-band to the other—simple enough to be operated by the entirely uninitiated members of the household. Even such a simple operation as the changing of the coils will present difficulties in certain cases, and a switching device is certainly preferable from the point of view of convenience.

The plan of using separate aerial and reaction coils, together with a separate tuning condenser for each band of wavelengths, is to be recommended, but is rather expensive, and a receiver built on these lines is inclined to be bulky; where signals from both short- and long-wave stations are easily received, the simplified circuit shown in Fig. 1 will be found useful. Three coils are mounted in the usual "three-way" holder. The (fixed) centre one is the reaction coil, while those carried in the movable sockets are the aerial tuning inductances; that required for the wavelength to be received is thrown into circuit by the operation of a switch. Readjustment of the variable condenser, which is connected across whichever coil happens to be in circuit, will as a rule be required when changing over.

It is hardly possible to choose a reaction coil which is really suitable for use on both long and short waves; in this matter a compromise must be effected, depending on local conditions. Where signals from the high-power station are receivable at great strength, no reaction will be required, so a coil may be selected in view of requirements for short-wave reception.

This simple method of changing-over is obviously adaptable to sets using one or two stages of either transformer- or resistance-coupled low-frequency amplification, as well as to the simple arrangement shown in the diagram. When interference from the local station is experienced, the selectivity of the receiver may be improved by inserting a fixed condenser of about 0.0002 mfd. in series with the aerial.

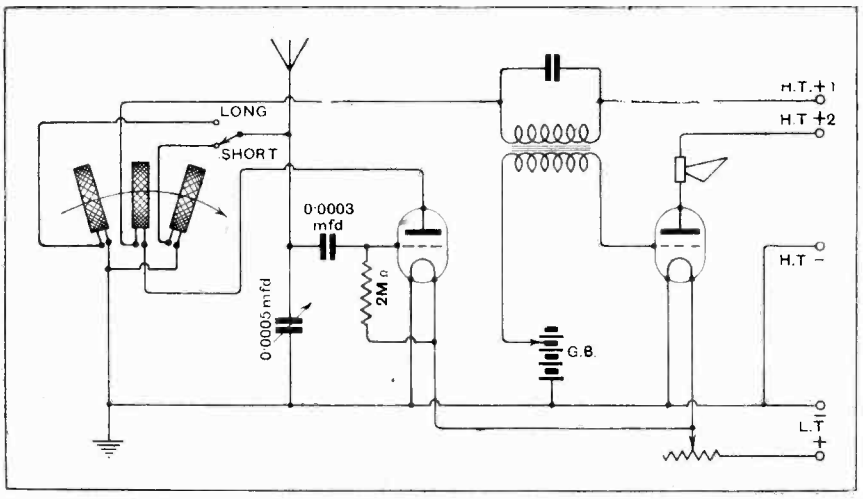


Fig. 1.—A simple receiver for covering two separate wavebands.

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L.F. OSCILLATION.

Reproduction of poor quality is not infrequently attributable to incipient oscillation in the low-frequency amplifier. This trouble is, as often as not, due to the presence of a comparatively high internal resistance in the H.T. battery. A resistance in this part of the circuit will be common to all the valves, and thus acts as a coupling between them. It is quite possible that the usual condensers of one or two mfds. which are commonly connected across the sections of the battery may not be sufficiently large to prevent this form of back-coupling. It should be realised that capacities of the order mentioned offer a by-no-means inconsiderable reactance to alternating currents corresponding to the lower audible frequencies, so it may be necessary to shunt larger condensers—up to 5 mfds.—across them.

It is a fairly easy matter to decide if the observed distortion is caused by low-frequency reaction due to battery resistance. If this trouble is suspected a variable resistance with a maximum value of some two to four hundred ohms (a potentiometer winding will serve) should be inserted in the positive high-tension lead (or

leads) feeding the anodes of the L.F. valves. Resistance should gradually be put in circuit, when it may be noticed that the particular form of distortion previously noticed becomes worse, until finally an L.F. howl is produced. If, on the other hand, the addition of quite a large resistance does not make any noticeable difference, and does not produce actual oscillation, the trouble must be looked for elsewhere.

A PUZZLING FAULT.

It will sometimes be observed, when switching on a second stage of low-frequency amplification, that signals, instead of increasing in strength very considerably, are only slightly louder or, at worst, are not magnified at all. At the same time, a distinct falling-off in quality may be evident. If the usual tests of the components associated with the extra amplifying valve show that everything is apparently in order, it may be assumed with some confidence that the high-tension battery is at fault.

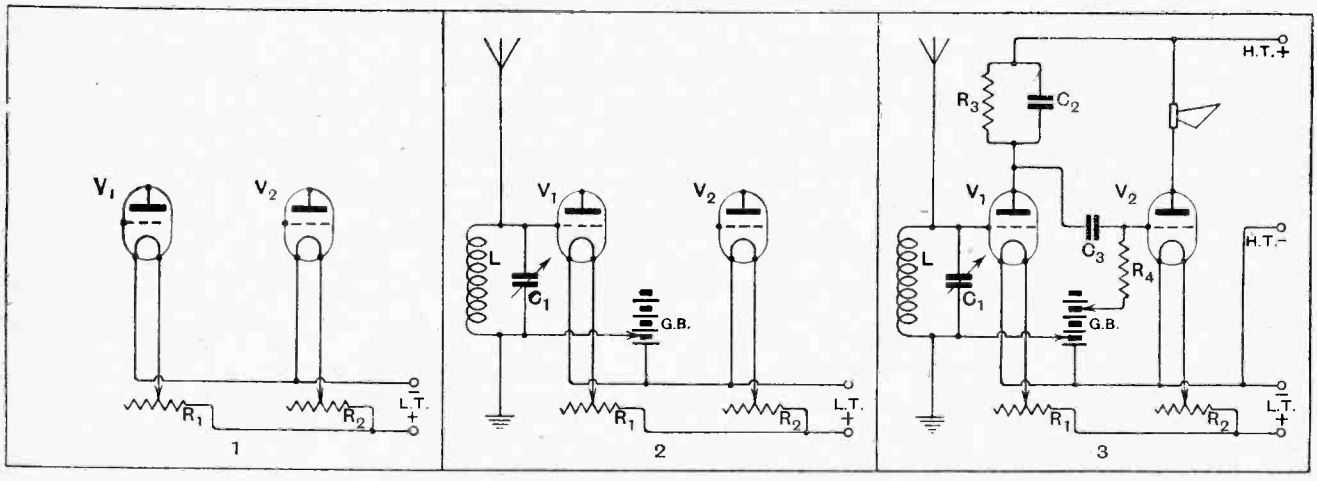
An accumulator or dry battery may yield fairly satisfactory results on the comparatively small current taken by one or two valves, in spite of the fact that it is nearly exhausted. When the extra load of another valve is thrown on it, however, there may be a very appreciable drop in voltage.

DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 62.—A 2-valve Resistance-coupled Receiver for Short Ranges.

The present series of diagrams is intended to show in an easily understandable manner the various points to which special attention should be paid in designing various typical wireless receivers. It is hoped that they will also be of assistance to those readers who have not yet mastered the art—really a very simple one—of reading circuit diagrams. The set illustrated below is suitable for high-quality loud-speaker reproduction of a medium-powered station at distances up to some ten miles, according to local conditions.



The filaments of the two valves, which are controlled by separate rheostats, are connected in parallel across the L.T. battery. V_1 functions as a "bottom bend" detector, while V_2 is the L.F. amplifier.

Aerial and earth are connected across a coil shunted by a variable condenser. This tuned circuit is joined to grid and filament of the detector valve, a negative bias battery being interposed for rectification.

A resistance, shunted by a condenser, is inserted in the plate circuit of the detector valve, which is coupled to the L.F. amplifier through a condenser fitted with a leak. The anode circuit of the L.F. valve is completed through the loud-speaker and H.T. battery.

THE resistance values of the filament rheostats R_1 and R_2 will depend on the characteristics of the valves and the voltage of the L.T. battery, and must be chosen in accordance with the rule given in this section of *The Wireless World* for February 23rd, 1927. The first valve (V_1) must have a very high amplification factor, of 35 or over, if loud-speaker results are to be obtained at the ranges mentioned above. V_2 is a power valve, and must be capable of handling input voltages sufficiently great to give the desired volume.

In Fig. 2 the aerial inductance L may be an ordinary plug-in coil, No. 35 to 50 for short-wave broadcasting, and about No. 150 for the high-power station. The aerial-earth system should be moderately effective, or the range will be considerably reduced, as this set does not make use of H.F. amplification or reaction. The majority of detector valves suitable for this receiver will require a negative grid bias of about $1\frac{1}{2}$ volts (a single dry cell).

Referring to Fig. 3, the anode resistance R_3 should have a resistance several times greater than that of the valve under working conditions. A value of from 0.5 to 1 megohm is recommended; a so-called "metallised" grid-leak is generally suitable for this purpose. The shunting condenser C_2 improves the efficiency of the detector and also tends to reduce in strength the higher audible frequencies, as is often desirable. Its value should generally not be greater than 0.0001 mfd. The grid leak R_3 should be chosen next, and must be several times larger than the anode resistance. From 3 to 5 megohms is suggested, with a coupling condenser (C_3) of from 0.001 to 0.005 mfd.

CURRENT TOPICS

News of the Week —in Brief Review

A TRANSATLANTIC CONSULTATION.

A Paris physician travelled to London last week to consult a New York patient *via* the Post Office Transatlantic Telephone Service. The conversation cost about £36.

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NEW USE FOR PHOTO-TELEGRAPHY.

The Chinese Post Office is reported to be interested in the possibilities of photo-telegraphy in the transmission of Chinese characters which cannot be sent by Morse code.

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WHAT ARE THEY?

A North London reader has asked us for details concerning a circuit embodying two megborns.

It is believed that these accessories somewhat resemble megaphonic megohms.

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BEAM TELEPHONY TO CANADA.

Great success has attended wireless telephone tests on the Marconi short-wave beam system between this country and Canada. A feature of the tests has been the absence of atmospheric disturbance.

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POLICE AND PHOTO-TELEGRAPHY.

The Wireless World learns that the Baker-Fulton system of wireless photo transmission, as described in the issue of March 24th, 1926, has been demonstrated before the Chief of the Vienna Criminal Investigation Department. It is understood that the Vienna police contemplate the possibility of adapting the system for use in tracking law breakers.

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WHERE THE ETHER IS FREE.

A reminder of the sweet freedom enjoyed by transmitters in certain lands beyond the sea comes with the news that a motor company in South America has installed a wireless telephony system for communication between its various branches. The firm in question is the General Motors Export Company of New York, and the new telephony system has been adopted by its South American branches. Short-wave stations have been installed in Valparaiso, Buenos Aires, Montevideo, and Sao Paulo, and similar equipment is being installed at two points in Northern Brazil.

One trembles to think what attitude would be taken up by the Postmaster-General if enterprise of the same sort were to break out in this country!

LICENCE JUMP IN CZECHO-SLOVAKIA.

On December 31st last the Prague Post Office had issued 175,000 licences to listeners in Czecho-Slovakia. In December, 1925, the number was only 17,000.

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ANOTHER TRANSATLANTIC TELEPHONY SERVICE?

Regular wireless telephonic communication between Spain and the Argentine within six months is the prospect held out by negotiations now in progress.

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LIGHTHOUSE WIRELESS.

The *Daily News* Wireless for Lighthouses and Lightships Fund, which closed several weeks ago, has been augmented by a number of late subscriptions, reaching the total of £2,540 16s.

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BROADCAST ADVERTISEMENTS IN MALAYA.

In accordance with the recommendations of the Malayan Wireless Committee, approved by the Government, an exclusive broadcasting licence is to be issued to one company for a period of five years. The company will have the right to broadcast advertising matter to the amount of 10 per cent. of the total daily broadcast time.

OUR YOUNGEST READER?

In a letter to the Information Department a reader states that he is not yet eighteen and has been taking *The Wireless World* since it started. This means he was thumbing our pages at the age of five. Can anyone beat it?

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U.S. RADIO EXPORTS DROP.

Foreign competition is said to be responsible for the pronounced drop in U.S. radio exports in 1926 as compared with the previous year. The value of the 1926 exports totalled $8,793,000, as against $9,904,000 in 1925.

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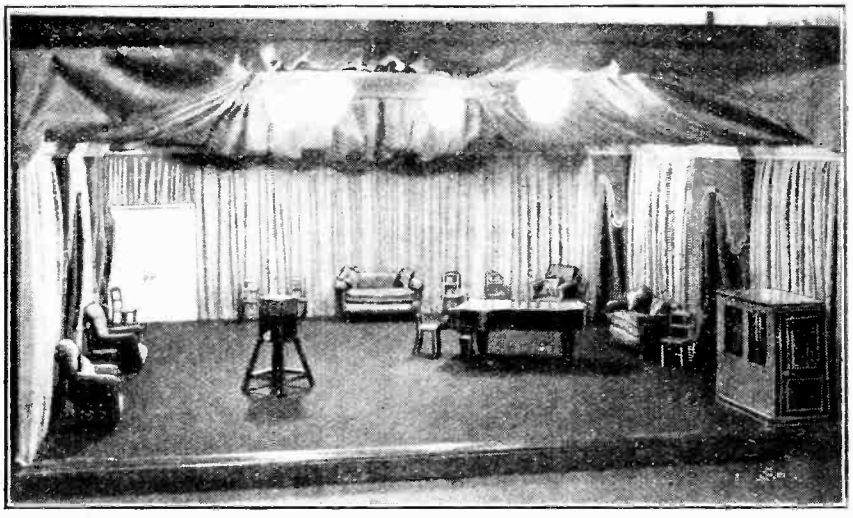
ALEXANDERSON ON TELEVISION.

On the question of whether we may expect television in the very near future, Dr. E. F. W. Alexanderson, the famous American engineer, is not so sanguine as other workers in the same field. "Our work has already proved that the expectation of television is not unreasonable," he declares, "and it may be accomplished with means that are in our possession at the present day. How long it will take us to attain practical television I do not venture to say. It is easy enough to design a television system with something like



2 LO IN MINIATURE. A model of one of the large studios at Savoy Hill now on view in the "Listeners' Hall" at the "Daily Mail" Ideal Home Exhibition. Note the control box in the right foreground.

40,000 picture units a second, but the images so obtained are so crude that they have no practical value; an operating speed of 300,000 picture units per second will be needed to give pleasing results."

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PROGRESS WITH THE BEAM.

During recent tests of the Marconi beam wireless telegraphy system between this country and Australia, transmission was maintained from Australia without a break for twenty-four hours. Two-way communication was carried on for several hours

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CINEMATOGRAPH AND WIRELESS.

A successful demonstration—the first of its kind—has been given in Berlin of the synchronisation of wireless with the cinematograph (says the *Morning Post*).

Two medical films which were shown in the auditorium of a medical school were explained as they were shown by a doctor speaking from the headquarters of the Telefunkengesellschaft. Perfect synchronisation was maintained all through between the loud-speakers and the pictures on the screen.

The transmission was conducted from the Königswusterhausen broadcasting station on 1,250 metres.

STRANGE INTERFERENCE.

A Northampton reader is experiencing a form of interference on the lower band of wavelengths which may have been noticed by residents in the same district. The disturbance, which closely resembles spark transmission, is heard most loudly on about 500 metres, and consists of half-second dashes spaced by alternate intervals of one and two seconds. Have other readers noticed this unusual transmission?

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BROADCAST CHANGES IN ITALY.

A Commission for the control of the Italian broadcasting services has been set up in Rome by Royal Decree, according to information received by the Department of Overseas Trade. The Commission will examine and report on all aspects of broadcasting, both technical and artistic. It will be interesting to see whether Signor Mussolini intends to take a personal interest in the broadcasting administration.

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DE FOREST OSCILLATION PATENT UPHELD.

The U.S. District Court of Delaware has awarded priority of invention for obtaining sustained oscillations, in connection with a three-electrode vacuum tube, to Lee De Forest, says a message from our Washington correspondent. The case involved alleged interferences between the Alexander Meissner, Lee De Forest, Langmuir and Armstrong patents and their assignees. It was taken up by the United States Government and Meissner against the De Forest Radio Telephone and Telegraph Co. and others in a suit of equity, following an award of priority to De Forest in 1924 by the District of Columbia Court of Appeals. The date of the De Forest patent as awarded by the Patent Office was August, 1912, whereas the Langmuir, Meissner and Armstrong patents were as of 1913.

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ALTERNATIVE BROADCAST PROGRAMMES.

In the House of Commons last week Lieut.-Comdr. Kenworthy asked the Postmaster-General whether the British Broadcasting Corporation had decided on its policy with regard to the building of high-power stations in order to provide alternative programmes all over the country. Sir W. Mitchell-Thomson replied that the present position was that the British Broadcasting Corporation were arranging to carry out certain experiments, and when those were concluded they might be in a position to submit proposals.

RADIO-TELEPHONY EXPERIMENT AT CROYDON.

AN experiment is at present being tried out at the London Terminal Aerodrome, Croydon, by which the Air Superintendent of Imperial Airways is enabled to listen to the radio-telephone conversations taking place between the Croydon wireless station and aircraft operating on the air routes.

Hitherto information of the arrivals and departures of aircraft, and of their progress along the routes, has been obtained by the Air Superintendent, as a matter of common routine, from the Control Tower at Croydon, where all messages to and from aircraft and other air ports are dealt with. Though this service was a reliable one and gave the operating companies the information they required concerning their particular machines, it was thought that quicker notice would be received of incidents, and routine reports would take less time to reach the company, if a loud-speaker were connected by a direct line to the Croydon receiver and transmitter circuits, so that everything received by that station and transmitted by it would be heard in the office where the loud-speaker was situated. As the Air Superintendent was the official most concerned, the loud-speaker was duly installed in his office.

This arrangement means, of course, that either he or someone representing him must always be in the office to note what is said, an arrangement which is obviously not so good as a written message in black and white which can be filed for reference and produced as evidence subsequently in case of dispute. The photograph shows the Air Superintendent (Major C. Brackley, D.S.O.), of Imperial Airways, at his desk with the loud-speaker behind him—and rather uncomfortably close!

If this experiment is unsuccessful, as there is rather a probability that it will be, compared to the normal method, it will be removed in due course. In the meanwhile it is an interesting test and may show the way to a more suitable means of rapidly disseminating advice and reports of aircraft movements to the various offices concerned.

AN INNOVATION AT CROYDON. Major G. Brackley, D.S.O., of Imperial Airways, with the loud-speaker which has been installed in his office to enable him to follow the movements of aircraft *en route*.

Broadcast Receivers

General Radio

Two-valve Set

A Complete Loud-speaker Receiving Installation for £12.

THE purchaser of the G.R.C.15 receiver does not have to enter into technicalities regarding the choice of valves, batteries, and other accessories, as is often the case with other receivers, for a *complete* set of accessories is sent out with each set. However interesting it may be to the wireless enthusiast to weigh the pros and cons of two- and six-volt valves, of H.T. and grid-bias valves, there must always be a very large section of the public for whom these things have no appeal, and who merely wish to have "the wireless" installed in their homes with the least possible expense and trouble.

Accessories and Equipment.

The General Radio Co., Ltd., have been quick to appreciate the commercial possibilities of a complete receiving equipment at a reasonable figure that can be installed by the handyman of average ability. Assuming that conditions are favourable for the erection of a suitable aerial, there is no reason why broadcasting should not be received within a few hours of taking delivery of this set. The instructions for erection and operation are both lucid and complete, and every possible requirement has been anticipated. In addition to the usual valves, batteries and loud-speaker, there are a pair of headphones complete with jack for tuning purposes and long-distance work, and a complete aerial and earth equipment, which includes wire and insulators, screws for fixing the aerial and earth terminal boards, and insulated staples for laying the earth wire.

The price of the complete outfit is £12, an extremely reasonable figure made possible, no doubt, by simplified construction in the receiver itself. The photograph of the interior of the receiver clearly shows the simplicity of the layout. The front panel and baseboard is cut in one piece from sheet metal, bent at right angles, and hinged in the cabinet to facilitate the removal of valves and adjustment of the aerial coil tapping. The metal panel and baseboard is at earth potential, and serves as the connection between — L.T. and earth. It therefore acts as an effective capacity screen, which will be at once appreciated when making fine adjustments of the reaction and vernier tuning controls. A further consequence of this method of construction is the simplification of the cabinet, as there is no necessity for a hinged top or back.

Features of the Circuit.

The first valve of the receiver is employed as a detector with reaction, the second valve being a low-frequency amplifier with transformer coupling to the first valve. The aerial tuning coil consists of a single layer of enamelled wire on a cylindrical Paxolin former. This coil is tapped at three points, leads being brought out to three sockets at the edge of the former marked "Short Waves," "Medium Waves," and "Long Waves." A flexible lead with wander plug inserted into the appropriate socket gives the wavelength band required, the total range of wavelengths covered by the receiver being 250 to 2,400 metres on an average aerial. This range is covered with the assistance of a fixed series aerial condenser provided with two terminals "A" and "C" for the aerial, so that it may be excluded from the circuit when required. In passing, it might be mentioned that the aerial and earth leads enter through two holes in the left-hand side of the cabinet, and cross over the tuning coil when the panel is pulled forward, and care must be taken that the aerial lead does not foul any part of the interior of the set after changing from the "C" to the "A" terminal, or *vice versa*. The aerial tuning condenser is of the well-known General Radio type, which is completely enclosed in the dial itself. The full range of the condenser is obtained by two revolutions of the dial, which is rather stiff in action by comparison with other types. This, however, is not a serious dis-

Broadcast Receivers—

advantage as one soon becomes accustomed to the "feel" of the movement.

The reaction coil is wound on a cylindrical Paxolin former of small diameter, and is mounted on a spindle to rotate inside the aerial coil. The coil is attached with its axis at an angle of 45° to the spindle. As will be seen in the photograph of the interior of the set, the aerial coil is also set at 45° to the axis of the spindle. By these means a 90° variation of coupling is obtained by rotating the reaction control through 180°. It will be at once apparent that this is equivalent to fitting a slow-motion dial with a 2 : 1 ratio. The reaction control knob is on the left-hand side of the front panel, and is matched on the right-hand side by a vernier condenser control for fine tuning.

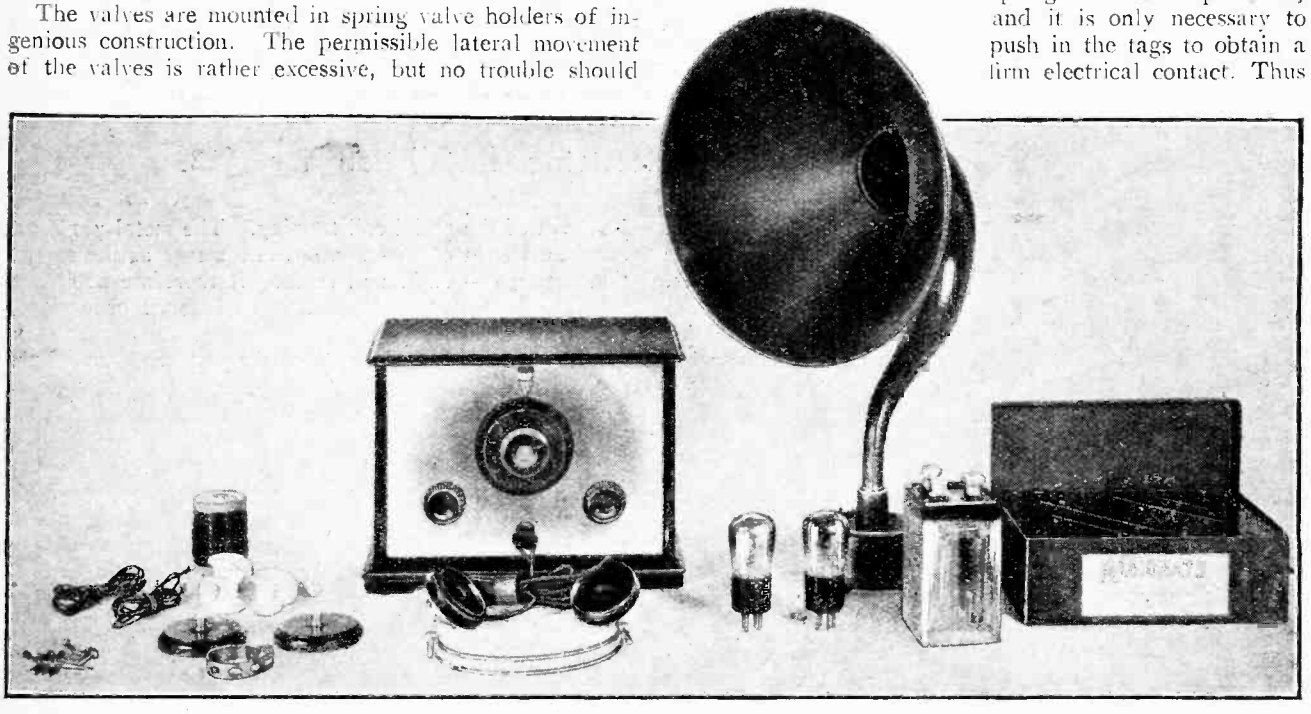
Valves and Batteries.

The valves are mounted in spring valve holders of ingenious construction. The permissible lateral movement of the valves is rather excessive, but no trouble should be encountered on this score under normal conditions. No attempt should be made, however, to transport the set from place to place with the valves *in situ*. Both valves are of the L.F. type (Six Sixty, S.S.2A, L.F.) each taking 0.1 amp. at 2 volts.

Battery connections are made through a multi-cored cable, a feature which has many advantages over the more usual terminal board. Two of the leads are fitted with spade connectors for the terminals of the L.T. accumulator, which is of the D.T.G. type (20 amp.-hour). The remaining four leads are provided with wander plugs for attachment to the 100-volt dry cell battery, which not only provides anode current for the valves, but also grid bias for the L.F. amplifier. For this purpose the negative end of the battery is provided with 1½-volt tappings. The negative grid bias lead is inserted permanently in the negative terminal, and the lead usually regarded as — H.T. is inserted at a point higher up the battery, depending on the grid bias required for the last valve. The two remaining plugs are inserted at about + 50 and + 100 volts for the detector and L.F. valves respectively.

Output Plug and Jack.

The telephone and loud-speaker connections are made through the medium of a plug and jack situated on the front panel below the tuning condenser. A separate pair of contacts is incorporated in this jack for switching on the filament current to the valves when the loud-speaker plug is inserted. The construction of the plugs calls for special comment, as it is a very simple matter to connect or disconnect the loud-speaker leads. Instead of the usual interior terminals with set screws for clamping the tag connections at the end of the loud-speaker leads, two spring contacts are provided, and it is only necessary to push in the tags to obtain a firm electrical contact. Thus the single jack provided serves both for the 'phones and loud-speaker both of which are provided with leads terminating in tag connectors.



The equipment of the G.R.C.15 receiver is unusually complete and includes all necessary accessories.

Performance.

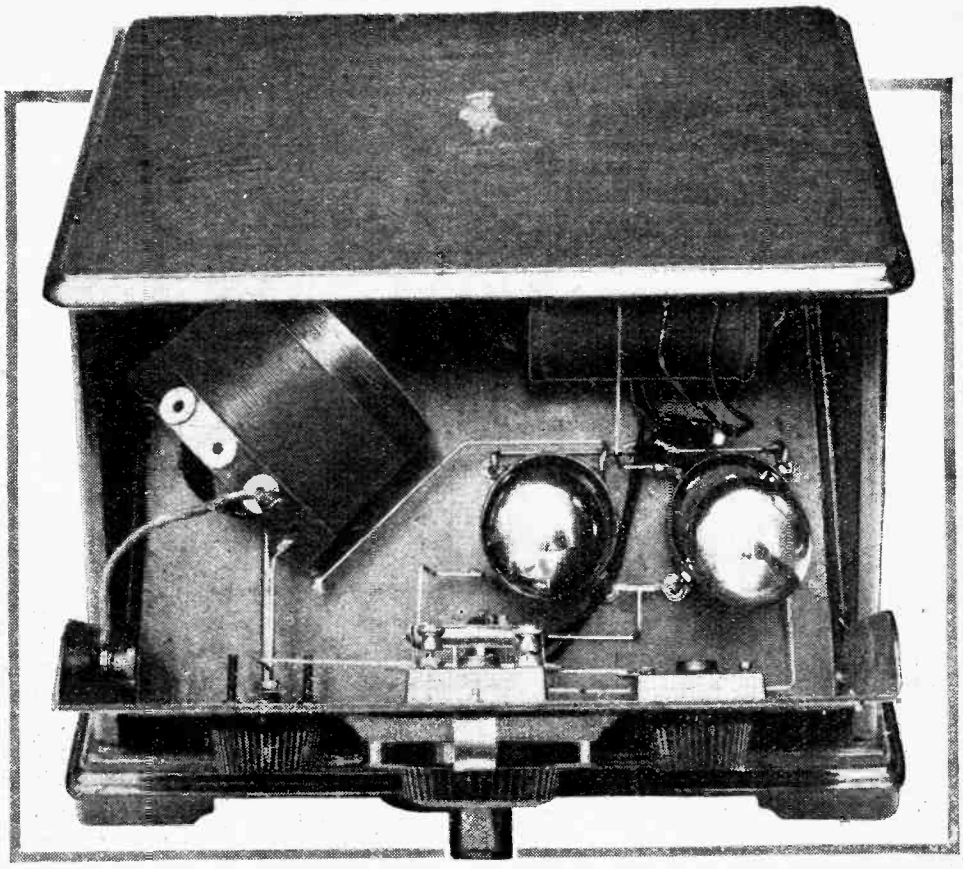
Tested at a distance of approximately four miles from 2LO and sixty-five miles from Daventry, ample loud-speaker volume was obtained from both stations, and on the former station the reaction control had to be reduced to zero and the set slightly detuned to prevent overloading the last valve. Several Continental stations were also received on the 300- to 500-metre wave-band with the aid of critical reaction, but the somewhat uneven distribution of capacity over the condenser scale increases tuning difficulties when searching for distant stations.

The loud-speaker volume is excellent for two valves,

Broadcast Receivers—

but the quality was characterised in the particular specimen under test by a peculiar metallic ring which could not be eliminated by any adjustment of the diaphragm or of the controls in the receiver. However, it is difficult to be hypercritical in view of the extremely reasonable price of the whole outfit, and the performance of the set as a whole is sure to give satisfaction in the market for which it is intended.

A three-valve set known as the G.R.C. Type 17, incorporating a further stage of L.F. amplification, is available for use at considerable distances from the nearest broadcast station or where greater volume is required. The price of this set complete with equipment is £15, and both this and the two-valve set may be purchased on the instalment plan. The address of the manufacturers is General Radio Co., Ltd., Radio House, 235, Regent St., London, W.1.



An interior view of the receiver with the hinged front panel pulled forward. Simplicity and sturdiness are outstanding features of the design.

A Striking Collection.

Friday, February 18th, was "Experimental Night" for the Bristol and District Radio Society. There was a large attendance of members and visitors in the Physics Lecture Theatre at Bristol University and also a large array of receivers built by members, including two super-hets, an "Everyman's Four," a three-valve "Hartley," a two-valve short wave, and a crystal-valve receiver, together with several wavemeters, a "One-meter" and a quartz crystal.

The chairman made the interesting announcement that the society would hold a special meeting with a display of wireless films at the Central Hall, Old Market Street, Bristol, on March 16th, the proceeds to be divided between the Lord Mayor's Wireless for Hospitals Fund and the Sets for the Sick Fund. It is hoped that every member and at least two thousand of the radio public of Bristol will be able to attend.

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

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Across Europe with a Wireless Car.

A most interesting lecture, entitled "My Experiences in Europe with a Wireless Set, a Dictaphone and a Motor Car," was given by Capt. C. Plugge, B.Sc., at the last meeting of the Golders Green and Hendon Radio Society.

NEWS FROM THE CLUBS.

The lecture was preceded by an inspection of the lecturer's car, which was equipped with a complete wireless installation and an artistically concealed loud-speaker. On test it was found that no interference was caused by the car's electrical equipment, although there was a considerable amount of fading when the car was travelling.

Describing his journey across Europe, Capt. Plugge referred to the great advance made by Germany in the direction of wireless, and he sounded a warning that this country would have to look to its laurels. The lecturer was especially interesting in his account of his trip nearly to the boundaries of Turkey and the return journey through Italy and France. The lecture was admirably illustrated with lantern slides.

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

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Testing Well-known Sets.

At the last meeting of the Sheffield and District Wireless Society a description and demonstration of two well-known and widely advertised receiving sets were given by Mr. G. Bagshaw, the designer, who is also responsible for their manufacture.

The first set was a straightforward two-valve (Det and L.F.) which gave remarkably good quality and sufficient volume to work a medium-sized loud-speaker on the local relay station.

The second set was a four-valve (2 H.F. Det and 1 L.F.) with neutralised tuned anode coupling for the H.F. valves and transformer coupling for the L.F., the design being adapted from a circuit given in *The Wireless World* by Mr. W. James.

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

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Experiences with D.C. Supply

"Your Juice from the D.C. Mains" was the attractive title of a lecture given by the hon. secretary, Mr. E. C. Wilson, at the meeting of the Southport and District Radio Society on February 21st. Mr. Wilson carefully explained the method he employs for reducing the voltage of the mains by means of lamps of suitable wattage in conjunction with a potentiometer and suitable smoothing circuits. The speaker pointed out that while the reduction in voltage was easily

accomplished, the removal of commutator ripple and mechanical noises required some patience and ingenuity. D.C. mains eliminators, Mr. Wilson pointed out, could be rather erratic in operation, and he cited a case where two eliminators of identical design were in use in houses eight doors apart giving widely different results, one having practically no ripple and the other giving more ripple than music!

Hon. secretary: Mr. E. C. Wilson, "Lingmell," Kirklees Road, Birkdale, Lancs.

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Demonstration of Wireless Control.

Under the auspices of the Croydon Wireless and Physical Society Major Raymond Phillips will give a lecture and demonstration this evening (Wednesday) entitled "Wireless Control and its Future." The meeting will be held at 8 o'clock (doors open 7.30) in the North End Hall, Croydon, and the chair will be taken by the Mayor of Croydon. Reserved seats are 5s. and 2s. 6d. (plus tax); unreserved seats are 1s. (plus tax); and balcony 6d. Tickets can be obtained from the hon. secretary, Mr. H. T. P. Gee, 51-52, Chancery Lane, W.C.2, or from Kinnairds, North End, Croydon, and other agencies.

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Evening with a Short-wave Set.

A profitable evening was spent on Monday, February 21st, by members of the Croydon Wireless and Physical Society when experiments were conducted with a two-valve short-wave receiver brought by a member. Morse signals from America and other short-wave stations were tuned in, and an opportunity was thus afforded to beginners of testing their knowledge gained at the fortnightly Morse instruction class. This practical experience proved very welcome, and beginners learnt much regarding the international call-signs and abbreviations used by the various transmitters.

The society's syllabus will be sent on application to the hon. secretary, Mr. H. T. P. Gee, 51-52, Chancery Lane, W.C.2. Visitors are cordially welcomed at any of the meetings, which are held every Monday at 8 p.m. at 128A, George Street, Croydon.

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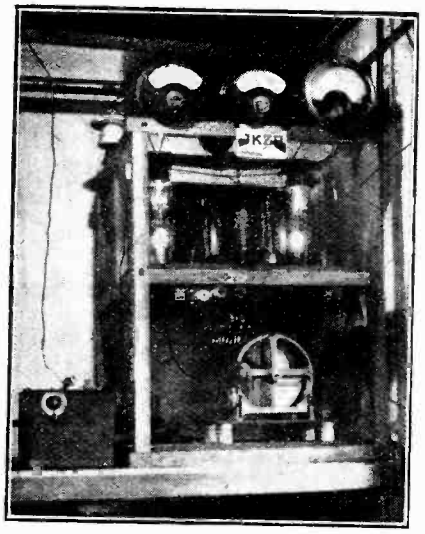
The Story of Short-wave Work.

The growing number of members of the Bristol and District Radio Society who are attracted by the subject of short-wave wireless were given much valuable information on Friday, February 25th, when Mr. W. A. Andrews, B.Sc., gave an address of absorbing interest. Mr. Andrews provided a historical *résumé* of short-wave communication, pointing out that the earliest wireless work was done on very sort wavelengths. He told how amateur stations, first allotted a wave length of 1,000 metres, were forced to reduce their wavelengths as the needs of other services increased, and how amateurs had made the most of their opportunities on the lower wave bands.

He considered, however, that amateur



An active amateur station in Japan. The transmitter of J KZB owned by the Tokyo Electric Co., Ltd., Kawasaki, near Yokohama and operated by Mr. Y. Imaoka

transmitters, although they had made great strides in technique, had not made any great discoveries in the fundamental principles of radio. The speaker gave some useful hints towards obtaining efficiency on the short wave lengths, providing detailed particulars of a number of satisfactory circuits, and emphasising the need for care in the choice and placing of coils and variable condensers.

Mr. L. E. Rogers won the society's weekly ballot, the prize being a set of short wave coils kindly presented by Messrs. Igranic Electric Co., Ltd.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 9th.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. Sale and Exchange Evening.

Croydon Wireless and Physical Society.—At 8 p.m. At North End Hall, Croydon. Lecture and Demonstration: "Wireless Control and its Future."

Tottenham Wireless Society.—At 8 p.m. At the Institute, 10, Bruce Grove, Tottenham. Lantern Lecture: "Reminiscences of the Society's Activities," by Mr. F. E. R. Neale.

Edinburgh and District Radio Society.—(In the R.S.S.A. Hall.) Exhibition of Apparatus.

THURSDAY, MARCH 10th.

Stretford and District Radio Society.—At the Café Imperial, Stretford. A Talk on Valves, followed by a demonstration of the "Straight Eight" by the Marconiphone Co., Ltd.

FRIDAY, MARCH 11th.

Leeds Radio Society.—At 8 p.m. At Callinson's Café, Wellington Street. Lecture: "Loud-speakers and 'Phones," by Mr. E. M. Washington.

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

MONDAY, MARCH 14th.

Southport and District Radio Society.—At 8 p.m. At 20, Scarisbrick Street. Lecture: "Simple Superheterodyne Receivers," by Mr. M. V. Cartmel.

Northampton and District Amateur Radio Society.—At 8 p.m. At the Cosmo Café, The Drapery. Lecture: "Loud-speakers," by Mr. H. B. Cure.

Croydon Wireless and Physical Society.—At 8 p.m. At 128a, George Street, Croydon. Lecture: "Modulation," by Mr. J. H. A. Whitehouse, of the B.B.C.

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The K.L.1. Valve.

A sample of the new K.L.1 valve was shown by Mr. Harwood, of the Marconiphone Co., Ltd., at the February meeting of the Kensington Radio Society. Mr. Harwood explained the unique design of the new valve and expounded its working principles.

An interesting talk was given on the Marconiphone "Straight-8" receiver, and the lecturer tuned in a number of stations with a volume and quality which left nothing to be desired.

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

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A New Loud-speaker.

Mr. Darvel, a member of the Ilford and District Radio Society, demonstrated a new loud-speaker at the meeting on Wednesday, February 23rd. The flare of the horn was 14in. in diameter, and Mr. Darvel explained that the curve had been worked out logarithmically; the instrument had been practically tested to obtain the best results. Working on two different sets the loud-speaker delivered good volume and quality, and showed reasonable sensitivity. Another member, Mr. Haddock, demonstrated a calibrated buzzer wave-meter and showed the ease with which fine tuning can be accomplished by means of such an instrument.

Acting secretary, Mr. H. H. Carr, 39, Lynford Gardens, Goodmayes, Essex.

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Experiments in Selectivity.

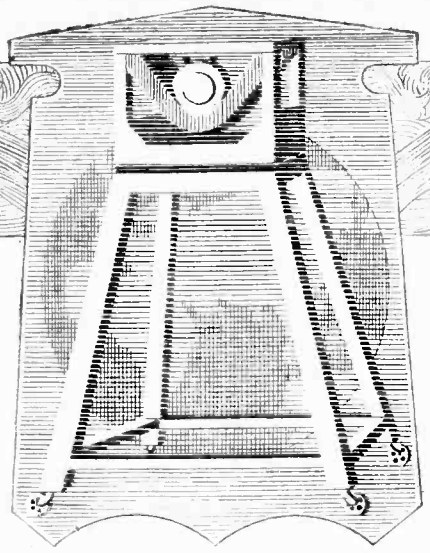
Considerable interest was aroused at the last meeting of the Tottenham Wireless Society when Mr. H. T. Winter (G2YK) lectured on "Selectivity from a New Angle."

Before we can experiment on selectivity, the lecturer said, we must consider actually what we mean by the term. Some sets were described as "very selective," and yet their owners were content to hear one station, while a "background" was provided by another. In the experiments which Mr. Winter had conducted he had demanded a dead silent "background" all the time. Three factors had to be considered. First, there was the distance of the transmitter; secondly, the power of the transmitter; thirdly, the frequency difference of the stations to be selected.

Describing his experiments, Mr. Winter said that with an average receiver tuning to 460 metres was necessary at six miles from 2LO before that station could be entirely cut out. When the receiver was removed to a distance of 16 miles the London transmission could be eliminated by tuning to 440 metres. At a distance of 30 miles the separation of Bournemouth and London was easy. Under normal conditions the strength of a signal varied as the square of the distance from the transmitter.

The assistant secretary, Mr. J. W. Wroth, of 5, Henningham Road, Tottenham, has been granted a transmitting licence with the call-sign of 2WT.

BROADCAST BREVITIES



NEWS FROM ALL QUARTERS.

By Our Special Correspondent.

Programmes for the Dominions.—A Talk with Los Angeles.—The Boat Race. — B.B.C. at Olympia.—Oscillation.

Are the Dominions Interested?

Last week there was another flattering of wings over the suggestion that the B.B.C. would soon experiment in broadcasting on short wavelengths to the Dominions. There is nothing new in the idea; indeed, it has been toyed with for more than a year, but we can take it as certain that nothing will be done in this direction until the alternative programme scheme has been brought to maturity. "Charity begins at home" is an excellent adage which the B.B.C. is wisely keeping in mind. Moreover, it has yet to be shown that the Dominions are thirsting to hear the B.B.C. programmes; what doesn't please Tooting may not please Toronto.

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The Short Wave.

There is, however, a possibility that if and when the regional scheme becomes a fact Dominion broadcasting experiments may be conducted from Daventry Junior. Whether these transmissions will be on really short waves is open to doubt. I hear faint rumours that certain of the engineers are losing their first fine frenzy of admiration for the short wave.

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A Call from Los Angeles.

Captain West, of the B.B.C., had a weary wait two Saturdays ago when he was "standing by" for a Post Office transatlantic telephony call from Los Angeles. The call was expected at 2.30 and came through at 6. The speaker was Mr. Earl Anthony, in charge of the Los Angeles broadcasting station KFI, and he put forward an interesting suggestion. His idea was to transmit a programme from Los Angeles for the benefit of British listeners, using WGY, Schenectady, connected to KFI by land line, as a half-way house.

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Listen for KFI.

How many readers remember that a relay from Los Angeles in the manner suggested was actually carried out two years ago? The trick was done in March, 1925, the relay lasting about 10 minutes, but the results were very poor. I understand from Captain West that an effort to fall in with Mr. Anthony's proposal may be made before the end of this month. It is possible that Los Angeles will offer a special attraction in the shape of a talk by Douglas Fairbanks

A 7,000-mile Talk.

By the way, Captain West found the quality of telephony from Los Angeles rather poor, though perhaps this is hardly to be wondered at in view of the fact that the distance covered was over 7,000 miles! Half of this distance was spanned by land line. There was a complete absence of fading and atmospherics.

A Boat Race Doubt.

It appears that we are to enjoy the thrills of the Grand National and the University Boat Race without stirring from our armchairs. Despite the threatened difficulties connected with the broadcasting of the former event, I hear that the B.B.C. engineers are more confident of success with the steeplechase than with the boat race. Stationary microphones and duplicate apparatus can be provided at Aintree; not so on the Thames. The launch following the crews will be equipped with a short-wave transmitter, but lack of space will preclude duplication. It is on this score that the engineers are nervous, for during the past year or two the duplication of "O.B." gear has been an invariable rule.

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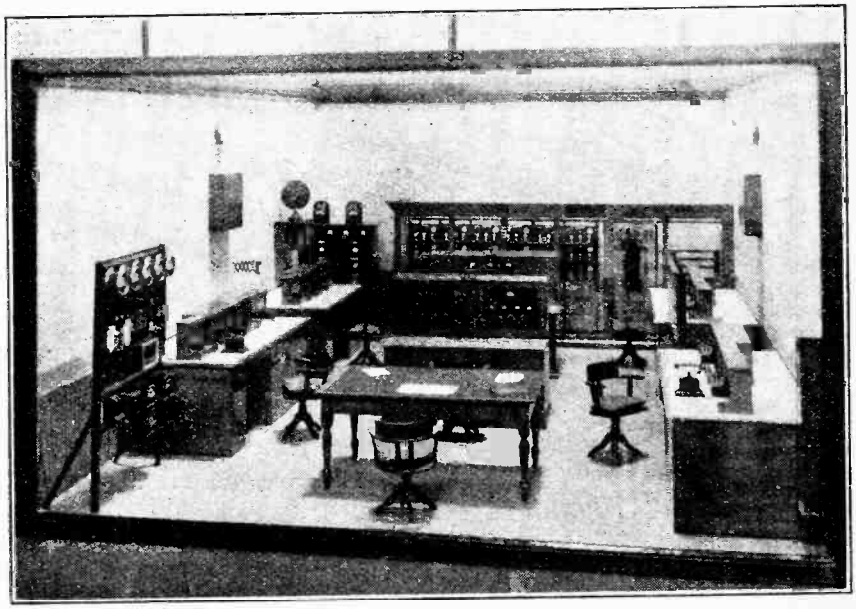
Keston in Waiting.

The transmission from the pursuing launch will probably be picked up by a receiver on the river bank and relayed by land line to 2LO. But if trouble is experienced through oscillation, jamming, or other causes, Keston may take a hand.



A CONTROL ROOM IN MINIATURE. A cleverly built model on view in the Listeners' Hall, at the *Daily Mail* Ideal Home Exhibition, Olympia. The "S.B." board can be seen in the background with two control tables on each side. The two check receivers for London and Daventry are shown in the left-hand corner. The line corrector occupies the centre, while on the left will be seen the switchboard controlling the central battery

In the "Listeners' Hall," Olympia.

Entering the "Listeners' Hall" at the Ideal Home Exhibition last week, I was struck by a certain "glass-case" atmosphere suggestive of that subtle something which changes an exhibition into a museum. The signed photographs of broadcasting celebrities gave one the faint impression of departed glories.

But the fancy passed when the orchestra struck up. I say "orchestra" advisedly, for the reproduction of Daventry's morning programme, using Receiver "C," was almost uncannily realistic. This receiver is admittedly the best of the three typical sets, "A," "B" and "C," which the B.B.C. are demonstrating in order to prove what *can* be done. Circuits of all three receivers are shown on the walls, so little excuse is left for asking awkward questions, which, incidentally, are not encouraged!

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Overheard at Olympia.

Elderly lady in the "Listeners' Hall": "Please I want to see the man talking into the microscope."

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"Rain, Rain, go to Spain."

The great barrier constituted by the Pyrenees makes for very great differences between the climates of France and Spain, and for this reason Spanish listeners derive little benefit from the French broadcast weather forecasts.

THE CHIEF SCOUT BROADCASTS. This photograph, taken two months ago, shows Sir Robert Baden-Powell addressing a gathering of scouts and guides at Cape Town, South Africa. The upper microphone, a Marconi Magnetophone, conveyed the speech to the local broadcasting station. Beneath it is a microphone operating the Marconiphone public-address amplifier.

An interesting step towards independence in this direction has been made by Radio Barcelona, which has inaugurated a new service of weather reports in conjunction with the Spanish observatory at Tibidabo. A special land line has been installed between the station and the observatory, so that listeners in the north of Spain will be able to rely on accurate weather forecasts at least twice a day.

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For Esperantists.

For the benefit of Esperantists I am asked by the British Esperanto Association to spread the good news that we may expect an Esperanto programme from Cleveland, Ohio, in the early morning of Monday next, March 14th.

The station is WHK, working on 272.3 metres, and the transmission, consisting of American music and short Esperanto talks, will take place between 5 and 7 a.m. (G.M.T.).

Reports of reception will be welcomed by the station officials at Carnegie Hall, Cleveland, Ohio, U.S.A.

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Sir Oliver Lodge's Programme Postponed.

"My Programme," by Captain Harry Graham, originally fixed for March 21st, is now changed to March 11th; and Sir Oliver Lodge's proposed programme for the latter date has been postponed to a date when the great scientist can find more leisure than he has at present.

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Beau Nash to Broadcast.

The history of Bath is linked up with the story of Beau Nash. In a concert from the Pump Room of this famous old watering place, which will be relayed to the Cardiff station on March 24th, Beau Nash will talk to his contemporaries. The story of the spring will be given, the chimes of the abbey will be broadcast, and the Mayoress of Bath, that well-known novelist, Madam Sarah Grand, will give a good-night message.

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New Oscillation Pamphlet.

With the view of overcoming the oscillation nuisances the B.B.C. is preparing a further pamphlet on the subject, showing how listeners may avoid the trouble. The number of complaints of oscillation now received at Savoy Hill is over 400 a week.

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When Noise Annoys.

One or two outside broadcasts have come in for criticism lately owing to the presence of extraneous noises. The question of extraneous noises can be viewed from more than one angle.

In the case of a running commentary on a football match the incidental sounds produced by a seething crowd undoubtedly help the listener to feel that he is sharing in the spectators' joy; but when an orchestra is being broadcast from an hotel the sounds of the clashing of knives and forks are too poignant for words, particularly when the listener is hungry.

Fortunately the actual noise produced by plate and cutlery is generally absent from hotel transmissions, but the "ponging" and other disturbances which have crept into recent broadcasts of this type come from no other source. The problem is a complex one. Hotel guests can hardly be asked to "down forks."

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Big Business in Hungary.

After sixteen months of successful working the Budapest broadcasting station is installing a new 3-kilowatt transmitter built by the Telefunken Company. Many improvements have been made in the aerial system, and it is hoped that Budapest will now make itself heard over a much wider area than hitherto.

But the new station will be a mere infant beside the hypothetical 60-kilowatt station which the authorities appear to be planning, according to information received from a Hungarian correspondent. Estimates for such a station have been submitted by four well-known firms, viz., the Marconi Company, the Telefunken Company, Standard Telephones and Cables, and La Compagnie de T.S.F. Française, and the decision of the Hungarian Broadcasting Company is now being awaited with interest.

FUTURE FEATURES.

Sunday, March 13th.

LONDON.—Military Band Programme.
BIRMINGHAM.—Symphony Concert.

Monday, March 14th.

CARDIFF.—"Some Summer Eve," a Cameo by Gordon McConnel.
MANCHESTER.—Romantic Music and Folk Songs.
GLASGOW.—Popular Russian Programme.
ABERDEEN.—"By Virtue of a Broadcast," play by Frank H. Shaw.

Tuesday, March 15th.

DAVENTRY.—The Compositions of Bela Bartok.
MANCHESTER.—Vaudeville.
BELFAST.—Songs and Dances of the 'Nineties.

Wednesday, March 16th.

LONDON.—Irish Concert.
BIRMINGHAM.—Irish Concert.
ABERDEEN.—Scottish Concert.
BELFAST.—Irish Programme.

Thursday, March 17th.

LONDON.—B.B.C. National Concert relayed from Royal Albert Hall.

Friday, March 18th.

LONDON.—Compositions by Armstrong Gibbs.
BOURNEMOUTH.—An American Programme.
CARDIFF.—"Seconds Out," a Programme with a Punch, arranged by Jimmy Wilde.
MANCHESTER.—"Making His Name," a comedy.
GLASGOW.—Rimsky Korsakov Anniversary Programme.

Saturday, March 19th.

LONDON.—"The Arcadians."
BIRMINGHAM.—Popular Celebrity Concert relayed from Central Hall.

A TOUR ROUND SAVOY HILL.

Part V.—The Control Room.

By A. C. SHAW.

IN the last article of this series the contributor aptly described the London station control room as the nerve centre of British broadcasting. A more fitting term could hardly be applied, for it is from this room that the various programmes from the London studios are controlled and linked up with the B.B.C. stations throughout the country. How is it all done? What apparatus exists to allow of the smooth and rapid changes in programmes that take place several times during an evening's transmission? Why is it that when these changes are taking place there is hardly a pause between the various items, or noise of any kind that one usually associates with the changing of electrical or mechanical apparatus? Everything is really very simple, and it is essential that this should be the case, for the whole success of smooth running depends chiefly on the apparatus used being comprehensive but simple to operate.

Battery System.

Fig. 18 shows the layout of the various units in the control room, and it will be noticed that there is a central battery room adjacent equipped with two banks of 6-volt, 720 A.H. batteries for filament lighting, the total possible number of valves operated off this battery being 120, each valve taking 0.85 amp. There is also a battery for H.T., consisting of two banks of 300-volt, 22 A.H. cells, the large capacity being used because of the low internal resistance, this being necessary to avoid cross talk between amplifiers. This battery is the source of plate voltage for all valves in the control room. In addition, there are two banks of 24 volts utilised for grid negative on all "B" amplifier units and a single 24-volt battery used in connection with relays and "engage" lamps. Connection is made to the main switchboard from the L.T. batteries by means of ½in. copper rod with suitable fuses fitted close to the battery. The H.T. is wired with ¼in. copper rod, the grid negative battery being connected direct to the amplifiers through a small separate switchboard by means of lead-covered wire. The L.T. is charged from a motor generator, and the H.T. direct from the mains, the grid negative and relay batteries being charged from another small motor generator. The main switchboard is fitted in the control room proper, connections being made to the various units throughout the control room by means of overhead copper rod, the bare rod terminating at a suitable height and being continued in flexible cable, *via* a plug and socket, to the unit concerned.

The battery supply of any unit can be controlled either from the unit itself or from the main switchboard.

Amplifying Unit.

Fig. 19 shows a complete amplifying unit consisting of an input board, "B" amplifier, output board, and miscellaneous amplifier. This latter amplifier need not be seriously considered, as it is not for use in connection with transmission. The lines from the outputs of the "A" amplifiers, referred to in the last article (Part IV), run direct to the main control room *via* a central distribution panel, and from this panel radiate to four amplifying units, all incoming or outgoing lines on these units being in parallel.

In the case of the input and output boards connection is made in a manner similar to that used in the Post Office, jacks being used for this purpose. On the input board terminate studio lines, outside broadcast lines,

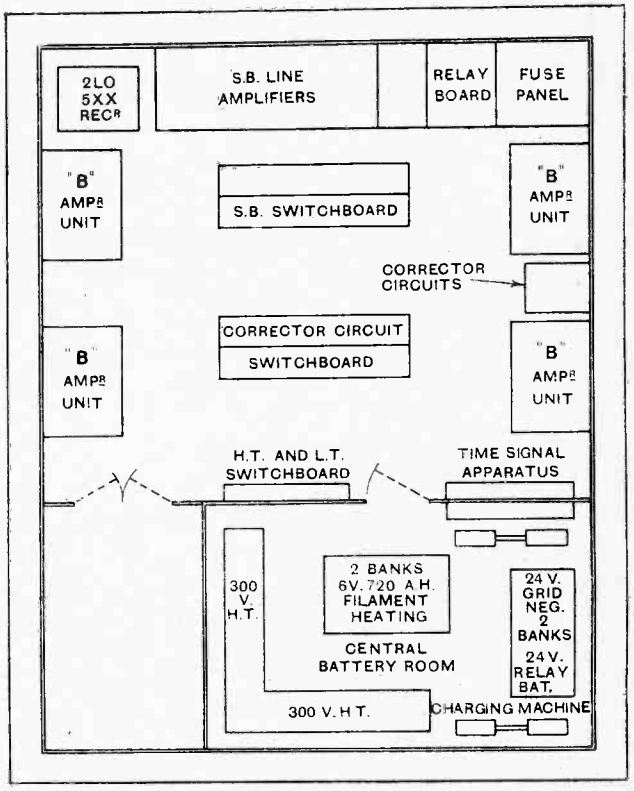


Fig. 18.—Layout of control room at Savoy Hill.

Greenwich and Big Ben lines. It can readily be seen, therefore, that if these lines are connected to a strip of jacks on one board, it is easy to change from one point to another in a very short time (see Fig. 20). These changes are made by means of a plug and cord connected direct to the input of a three-stage amplifier. This amplifier, which is known as the "B" amplifier, is, perhaps, the most important of all amplifiers in the broadcast chain. The design of suitable input and output transformers has been given very considerable attention; in fact, the whole amplifier has been made as near perfect

A Tour Round Savoy Hill.—

as possible, and with an adequate factor of safety to ensure no possibility of distortion when dealing with the greatest volume that may be necessary to pass on to the transmitter.

Volume Control.

There are three stages of amplification on this amplifier, separate potentiometer control being provided on the grids of the first and second valves. The last stage of the amplifier has three parallel valves to ensure that there is no possible chance of overloading. This amplifier is used throughout the whole of a transmission, an engineer being seated at the control table watching meters fitted on the amplifier to show him when the transmitter is about to run into grid current, indicating distortion, and, in addition, watching the volume meter, which tells him whether his control of the output volume is correct. He sits there, wearing telephones, watching these needles, hands on the control knobs, turning slightly this way, slightly that, anticipating where possible and ever alert to the needs of crystal user as well as the owner of the finest valve set. It is often necessary for him to control from a musical score when operas, symphonic concerts, etc., are being broadcast. This engineer's work is by no means easy, as it means concentration throughout the whole of the transmission. It is therefore necessary that he should be a man of wireless ability and musical knowledge, and it is necessary for him to undergo several weeks' training before being allowed to take over control of any transmission. In front of him he has a modulation meter indicating to him the reading of a similar instrument fitted at the transmitter. These two instruments are checked several times a day, to avoid any possible chance of a fault developing on the control room modulation meter. The modulation meter itself is wired direct from the wireless check receiver, so that there is a constant indication of the modulation of the carrier wave. When the modulation is extremely heavy or "peaky" there is a tendency for the transmitter to run into grid current, which would result in distortion. As the control engineer is responsible for ensuring that this does not occur, a grid meter is fitted which is synchronised with a similar meter fitted at the transmitter. It should be noted that whereas the volume meter gives a constant indication, the grid meter does not indicate until the transmitter has run into grid current with consequent distortion.

Connected directly to the output of the "B" amplifier is the output board, and from this board lines radiate

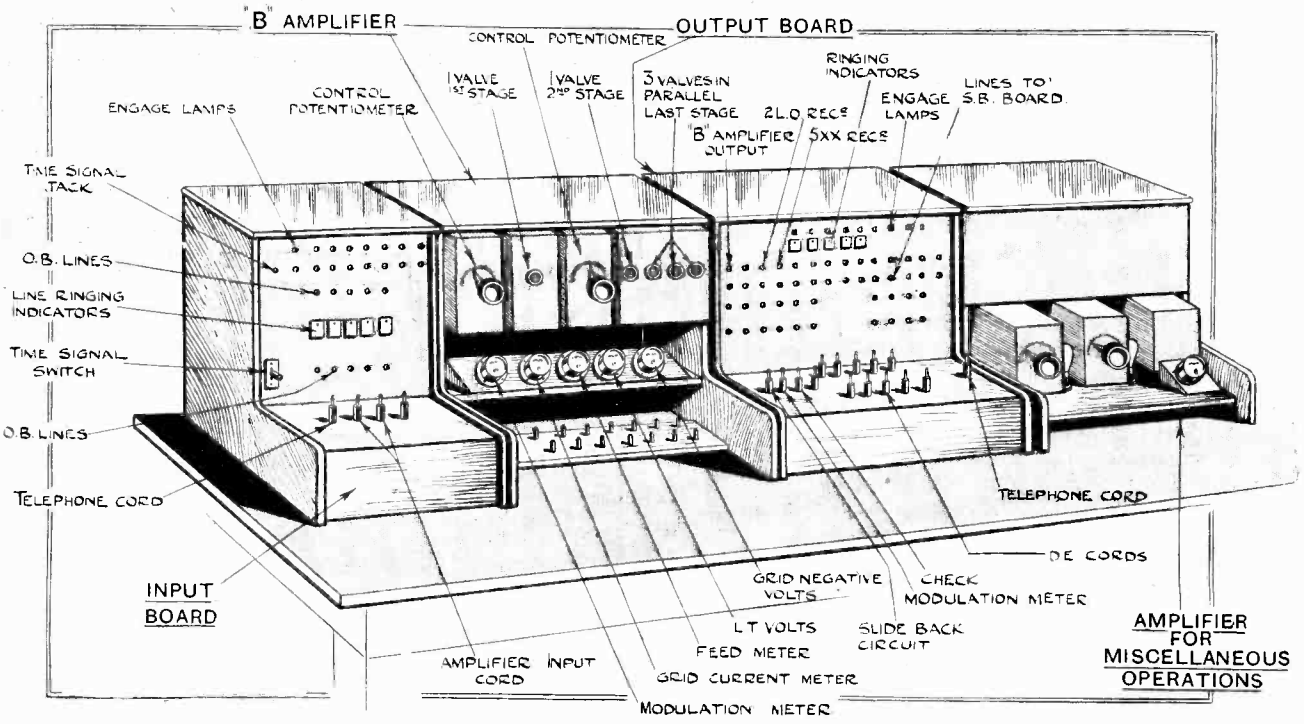


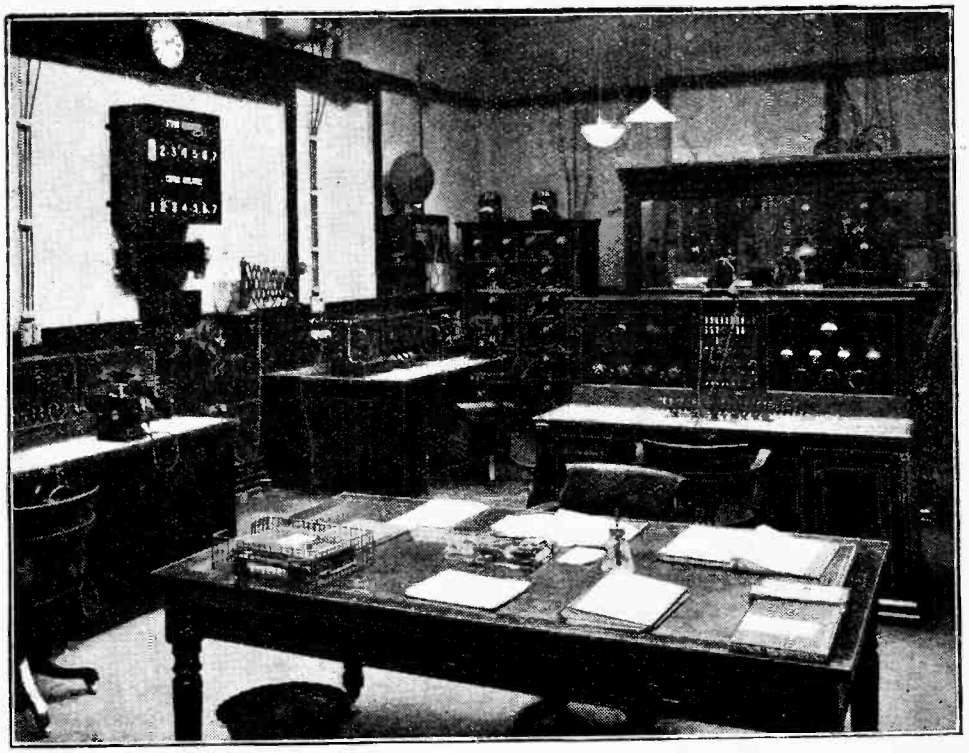
Fig. 19.—Complete amplifying unit.

to various parts of the control room and also to the Oxford Street transmitter. Three lines are constantly in use to the latter, one being utilised for the actual transmission, one for ordinary telephone conversation, and one being kept in reserve should one of the other lines break down. Should trouble occur in this respect, it is a matter of half a second or so to make a change from one line to the spare. Lines connect direct from the output board to the simultaneous switchboard, so that programmes being passed through the output board may be passed direct to provincial stations. In this manner the transmissions of Daventry are carried out daily, passing through a special line amplifier, about which more will be said in a later article.

The engineer controlling must listen to the transmission by wireless, and to effect this the London and Daventry checking receivers terminate on the output board, so that

A Tour Round Savoy Hill.—the controlling engineer simply connects up a pair of phones to the appropriate jack, and the results he hears are those that every other listener should hear.

The complete amplifying unit has now been described. There are four such units, and the wiring of each is so arranged that should one break down or become faulty in any way an instantaneous change can be made without affecting transmission. As all wiring is arranged in parallel circuits it is easy to understand that similar connections are made on every board, and that what holds good for one unit must hold good for another. It is therefore possible to take a transmission from one studio on two "B" amplifying units. This would, of course, not be necessary, but it can also be seen that if it is necessary at the conclusion of the programme from the studio to fade in an O.B., this can easily be done using another "B" amplifier, paralleling the outputs in a suitable manner, gradually fading in one item while the other is being faded out.



Interior of control room at Savoy Hill. This photograph should be studied in conjunction with the schematic plan in Fig. 18.

In the last article it was mentioned that an amplifier exists between the studio and the main control room. In the case of an O.B. there is a similar amplifier giving slightly more magnification to compensate for line loss. The conditions in the control room, therefore, are similar in every respect to that of a transmission being taken from the studio. You have often heard the announcer say "Goodnight; *goodnight* everybody," and at the same time a dance band would gradually be faded in, so that there was actually no break between the end of the studio performance and the beginning of the dance music. At the appropriate time the engineer at the place of O.B. is given a signal to put the transmission on to the line. Everything is connected up in readiness. An engineer is listening by wireless to the end of the studio performance and as the announcer concludes his closing-down announcement he raises the controls of a separate "B" amplifier to such a level that it does not interfere with what is being said in the studio but a background of dance music can be heard. By the time the announcer

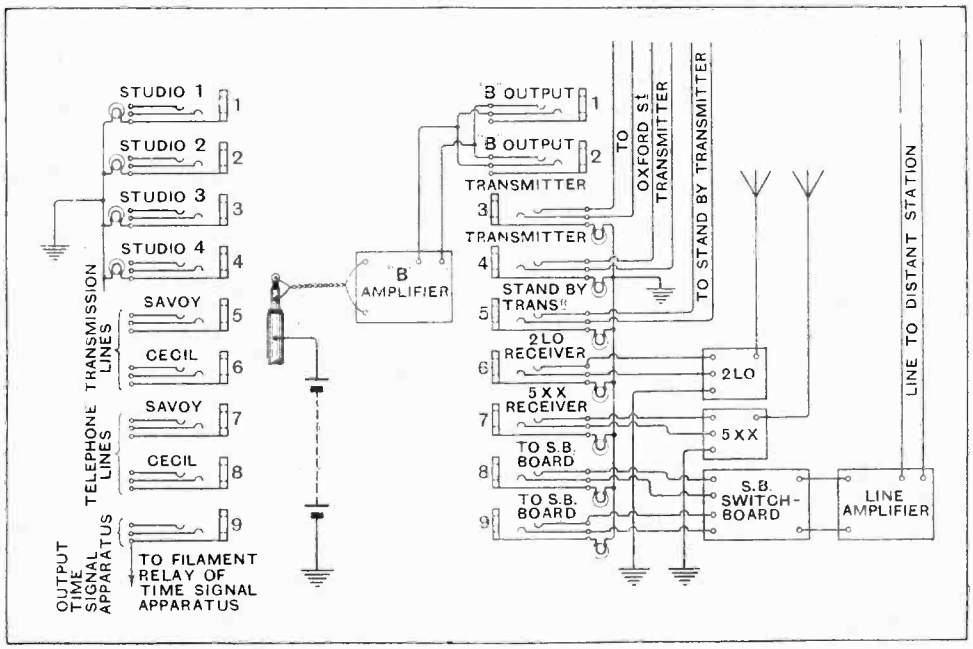


Fig. 20.—Termination of land lines in control room.

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has concluded the dance band is at full strength, so that the transmission is then again normal. A later and more efficient method of doing this is now being introduced whereby the whole operation can be carried out on one amplifying unit

Foolproof Device.

If reference is made to Fig. 20 it will be noticed that connected directly to the sleeves of the input and output board jacks are a number of engage lamps. These are not connected with transmission, but are a method of making connections on amplifying units foolproof. As soon as the input plug and cord of a "B" amplifier are connected to any studio line a battery connected to the sleeve of the plug itself passes a current through a lamp connected to the sleeve of the jack, thus giving visible

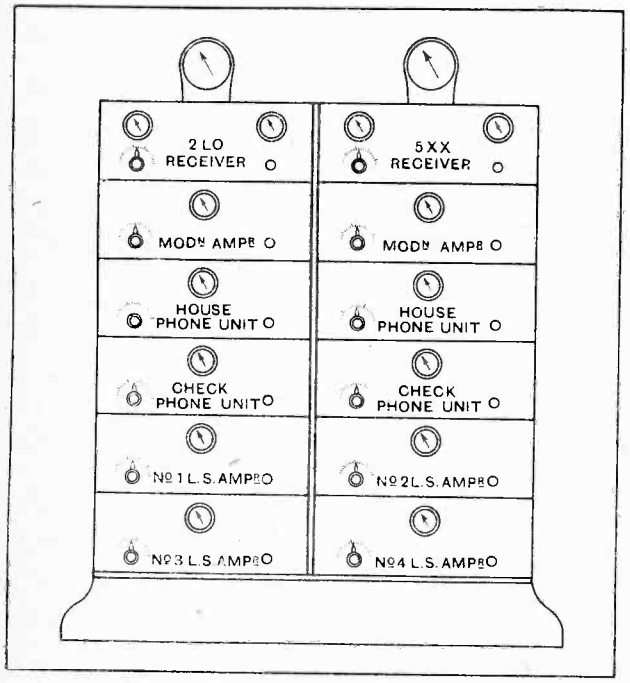

Fig. 21.—Receiver unit for 2LO and 5XX.

indication that this particular line is engaged. The other input boards being in parallel with the one being used are also affected, so that the four lamps give warning that that particular line is in use. This method of indicating when lines are engaged also applies to the output board, so that there is very little likelihood of accidental dual connection being made of separate amplifying units.

O.B. Line Tests.

In connection with lines to O.B.'s, tests are carried out on these lines daily. There are 200 pairs of lines terminating on a plug and jack board in the control room, any of which may be utilised during the day's transmission. Therefore, each morning an engineer makes a test of each line to prove whether the insulation has fallen below a certain standard, whether the lines are in contact, whether they are earthing, or whether they are connected through to the place of O.B. This is the daily test that is carried out on all lines. In addition, tests must be carried out on O.B. lines previous to transmission to ensure that no "cross-talk" or telephonic conversation gets across from an adjacent pair not running to Savoy Hill. These latter tests are also made to ensure that at the last moment the lines have not become faulty since the morning test and that they will be suitable in every way for a transmission. It sometimes happens that the lines become faulty a few minutes before transmission, and steps must be taken at once to ensure that other lines are available. In 1925 a transmission had been arranged from the racecourse on Derby Day. Ten minutes previous to the transmission a test had been carried out and the engineers in the London control room had been speaking to the engineers on the racecourse. The tests had proved in every way satisfactory. A few minutes before the transmission was due to begin the lines became defective, so much so that the transmission failed entirely.

Checking Quality.

In a small listening room close to the main control room a loud-speaker is fitted, operating off the London or Daventry check receiver unit. In this listening room an engineer sits the whole of the evening listening to the quality of the transmission. He sits there alone, prepared for any trouble that may arise and taking particular notice of the difference, if any, in the types of transmission from the various studios. He should know whether the piano in Studio 1 is similar in every respect to that in Studio 4, whether there is too much echo or too little being superimposed on the transmission. Immediately he notices any defect he makes enquiry of the control room, who supplies him with the necessary information and what steps have been taken to rectify the fault. It is also part of his duties to superintend the balance of musical items, and in this he is assisted by specialists. He has direct communication with all studios so that he may quickly learn of existing studio conditions. Perhaps a talk is being given in No. 6 studio. The speaker's voice may not be ideal for broadcasting. There may be a distinct "griddiness" or nasal sound about the transmission. The engineer listening immediately notices this and telephones through to the studio concerned, confident that no engineering fault exists. He is able, therefore, to localise quickly any fault that may arise.

The Operation of Time Signals.

All listeners have heard the tuning note of one minute's duration, followed either by the time signal from Greenwich or Big Ben. The standard time signal, of course, is that from Greenwich, for the error is never more than 0.002 of a second. The tuning note and Greenwich time signal are both operated from the same apparatus, and if reference is made to Fig. 22 the actual circuit and operation can easily be followed. The lighting of the valve filaments is done by the insertion of a plug into the time signal line jack on the input board, operating contacts in the filament circuit by means of a relay. The circuit immediately becomes operative, generating a note of low frequency which can be varied if desired by means of the condenser across the reaction coil. A coupling coil connects to the input of the amplifier direct, but it will be noted that unless the Greenwich Relay is actuated

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the path to the amplifier is short-circuited by the relay contacts. This short-circuit path is removed by operating the relay from a key fitted on the input board, so that the note of the oscillator is connected to grid and filament of the amplifier. When this short-circuit is again made by altering the position of the switch, thereby releasing the relay, the circuit is then in readiness to be actuated by the Greenwich relay. As soon as contact is made at

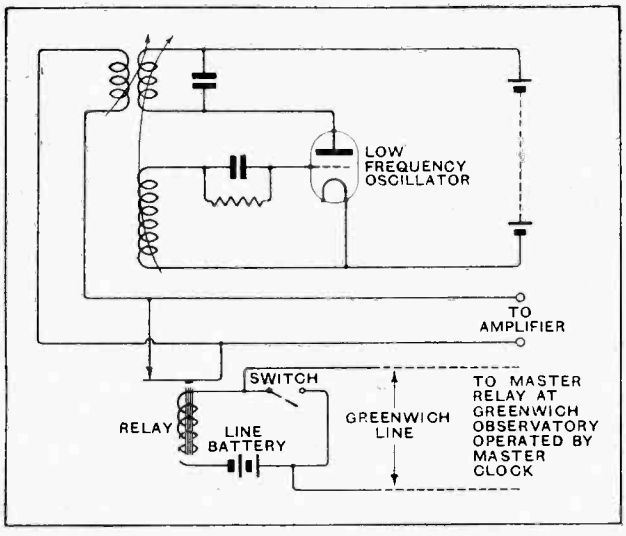

Fig. 22.—Circuit for tuning note and Greenwich Time Signal.

Greenwich the relay again operates, the short-circuiting path is removed, and all listeners receive the familiar six dots.

The operation of the Big Ben time signal is a much simpler arrangement. The sound waves of Big Ben chimes affect a microphone suspended in the tower. This microphone is bound up in cotton wool, the whole being encased in a sealed rubber football bladder. This has the necessary damping effect, and tends to lessen the effect of atmospheric conditions. The microphone is inspected frequently, and on one occasion the engineer found that birds had pecked a hole in the bladder and had taken away a good deal of cotton wool! A line from Savoy Hill connects direct with Big Ben, the polarising battery for the microphone being switched into circuit by means of the time signal switch key on the input board, the output being taken from the secondary of a suitable transformer on to the time signal jack on the input board. It may be worth mentioning that the common battery system is utilised in connection with all time signal apparatus, and that current from the central 300-volt battery (suitably reduced to 50v.) passes on the Greenwich lines whenever the time signal from Greenwich operates.

Co-operation must exist between the announcer in the studio and the engineer in the control-room, and it is essential that the code of signals used should be extremely simple and rapid to operate. In addition to ordinary telephone communication, a method of signalling exists which gives the necessary cue to the announcer and engineer when a programme is about to commence or end. Over each studio door, inside and outside, red lights are fitted. Inside the studio, handy to the announcer, there is a buzzer push which communicates direct with the control room. This buzzer push, besides operating a buzzer which gives an audible indication, also operates a relay which in turn operates green lights indicating the studio that is buzzing, thus providing the visual indication of the studio in service. Whenever it is desired to connect the studio direct to the aerial, the announcer gives one short buzz, the engineer sitting at the control table immediately connects up the "B" amplifier to the studio, fades in on his controls, and switches on the studio red light. The announcer seeing this red light knows that he can go ahead. At the conclusion of an item the announcer desires that the studio should be taken off the aerial. He gives two short buzzes, the engineer hears these, the green light indicating which studio has buzzed, he immediately fades down his controls and switches out the red light. As soon as the red light has disappeared, the announcer knows that he may carry on casual conversation. Occasionally it has happened that this casual conversation in the studio has been radiated, due to a slight misunderstanding, but it is not often that this occurs. This method of signalling applies to all studios.

During the whole of the programme constant touch is being maintained between the announcer and the Senior Engineer, so that nothing will occur to endanger the smooth running of the programme. In case of anything unforeseen happening, either due to the artist not appearing or due to a technical breakdown, there is always a studio in reserve and a pianist waiting for his services to be utilised

General Supervision.

There are a hundred and one small matters concerned with the running of a programme, both from a programme point of view and from an engineering point of view, and it is necessary that at least one person should have a bird's-eye view of everything in connection with the transmission. To this end the Senior Engineer is doing nothing else but assign the various amplifier units in the control room to the different programmes to be broadcast. Sometimes as many as four separate items are being passed through the control room to London, Daventry, and provincial stations, and to make these programmes work harmoniously one with the other is a matter of great importance. There is nothing haphazard about it; every item must work to schedule time, and to this end plans are forwarded to the control room showing the items taken by stations at a specified time, so that the Senior Engineer can see in a moment what to arrange in connection with programmes of stations other than London. There is,

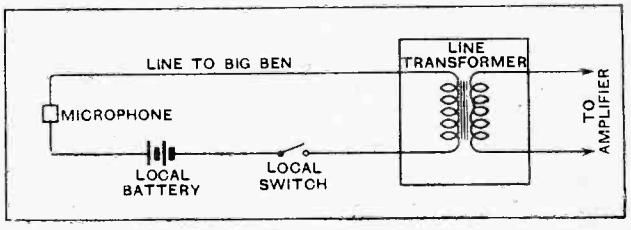

Fig. 23.—Big Ben microphone circuit.

A Tour Round Savoy Hill.—

of course, an engineer operating the S.B. board connecting up to various stations, attending to changes of lines where necessary, etc., but the general supervision of all that goes on in the control room is carried out by one man. He must be alert to any unforeseen changes in programme and rearrange items, perhaps on the London programme, accordingly. A provincial station due to take London at a certain time finds they are likely to overrun. What should be done? Should London wait until the station is ready, or carry on with perhaps a very important item, thereby allowing the provincial station to miss the beginning. Rarely do these things occur with much more than two or three minutes for consideration. Although dealing with a provincial station matter, the Senior Engineer must not lose sight of the fact that in a few moments he is to supervise the change-over from studio to perhaps an O.B. to listen to a very important speech. He must therefore deal promptly and effectively, giving clear-cut decisions concerning any matter that may arise during the course of an evening's programme. Sometimes it happens that a transmission from a studio, O.B., or provincial station becomes defective. It is left to the Senior Engineer to decide when the transmission is bad enough to cut. At the same time he must arrange with the announcer for an artist to be in readiness should the transmission fail. Here again a decision must be made and arrangements concluded at very short notice. In consequence of these possible happenings, the Senior Engineer must be alive to all that is taking place from the London studio, of what is happening at provincial stations, and fully acquaint himself with the state of affairs at a coming O.B. It is so easy to be caught napping that never for one moment must he lose his grasp on what is happening throughout the country.

In the next article a description of the apparatus and operation of the simultaneous broadcasting system will be given.

MICROPHONIC NOISES.

A Note on the Mounting of Valves.

By PAUL D. TYERS.

IN the early days of the thermionic valve little attention was paid to the method of mounting, it being usual to employ ordinary valve legs, which were simply screwed into ebonite panels fixed in any portion of the set. The development of the dull-emitter filament, particularly of the thoriated 60 milliamp. type, soon showed that some means had to be devised for counteracting the microphonic effects to which this type of valve was particularly subject. It is not surprising, then, that nearly all attempts to overcome this difficulty were confined to the design of valve holders.

Manufacturers, however, have worked upon the problem in two totally different ways. Some have mounted the valve holder on springs, while others have mounted it on sponge rubber. If we examine these two methods critically we shall find that they are widely dissimilar in their effect upon the valve. Let us consider first of all against what effects the valve is to be protected, and, subsequently, determine whether or not the method which we adopt not only fulfills these conditions, but, at the same time, introduces no other undesirable effects.

Sources of Microphonic Noise.

The object of suspending the valve is primarily to avoid microphonic noises in the telephones or loudspeaker. These are occasioned by vibrations of one kind or another which reach the set and are transferred to the filament or other electrodes of the valve. Vibration of the valve electrodes causes a low-frequency modulation of the anode current, which modulation, of course, is reproduced in the telephone receivers. Obviously, then, our system of suspension must be such that it interrupts the transference of any vibration to the valve. A second undesirable feature of valve vibration is that it tends to weaken the filament, and, therefore, even a vibration which does not necessarily manifest itself in the telephone receivers may be unduly weakening the filament. Obviously, then, it is essential to eliminate as far as possible vibrations of all frequencies.

If the receiver or the table upon which it is placed receives a blow, the result of the impact will be transferred to all the components of the set, and particularly the valves. If the valves are microphonic, that is, if the electrodes have any natural period of vibration which is not considerably damped, a ringing noise will be audible in the telephone receivers. Let us consider what will be the effect of mounting a valve on a spring type of holder. When the force of the impact is transferred to the base of the holder, which retains one end of the springs, most of the effect of the shock will be lost in the springs, and accordingly the sockets which are connected to the other end of the springs will receive very little impact. In the case of a rubber-mounted valve holder the effect will be practically the same, and accordingly it would appear that there is nothing to choose between the two methods.

However, a spring-mounted holder has a very definite natural period, and it is well known that any system capable of sustaining oscillations, that is, one which has a natural period, can be shock excited. For example, one may quote the case of an ordinary tuned circuit of a wireless receiver, which is shock excited by atmospherics. Obviously, then, if the vibrations to which the set is subjected were identical with, or near to the natural period of the spring-mounted socket, a condition of oscillation might be sustained, which, of course, would be very undesirable. In the case of a rubber-mounted valve holder one may compare it with a very highly damped electrical circuit, in which any oscillations would die out almost as soon as they started. This naturally means that a rubber-mounted valve holder is preferable in at least one respect to a spring-mounted holder.

Microphonic Noises.—

If one were to arrange a low-frequency amplifier in which the succeeding valves were mounted in spring type holders, it is obvious that any tendency for the production of sustained oscillations at the natural frequency of the holder, or some harmonic, or even the natural frequency of the electrodes, or, again, some harmonic, would cause the whole system to be very unstable. Further, if one were to place the amplifier in close proximity to a loud-speaker generating powerful sound waves, these sound waves would impinge upon the surface of the valves, and again tend to sustain the oscillation, the sequence of operations being identical with that of an ordinary regenerative valve circuit, in which energy of the output circuit is fed back to the input circuit.

A Concrete Example.

That this may actually occur is no mere supposition, and the writer once experienced trouble of this nature under the following conditions. A special five-stage amplifier had to be arranged rather rapidly for the purpose of operating two or three large loud-speakers situated in a fairly large hall. The source of supply of the necessary components was rather limited, and the valves were mounted in spring type holders.

As soon as the amplifier was switched on a faint humming sound was audible in the loud-speaker, which gradually grew in intensity until it became quite deafening. This was obviously a low-frequency howl, and was first thought to be due to insufficient screening in the amplifier. However, by bringing the loud-speaker nearer to the amplifier, the sound became much more intense, and reached its maximum more quickly. Vibrating one of the valves by knocking it greatly enhanced the effect. By placing the loud-speaker about a foot from the valves the whole system oscillated with extreme intensity, showing that there was a distinct regenerative effect caused by the sound waves generated by the loud-speaker impinging upon the valves. The trouble was primarily overcome by moving the set into an adjacent room, but when one of the spring-mounted holders had been substituted by a sponge rubber-mounted holder the trouble was completely cured, and it was found possible to place the loud-speaker about a foot from the set without obtaining any interference whatever. This seems to be a very practical proof of the superiority of the rubber-mounted holder over the spring-mounted holder.

The fundamental difference between the two types, of course, is that a rubber-mounted holder tends to damp out vibrations and shocks of all frequencies and intensities. Spring-mounted holders, while tending to eliminate to a very great extent any undesirable microphonic effects, have a most definite vibration frequency, and do not tend to damp out certain vibrations to any material extent. A spring type of holder is, no doubt, easier to manufacture than a rubber one, but, from an amateur point of view, excellent results can be obtained simply by mounting an ordinary valve holder, consisting of four sockets and a piece of ebonite, on a small block of sponge rubber, which can be obtained very cheaply. When comparatively thin connecting wires covered with sleeving are used for connection to the holder they may be soldered directly on to the usual terminals or soldering tags, without the necessity of introducing a flexible link. Experience shows that it is preferable from practically every point of view to mount valves on sponge rubber.

Book Review.

"Wireless Loud Speakers; A practical manual describing the principles of Operation, Performance and Design." By N. W. McLachlan, D.Sc., M.I.E.E. Iliffe & Sons, Ltd., Dorset House, Tudor Street, London, E.C.4. Price 2s. 6d. net, by post 2s. 8d.

Amid the torrent of wireless literature which has flooded the bookstalls of recent years, it is curious to observe how little has been written concerning the principles of loud-speaker design. While freely discussing the merits and demerits of various types of other components, writers appear to have left this problem almost entirely in the hands of the manufacturer, without attempting to come between him and the buying public with a clear statement of the difficulties involved and of those inevitable questions of compromise between size, quality, efficiency, and price, of which a better understanding on the buyer's side might frequently be an advantage to all concerned.

Here, at any rate, is a book which should be read by everyone whose wireless interests are supplemented by the ability to distinguish between the airs of "Rule Britannia" and "God Save the King"; to everyone, that is, for whom one loud-speaker is not as good as any other. The author is a musician as well as a scientist, and he is, therefore, particularly well equipped to deal with a subject which in some of its aspects is approached more easily from an artistic than from a purely physical standpoint.

After a preliminary discussion of general acoustic principles he deals with the well-known horn type of loud-speaker, and gives a clear explanation of the effect of the diaphragm or reed, the pressure chamber, and the horn itself. Then, on page 19, comes that distressing fact—*that in order to radiate low tones a long horn is needed.* Nine feet of exponentially bulging horn are difficult to cope with in an ordinary domestic room, so shortly afterwards we pass on to a critical discussion of the hornless types. This takes up the greater part of the volume, and after some chapters on the effects produced by a diaphragm in motion, certain well-known instruments such as the "Kone" and the B.T.H. "R.K." are described in some detail.

The success which has attended the author's own efforts in the design of hornless instruments will be known to many readers, and no one will regret that a certain amount of space is given over to the theory on which he has based the design of his reed and coil-driven cones. Many, indeed, will wish that he had given rather fuller constructional details of the latter.

A useful chapter on the design of suitable amplifiers for loud-speaker operation contains also some remarks on the possible effects of hysteresis in iron-core transformers. They will confirm the feeling of many of us that intervalve transformers, good as they undoubtedly can be, are always to some extent suspect, and can never be quite so good as resistance coupling.

The book is well illustrated with photographs and diagrams, and, with the exception of a few pages which demand careful reading, it is very easy to follow. At the same time, it merits the close attention of advanced wireless engineers, to whom the interesting analysis of the action of a driven diaphragm on pp. 64-72 (to mention one example) will give solid food for thought.

R. P. G. D.

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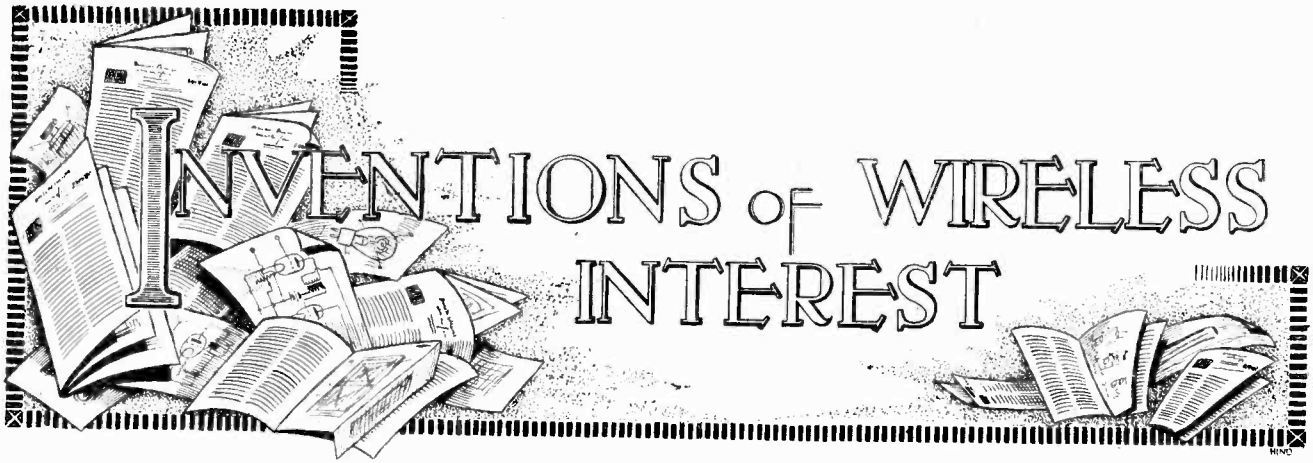
BOOK RECEIVED.

"Electrical Condensers: Their Construction, Design, and Industrial Uses." By Philip R. Coursey, B.Sc., F.Inst.P., M.I.E.E. Pp. 637, with 514 illustrations and diagrams. Published by Sir Isaac Pitman & Sons, Ltd., London. Price 37s. 6d. net.



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.

Multi-valve Receiver. (No. 261,893.)

Application Date: Oct. 19th, 1925.

A convenient method of using a multi-valve receiver either as a straight set or as a supersonic receiver is described by S. L. Forbes in the above British patent. The complete circuit is shown in the accompanying illustration, the more important portions being referred to by letter reference. The input comprises a centre tap frame F tuned by a condenser C_1 connected through a grid condenser and leak G to the grid of the first detector valve V_1. The valve V_2 is arranged as a local oscillator for supersonic reception. The anode circuit of the valve V_1 contains a long wave selector circuit in the form of a transformer T. A switch S_1 connects the anode circuit of the valve V_1 either to the high-tension supply direct or through a low-frequency transformer A_1. Valves V_3, V_4 and V_5 comprise an intermediate amplifier, while the valve V_6 acts as the second detector. The output of this valve is coupled by the audio-frequency transformer A_1 to two note magnifiers V_7 and V_8, a switch S_2 cutting out the last amplifier if desired. In order to cut out the superheterodyne portion, the anode circuit of the valve V_1 is connected directly to the audio-frequency transformer A_1, the remaining valves being disconnected from the circuit.

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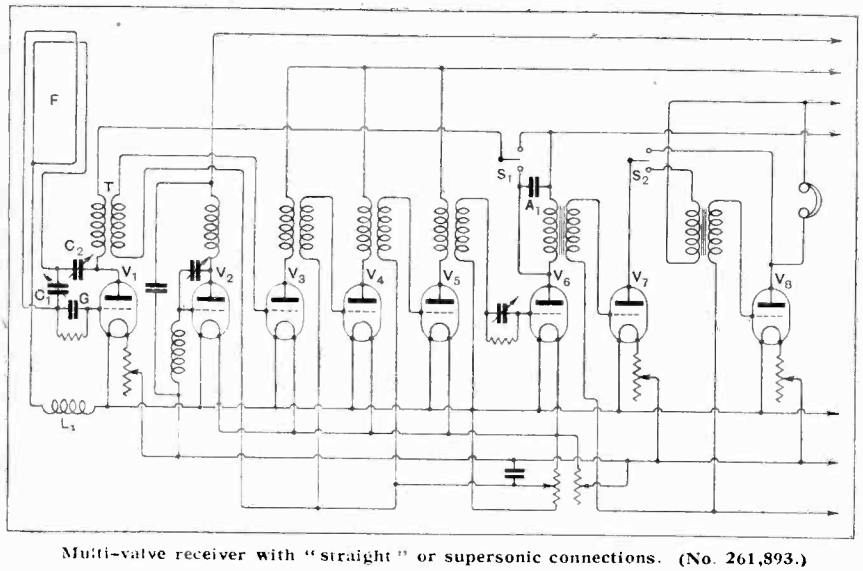
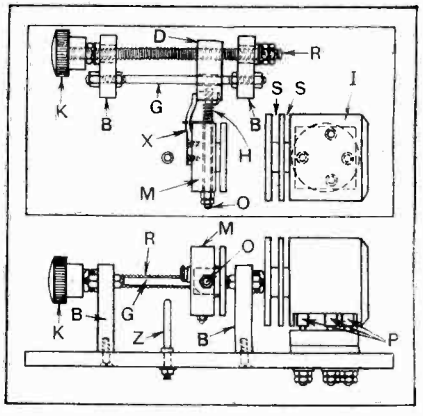
A Reaction Control. (No. 263,258.)

Application date: October 20th, 1925.

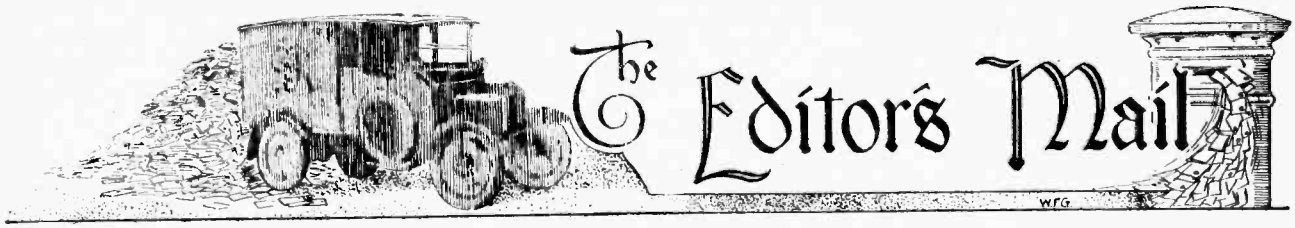
A special form of coil coupling or reaction control is described in the above British patent specification by A. Barringer and Ormsby and Co., Ltd. The variable portion of the holder is given a movement in two directions, *i.e.*, a lateral movement and an axial movement. The lateral movement is provided by means of a rotatable threaded rod R provided with a knob K. This is supported by brackets B, which carry a guide rod G. The moving element is fixed to a block D which is free to move along the guide rod G, which is provided with a thread which co-operates with the screwed rod R. Rotation of the knob K, therefore, causes the block D to travel backwards and forwards along the guide. The movable portion is shown as M, and is provided with a slot for retaining the winding. This is fixed to a stud O held in the block D. An extension X screwed to the portion M bears against the side of the movable block D, and, therefore, prevents the rotation out of the vertical plane of the portion M in a clockwise direction, while a helical spring H normally keeps the movable member in the vertical plane. Fixed to the base of the arrangement is a vertical stop Z. It will be obvious that, as the block D moves to the left, the moving member M will come into contact with the end of the stop. This, however, is below the centre line of the movable member, and, therefore, as this moves still farther to the left it will cause it to rotate about the stud O, so that the plane of the moving coil is finally at right angles to that of the fixed coil.



Multi-valve receiver with "straight" or supersonic connections. (No. 261,893.)



Variable reaction control. (No. 263,258.)



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. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—Why do some of your correspondents take such delight and every opportunity of criticising the praiseworthy efforts of the B.B.C. engineers in their striving after perfection?

Perhaps your correspondent Mr. E. C. Richardson is unaware that the quality obtained with the very best of amplifiers and loud-speakers can be utterly ruined by the machinations of an ignorant—or selfish—radiating neighbour, as I know to my sorrow. Admitted, it is not easy to differentiate at times, but I fancy if Mr. Richardson's receiver were as good as the B.B.C.'s transmitter he would not have much fault to find with the pianoforte recitals or any other musical item.

London, S.E.4. HAROLD C. HUXTER.
February, 1927.

Sir,—Will you permit me through your columns to reply to Mr. E. C. Richardson's letter in the issue for February 16th?

I feel that it would not be right for the non-technical public to gain the erroneous impressions Mr. Richardson's letter is likely to convey.

I state definitely that his remarks, "Surely the time has now come for a frank avowal that the transmissions are never perfect (or anywhere near it), and also, at times, they are decidedly bad," are completely unjustified. (I am, of course, assuming that he refers to pianoforte music transmitted from the London studio, and not from "outside.")

It is well known that transmission is not perfect, but its imperfections are not apparent to the average music-loving public. Would Mr. Richardson suggest that the pianoforte recital as heard in the concert hall is perfect?

I suggest that Mr. Richardson looks to his set, loud-speaker, etc., paying particular attention to the harmonising of components: employment of correct grid bias, if he has none; use of suitable valves, including a good power valve in the last stage. ROBERT N. BALLARD.

London, W.3.
February 24th, 1927.

Sir,—It is with interest that I read the correspondence that is being exchanged through your columns concerning the pianoforte music served out by the B.B.C. I have been experiencing similar trouble to that which your correspondents complain of, and, from what I can gather, there is certainly one studio at 2LO at fault. This is studio No. 4. Whether the cause of the "blasting" is the microphone used or the acoustics of the studio I am unaware, but there is no doubt that piano music transmitted from this studio is always distorted. I reached this conclusion some months ago, when, during some transmission or other, I cannot remember exactly what it was, the announcer mentioned that studio No. 4 was about to be used. Piano music was transmitted with the accompanying "blasting" on some notes. When a change was made to another studio perfect reproduction was the result.

London, N.W.2. M. W. PILPEL.
March 2nd, 1927.

Sir,—I was glad to read the further correspondence in your issue of March 2nd about the transmission and reception of piano music.

I may perhaps add that my reception of the piano agrees very closely with that described by Mr. Rossiter, and that my set approximates to your (most excellent) "Everyman's Four" receiver. The only material difference is that the output to the L.S. is through a (high inductance) choke-condenser arrangement, followed by the transformer recommended by the makers of the L.S., which is a Western Electric "Kone." The last valve is a B.T.H. B11, and this, with suitable bias and 180 volts on the plate, should surely allow for plenty of margin?

The anode resistances I use are: For the first stage a 2-megohm grid leak (Ediswan), and for the second a 100,000-ohm wire-wound Varley. This last follows a B.T.H. B4, which again should allow plenty of latitude as the third valve.

West Byfleet. E. C. RICHARDSON.
March 2nd, 1927.

BROADCASTING IN GERMANY.

Sir,—I see a comment on the broadcasting of a boxing match in Germany on page 242 of the February 23rd issue.

I heard that on two valves on phones, and it was just as you say; I heard every sound, the blows included.

I think the B.B.C. will have to look to its laurels.

Whitby, March 1st, 1927. W. SCOTT HODGSON.

CATALOGUES RECEIVED.

J. H. Taylor & Co., Macaulay Street, Huddersfield. "Reliability" Wireless Guide No. 9, an encyclopædia of the best wireless goods by the most reliable makers.

F. A. Hughes & Co., Ltd., 204-206, Great Portland Street, London, W.1. Illustrated price list of "Blue Spot" wireless products of the Ideal Radio Manufacturing Co., Ltd., of Berlin.

Eunice Wireless Cabinet Works, Ltd., 52, Myrtle Street, London, N.1. Price list of "Eunice" wireless cabinets.

R. Clarke & Co. (M/cr.), Ltd., "Atlas" Works, Old Trafford, Manchester. Illustrated catalogue of "Atlas" radio components.

Enterprise Manufacturing Co., Ltd., Electric House, Grape Street, Shaftesbury Avenue, London, W.C.2. List 89—a price list, with illustrations, of "Emaco" wireless cabinets.

Ernest J. Baty, B.Sc. (Hons.), 157, Dunstable Road, Luton. Card giving particulars of the "Wireless Doctor Service" for receivers.

Radio Instruments, Ltd., 12, Hyde Street, New Oxford Street, W.C.1. Descriptive folder relating to the "R.I." rectifier, for charging batteries from A.C. mains.

Swedish General Electric Ltd., 5, Chancery Lane, London, W.C.2. List No. A30 dealing with "Century" single phase and polyphase electric motors.

H. Maddison, 2a, Ronalds Road, Holloway Road, London, N.5. Price list of "Allwoodorn" loud-speakers.

Dent & Co., & Johnson, Ltd., Linwood Works, Linwood, nr. Paisley. Illustrated catalogue of "Linwood" loud speakers.

Fry's (London), Limited, Enox House, 24-26, Water Lane, London, E.C.4. Price list of "Enox" British trade hack saws.

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.

Adding a Stage of H.F. to "Everyman's Four."

I have an "Everyman's Four" receiver and the results are very wonderful, considering that I have to work with an indoor aerial and live in a flat almost completely screened by other buildings. For this reason I propose trying a second H.F. stage, as in "The Wireless World Five," by the same author, but I thought of using the existing "Four" and merely adding the second stage as shown in the diagram. Is this likely to prove a satisfactory arrangement?
F. M. S.

The answer to this question is Yes, the arrangement *can* be made satisfactory; the H.F. portion can be made stable, but only by exercising a considerable amount of care, and our correspondent must be prepared to put a good deal of work into the receiver. It is extremely difficult to stabilise such an arrangement, due to various stray couplings.

We really think it would be better to make "The Wireless World Five" as described, with complete shielding, for not only is it necessary to remove stray capacitative and magnetic couplings, but electric couplings have also to be made negligible.

The easiest way of doing this is by complete shielding; a copper box will prevent stray capacitative and magnetic couplings, while the addition of suitable by-pass condensers will render the remaining couplings of negligible amount. It should also be noted that it is better to assemble, as the first stage, the input transformer and the first valve; as the second stage, the second transformer T_2 and valve V_2, and so on, rather than to arrange the parts as indicated.

Even with complete shielding it is none too easy a matter to obtain uniform stability and amplification over the whole tuning range, but this has been achieved in "The Wireless World Five." This receiver balances so nicely that the removal of the aerial and earth, which greatly reduces the load on the input circuit to the first valve, does not affect the stability, neither does adjustment of the voltage. An important feature in this receiver besides the complete screening is the use of by-pass condensers, and our correspondent is strongly advised not to omit these from the set on the grounds of economy, as such an omission is bound to cause trouble. The receiver as shown in the diagram here is an extremely interesting one, and if our reader wishes to obtain a full appreciation of the effects of minute stray couplings he could not do better than experiment with such an arrangement.

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Valves for "Everyman's Four."

Since the original "Everyman's Four" receiver was described in THE WIRELESS WORLD *other valves have appeared on the market, and as I am just about to purchase a set of valves for the receiver, which I have just finished, I am wondering whether certain of the new valves are more suitable than those originally recommended for this receiver on the grounds of filament economy, amplification, and selectivity.* J. C.

As new valves are placed on the market we test them in order to find their characteristics and to determine their suitability for various receivers.

For the "Everyman's Four" receiver a valve is required in the H.F. position which will give an amplification of about 40 with the H.F. transformer specified, and the A.C. resistance of the valve must not be less than a certain figure to maintain the standard of selectivity. A new valve which can be strongly recommended for the first stage is the Cossor 610 H.F., which has an amplification factor of 20 and an A.C. resistance of 20,000 ohms, while it consumes a filament current of 0.1 ampere only. For the detector position a Cossor 610 R.C. can be used with a 610 H.F. in the first low-frequency stage, and either a 610 L.F. or a 610 P Stentor Six in the output position. When a 610 R.C. is used as the detector a fixed resistor of 7.5 ohms should be used at R3, while R4 should be short-circuited. An excellent detector is the Cossor 2-volt R.C. valve, and when this is used a fixed resistor of 15 ohms should be fitted at R3 and one of 30 ohms at R4. Resistors R3, R4 were used in the original receiver with a 2-volt detector valve, and the voltage drop across the resistor R3 was utilised to bias the grid of the detector negatively.

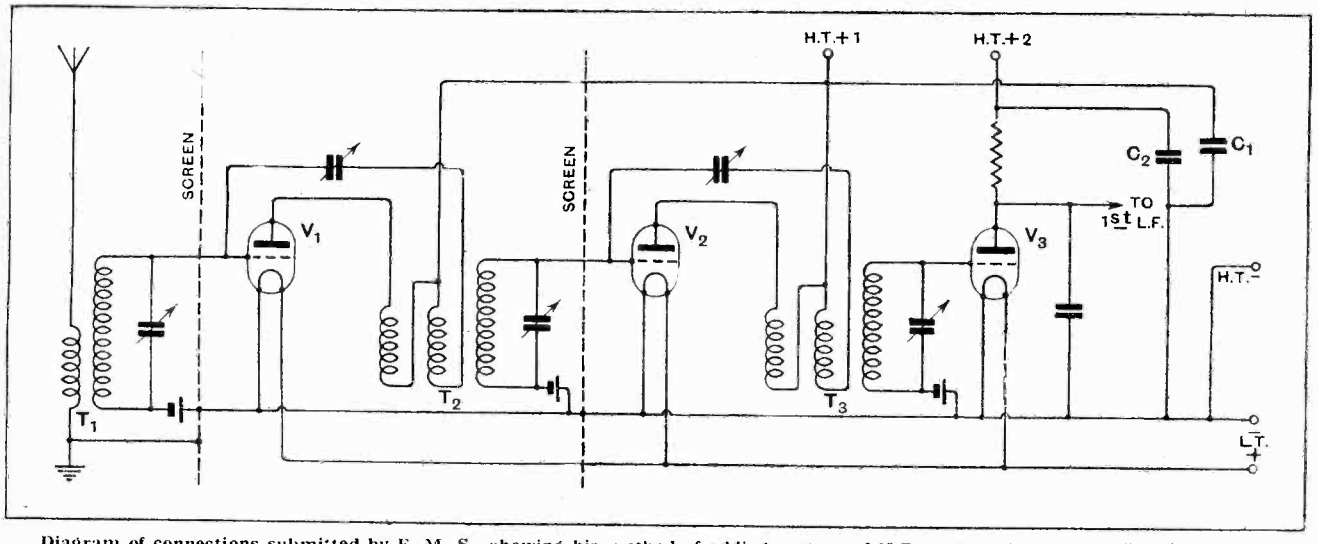

Diagram of connections submitted by F. M. S., showing his method of adding a stage of H.F. to the "Everyman's Four" Receiver. T_1, T_2 and T_3 are the usual H.F. transformers, V_3 is the anode rectifier, and C_1 and C_2 are by-pass condensers.

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A CAMPAIGN FOR QUALITY.

WRITING under this title in our issue of February 16th we urged upon the B.B.C. the desirability of conducting demonstrations giving first-class reproduction in order that the public might have the opportunity of hearing a standard against which to compare their own receivers. We were particularly pleased to see that this idea is carried out at the Ideal Home Exhibition, where, in the B.B.C. section, three sets of different power are being used and demonstrated. This week we publish an article giving details of the circuits of these receivers. We hope that this demonstration will be followed by many others throughout the country, but there is more work to be done in this direction than the B.B.C. alone is likely to be prepared to undertake, and it may be remembered that we recommended that a committee should be formed representative of the wireless industry and the B.B.C. to consider means to be adopted for providing demonstrations of this kind.

CONTENTS.

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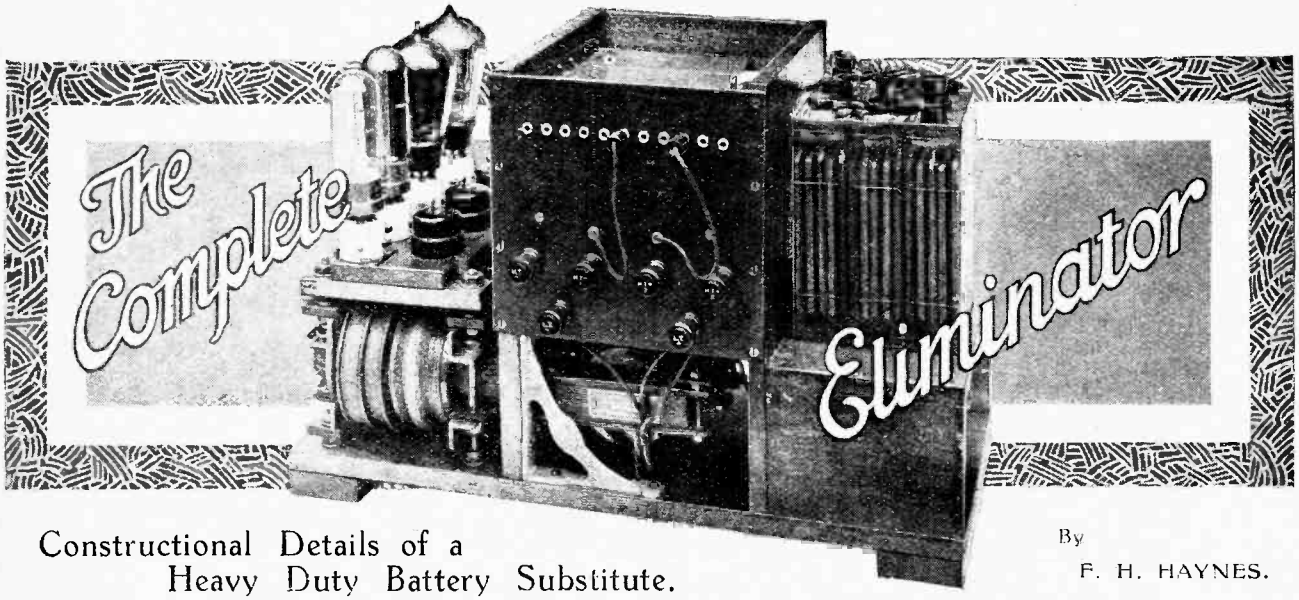
LEAGUE OF NATIONS BROADCASTING STATION.

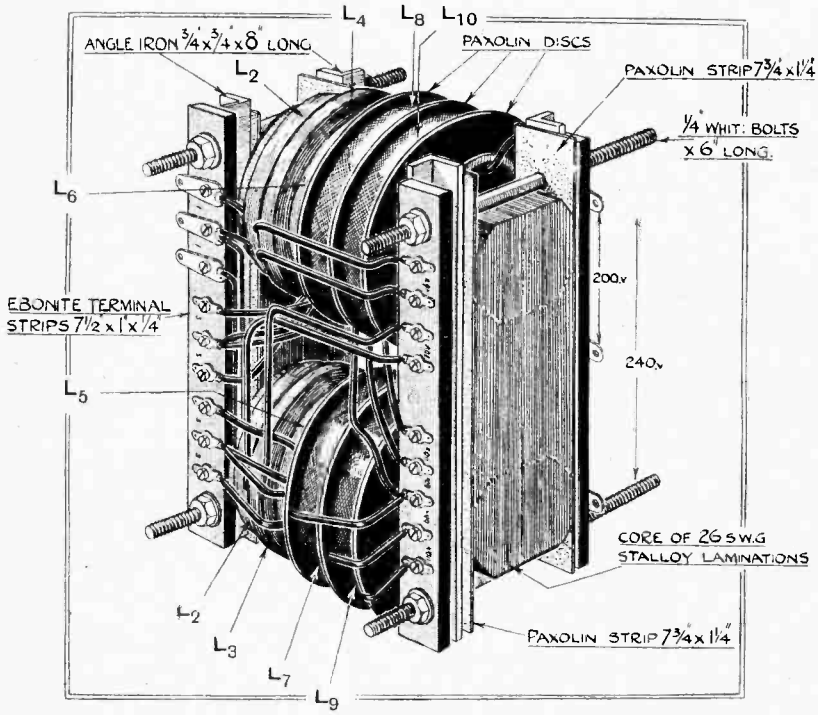
THE idea of the League of Nations having its own broadcasting station centrally situated in Europe is not new; the suggestion was, we believe, first made very soon after broadcasting became general in Europe, and we understand it is now hinted that the question of funds alone has delayed matters hitherto. It is quite easy to take sides on a question of this kind. On the face of it, before we come to investigate carefully, it would seem that a League of Nations central broadcasting station would be a valuable weapon for peace, as its object would doubtless be to keep the nations informed of the activities of the League, whilst it would be available if any emergency required that prompt communication should be established with various countries. But we foresee a good many objections. Even with a peace organisation such as the League of Nations, it would probably not be desirable to broadcast any momentous decisions which the League might have to make, and, further, the difficulty of language would discount the value of the broadcasting station as a means of simultaneously acquainting all the inhabitants of Europe when such a course might be thought desirable. The station would probably be used only very occasionally for definite League purposes, and, unless regular programmes of entertainment were put out, it seems most unlikely that any special message broadcast at short notice would be heard except perhaps by a few stations arranging for a constant watch on that wavelength. If the purpose of the station is not to broadcast, but rather to provide an alternative method to the more usual channels for communicating with the respective Governments, then we believe that a more satisfactory method would be to employ a wireless telegraph rather than a telephony broadcasting station.



Constructional Details of a Heavy Duty Battery Substitute.

By F. H. HAYNES.

RECENT developments in loud-speaker design have necessitated the adoption of low-frequency amplifiers of liberal output. High plate potential, of the order of 150 to 250 volts, is required for the final valve, and the current taken is usually greater than can be economically supplied from primary cells or an accumulator high-tension battery built up of the usual small cells.



CONSTRUCTIONAL DETAILS OF A TRANSFORMER. The windings are arranged to supply outputs for battery charging as well as two high-tension voltages. A tapping point on the primary makes provision for using this transformer on supply voltages of 200–240.

Obtaining a High Anode Potential.

Unless public supply mains are available one cannot hope, with the valves of to-day, to obtain the high voltage at moderate load required by some of the more recent types of loud-speaker. Dry cells, although capable of supplying the heavy current taken by the output stage, are costly to maintain owing to the large number of cells required to give the high voltage and the heavy discharge rates to which they are subjected. Secondary high-tension batteries of suitable voltage are very costly to install and maintain, and unless liberal in size individual cells will reverse polarity on heavy discharge. Accumulator batteries need to be installed in duplicate, and apart from their almost prohibitive cost require constant attention, also their life is particularly limited. Direct-current supply is distributed for public use up to a potential of 250 volts, and although this may serve as a practically costless source of high voltage supply, mains noise is difficult to remove even with the most liberal smoothing equipment. It is in the case where alternating current supply is available that a smooth high-voltage output can readily be obtained.

In the design of both loud-speakers and amplifiers recently described in the pages of this journal the use of high anode voltages have been advocated, and it is at the request of many readers that a rectifier for this purpose has been developed. For operating a three-valve set a rectifier of very simple design was described in the issue of July 7th, 1926, and although quite cheap to build was found to be capable, at a demonstration given recently to the members of the Wembley Radio Society, of operating the special demonstration

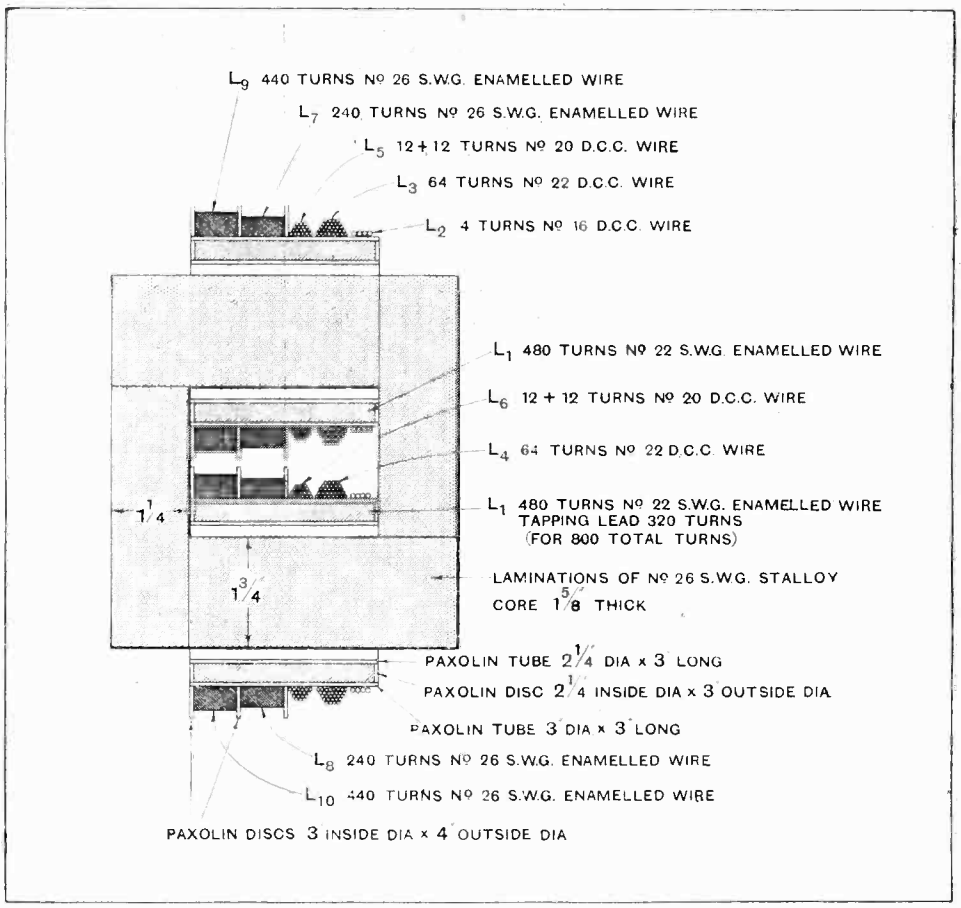
The Complete Eliminator.—receiver,[1] and in spite of the heavy load taken by the output stage, a single L.S5a valve, ripple could not be detected even during periods of silence and with the H.F. valve adjustment brought near to the point of oscillation.

Effect of Overloading the Rectifier.

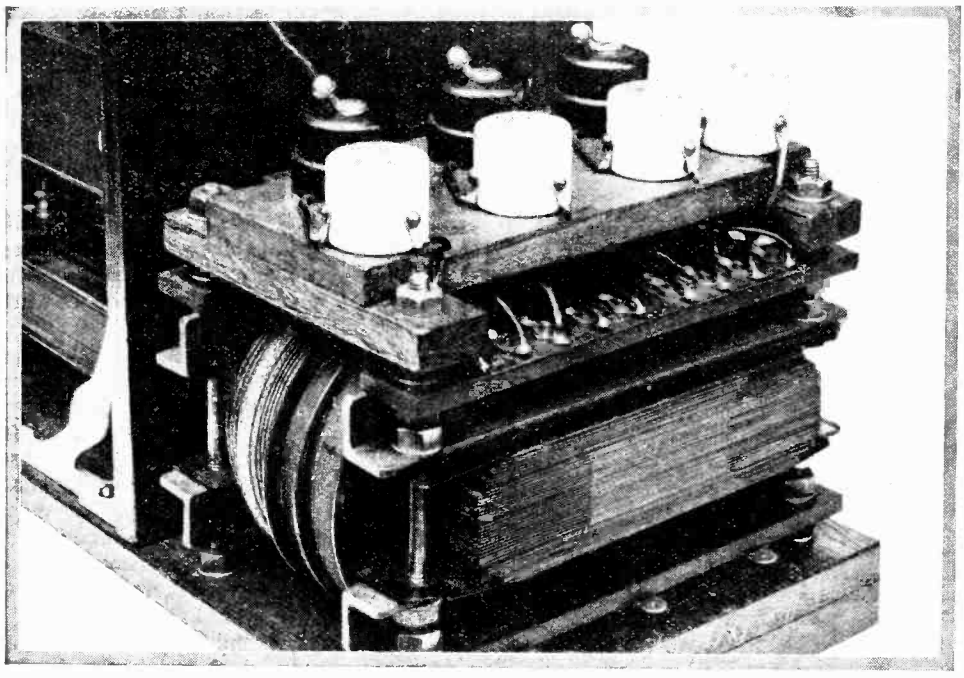
It must be clearly understood that in a rectifier the voltage drop across the rectifying valve increases as the resistance of the external circuit decreases, and the overall test of the performance of an A.C. battery eliminator is to determine the voltage across the output terminals on various loads, at the same time connecting a single-stage L.F. amplifier across the terminals and listening for hum as the load is adjusted. Owing to the appreciable resistance of the rectifying valve, transformer and choke coil windings, the output potential falls away rapidly as the current taken from the eliminator is increased, and for this reason a rectifier of insufficient output fails completely when subjected to a heavy load.

Another effect arises in the case of a rectifier of inadequate output in that the output voltage varies with the changes in the anode current taken by the amplifying valves resulting in distortion. Although the use of large-capacity smoothing condensers may overcome this difficulty, other valves drawing their anode current from the same rectifying equipment will be affected by the

[1] *The Wireless World*, Feb. 16th, 1927, p. 189.



TRANSFORMER WINDINGS. All windings are in the same direction, though where sections on opposite limbs are series connected junctions are made between the pairs of ends at the termination of the windings, as distinct from joining the beginning end of one coil to the finishing end of another.



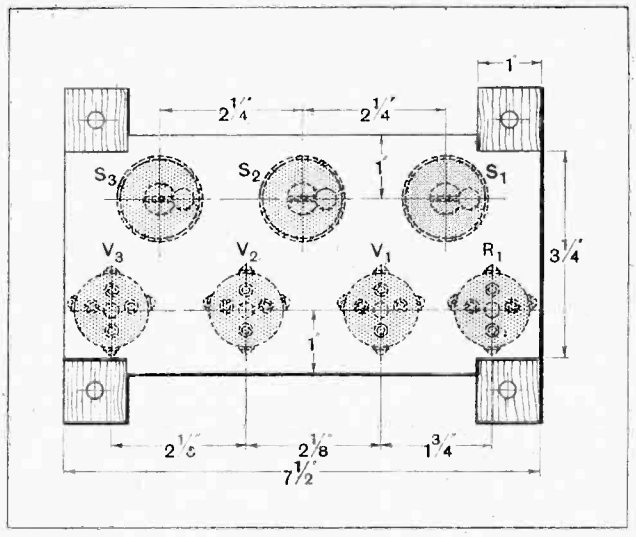
THE TRANSFORMER UNIT, showing the method of supporting the rectifying valves on a platform immediately over the transformer terminals so as to provide short connecting wires, at the same time keeping the leads carrying alternating currents away from the smoothing equipment.

The Complete Eliminator.—

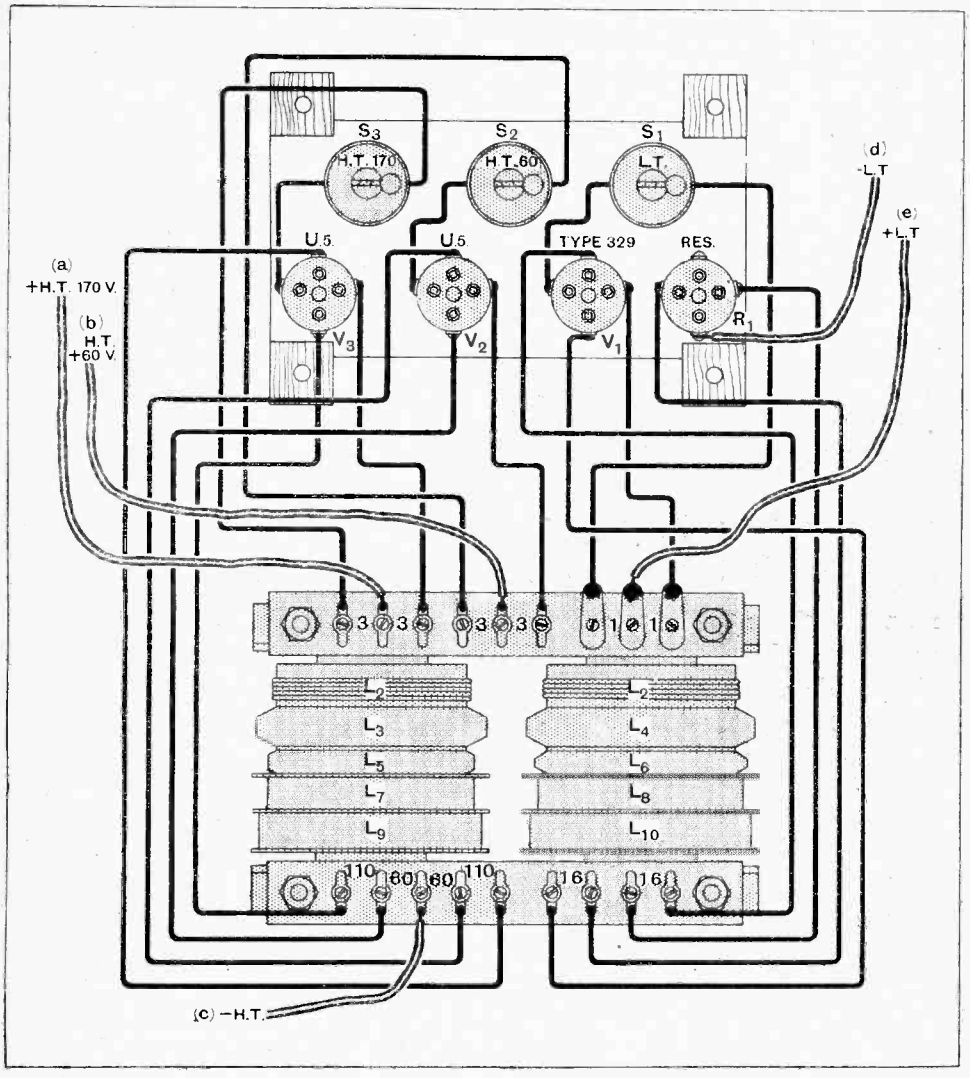
appreciable fall in voltage which occurs. A change of load taken by one of the receiving valves must not affect the anode voltage applied to another.

Several Voltage Outputs.

There is the practically insoluble problem of the means to employ for obtaining the several different voltages required by the various valves of the receiver. If a potential divider is shunted across the rectified and smoothed output many more watts will be dissipated across it than are taken from the output terminals, the potential divider load calling for greater current-carrying capacity in the smoothing chokes and larger-capacity shunt condensers. There is considerable latitude, of course, in the value of the resistance across which the various potentials are tapped off, but if an endeavour is made to limit the current which it passes by increasing its resistance, then the voltage on any one tapping may become appreciably controlled by the value of the current taken by other valves also deriving their supply across the resistance.



VALVE PLATFORM Dimensional drawing showing the location of the valve holders and switches.



TRANSFORMER UNIT CONNECTIONS. Actually the connections are only a few inches in length and the flexible wires pass straight down through the baseboard.

The alternative method, and one commonly used, consists of connecting a resistance in series with the positive output lead so that a voltage drop is produced. Quite a small change in the current passed by this resistance will produce a proportional change in the voltage dropped across it, and as its normal value may be much greater than any of the other resistances in the circuit, which include the rectifying valve, chokes, and the valves in the receiving set, the actual potential developed may change over a wide voltage range. Adjustment of grid bias, for instance, which might normally double or treble the anode current may, actually, have little effect owing to a slight rise in anode current considerably increasing the voltage drop across the resistance. A continuously variable resistance, however, of ample current-carrying capacity may be employed and brought to the best adjustment, though in some instances little effect is produced.

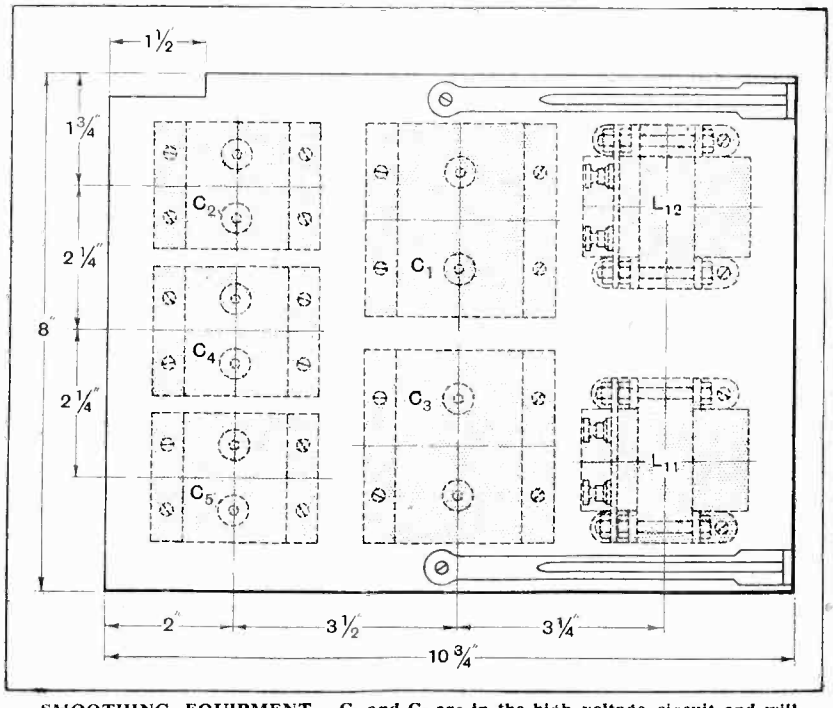
Undoubtedly the best method of deriving two voltage outputs is to run two independent rectifiers, even if

The Complete Eliminator.—

this necessitates the use of the two valves in half-wave rectifying circuits where otherwise they might be connected up to give full-wave rectification.

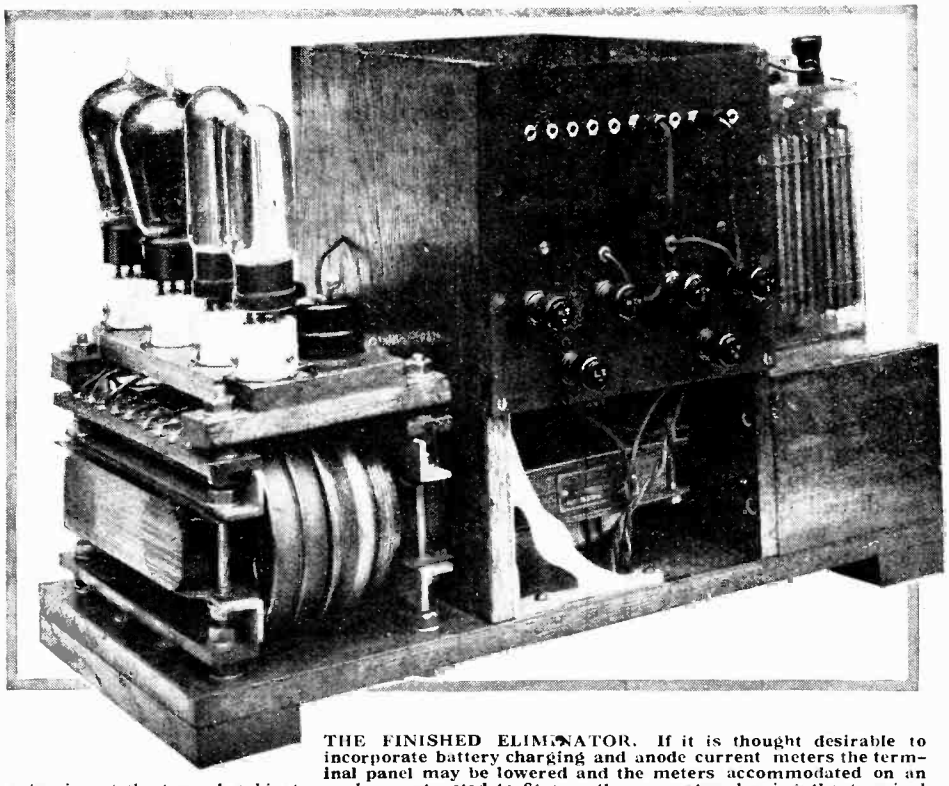
The L.T. Supply.

With the object of entirely dispensing with battery charging, the L.T. supply is included in the eliminator, the aim being to provide an instrument which will not only take the place of the batteries, but one which will render service without attention. Although an accumulator is included in the equipment, it is used essentially for the purpose of smoothing the L.T. supply and for holding the voltage constant. To incorporate all the requirements already discussed, the eliminator must embody a full-wave rectifier giving a high voltage output of, say, 200 to 300 on a load of perhaps 60 mA., a second full-wave rectifier giving adjustable outputs for feeding all but the power stage and a small full-wave arc rectifier for L.T. supply. To operate these several circuits all the necessary voltages are derived from a single transformer designed so that any section can be run independently without appreciably affecting the potentials developed across other windings.



SMOOTHING EQUIPMENT. C_1 and C_3 are in the high-voltage circuit and will withstand 600 volts. C_2, C_4 and C_5 are the low-voltage condensers. The smoothing chokes are designed to pass a heavy current without saturation or heating.

The building of this transformer will not be found difficult if a supply of iron strip of the two widths required is available for assembling the core, though the complete transformer can be procured already made up at a moderate cost.



THE FINISHED ELIMINATOR. If it is thought desirable to incorporate battery charging and anode current meters the terminal panel may be lowered and the meters accommodated on an extension at the top. A cabinet may be constructed to fit over the apparatus, leaving the terminal panel exposed.

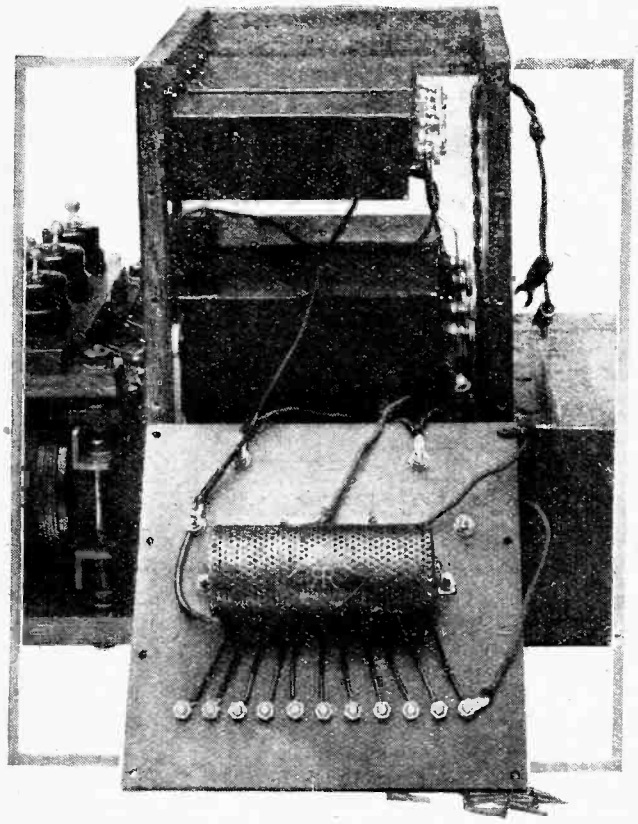
Constructional Details of the Transformer.

Paxolin tubes form the basis for the primary winding, supporting discs being cut from Paxolin sheet to carry larger-diameter tubes, on which are wound the several output sections. Other discs are fitted to separate the high-voltage windings. Complete winding data is given, the two formers being wound in the same direction, and where windings on opposite limbs are series connected junctions are made between the pairs of ends at the termination of the windings, as distinct from joining the beginning of one coil to the finishing end of the other. Each winding must be carefully terminated in a convenient

The Complete Eliminator.—

position for connecting to its particular tags. There are no fewer than 25 leads from the windings, and these are brought to 21 tags.

As it is essential to keep the connecting wires of the smoothing circuits away from leads carrying alternating



THE POTENTIAL DIVIDER. The leads are conveniently arranged for bringing to the sockets, and the connections to the panel are made with flexible wire.

current, the transformer with its rectifying valves is assembled as a unit, the connecting tags being suitably arranged for joining to the various valves. Extensions on the bolts which clamp the core laminations together serve for fixing the transformer to the baseboard and for supporting the wooden valve platform. Small-diameter valve-holders are adopted owing to the limited space, and a miniature tumbler switch is fitted in each of the filament leads, all the connecting tags from the filaments being assembled on an ebonite strip along one side of the transformer. Holes are drilled through the valve platform so that the connections, which in each case are only a few inches in length, pass directly to the respective tags. For wiring the filament circuit of the small arc rectifying valve wire not less than No. 16 S.W.G. must be used, though the remainder of the leads are No. 22 S.W.G. in sleeving. Five wires only, comprising the three H.T. and two L.T. leads, pass from the transformer unit, which can be tested after assembly and then secured to the end of the baseboard. The transformer unit is not required to give mechanical support to other of the gear, all leads passing down directly into the base

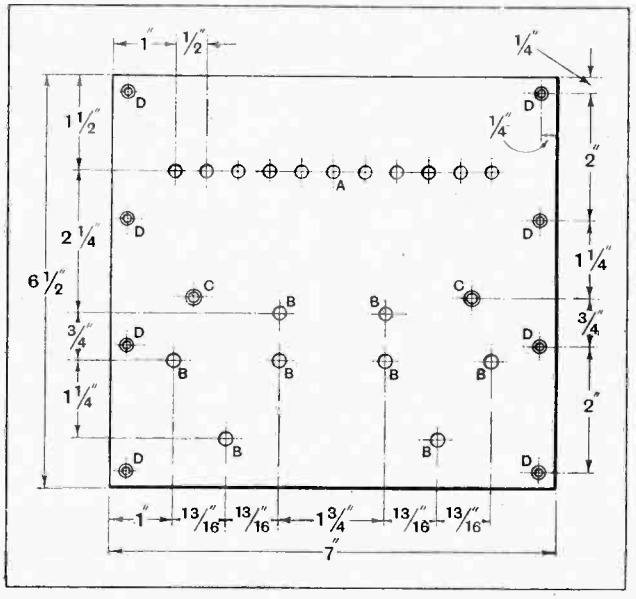
LIST OF PARTS.

Mains transformer (Rich & Bundy, 13, New Road, Ponders End, Middlesex).
2 Low-frequency choke coils (Rich & Bundy, 13, New Road, Ponders End, Middlesex).
4 Athol valve holders.
3 Miniature tumbler switches.
2 Condensers, 4 mfds., 600-volt type (T.C.C.).
3 Condensers, 4 mfds., 300-volt type (T.C.C.).
1 Condenser, 10 mfds., 300-volt type (T.C.C.).
Ebonite sheet, ¼in. thickness, for constructing terminal panel 6½in. × 7in.
Potential dividing resistance (Regent Radio Supply Co., 45, Fleet Street, London, E.C.4).
13 Sockets (The Lisenin Wireless Co., 1a, Edgware Road, London, W.2).
2 Plugs.
6 Terminals, H.T. —, H.T. + 1, H.T. + 2, H.T. + 3, L.T. —, L.T. +.
Planed oak, ¼in. thickness, for constructing the framework, or this can be obtained already constructed at a moderate cost.
1 Pair of aluminium brackets, "Camco" (Carrington Manufacturing Co., Camco Works, Sanderstead Road, South Croydon).
Various brass wood screws.
The valves are: Osram or Marconi, type "U 5," and Phillips, type 329, with resistance tube.

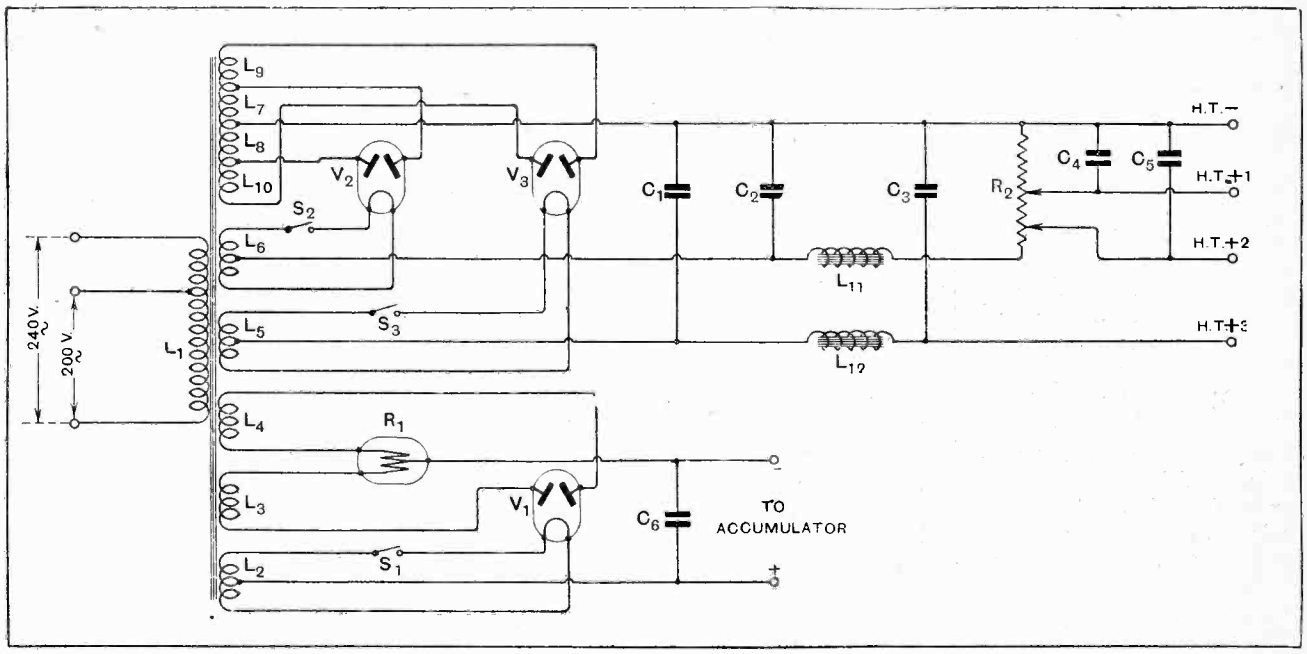
in order to connect to the smoothing chokes at the bottom of the smoothing equipment and the L.T. smoothing condenser without passing near the output leads.

Smoothing Equipment.

A vertical board carries the smoothing chokes and condensers. They are screwed into position on the board and wired before the mounting board is secured in position to the base. Owing to the weight of the condensers this board, after being secured by four screws passing through to the base, is further strengthened by a pair of



TERMINAL PANEL. Dimensional drawing showing the location of the terminals and sockets. Thickness ¼in.; A, ¼in.; B, 7/32in.; C, 5/32in. and countersunk for 4BA screws; D, ¼in. and countersunk for No. 4 wood screws.



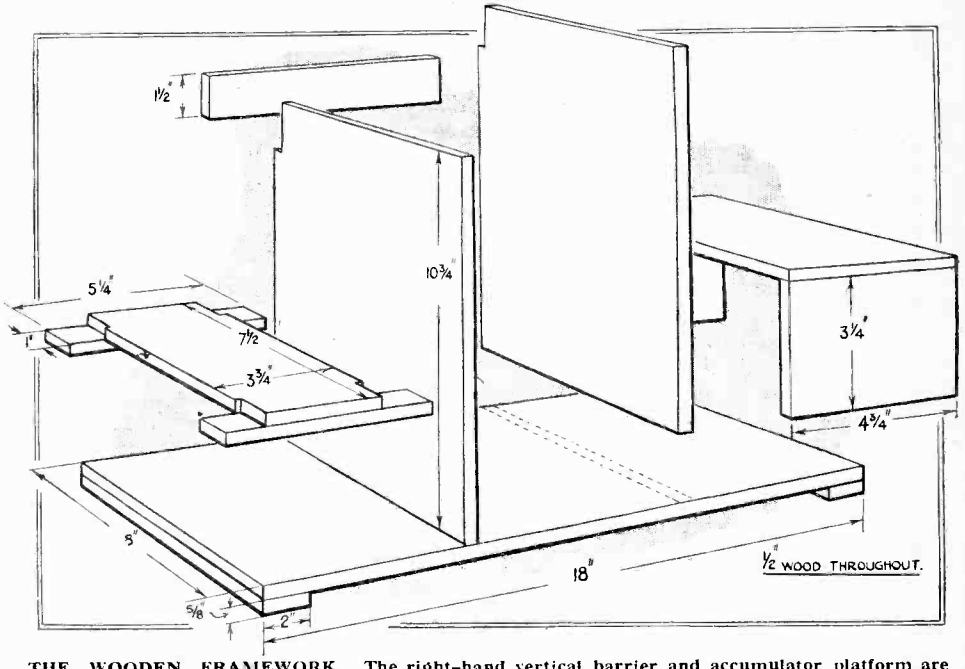
BATTERY ELIMINATOR CIRCUIT. The many sections of the transformer can be identified by reference to the sectional view on page 311. Switches S_1, S_2 and S_3 should not be used when the receiver is in operation, S_2 and S_3 being at high voltage, while the breaking of the heater circuit by S_1 will not stop the operation of the rectifier V_1 after the temperature of the heater has once been raised. V_2, V_3, full-wave thermionic rectifiers. C_1, C_2, C_3, C_4, C_5, are 4 mfds. C_6, 10 mfds. R_1, protecting resistance. R_2, potential divider, 10,000 ohms. L_{11}, L_{12}, smoothing chokes, 20 henries.

substantial brackets. By reference to the circuit diagram and to the plan view of the smoothing apparatus, the various condensers can be identified, and this layout should be followed owing to convenience of wiring. Although not appearing in the illustrations, a large-capacity low-voltage condenser is accommodated under the platform which supports the accumulator.

Both of the H.T. circuits are capable of giving liberal output, and consequently a potential divider may be used to supply the several voltages required by the H.F. detector and first L.F. stages, particularly as only a small current will be taken in these circuits. A critical voltage is, moreover, usually required, not only in the case of H.F. valves but the detector if an anode bend rectifier, while the first low-frequency valve may be of a type providing for only a limited grid voltage swing.

Terminal and Instrument Board.

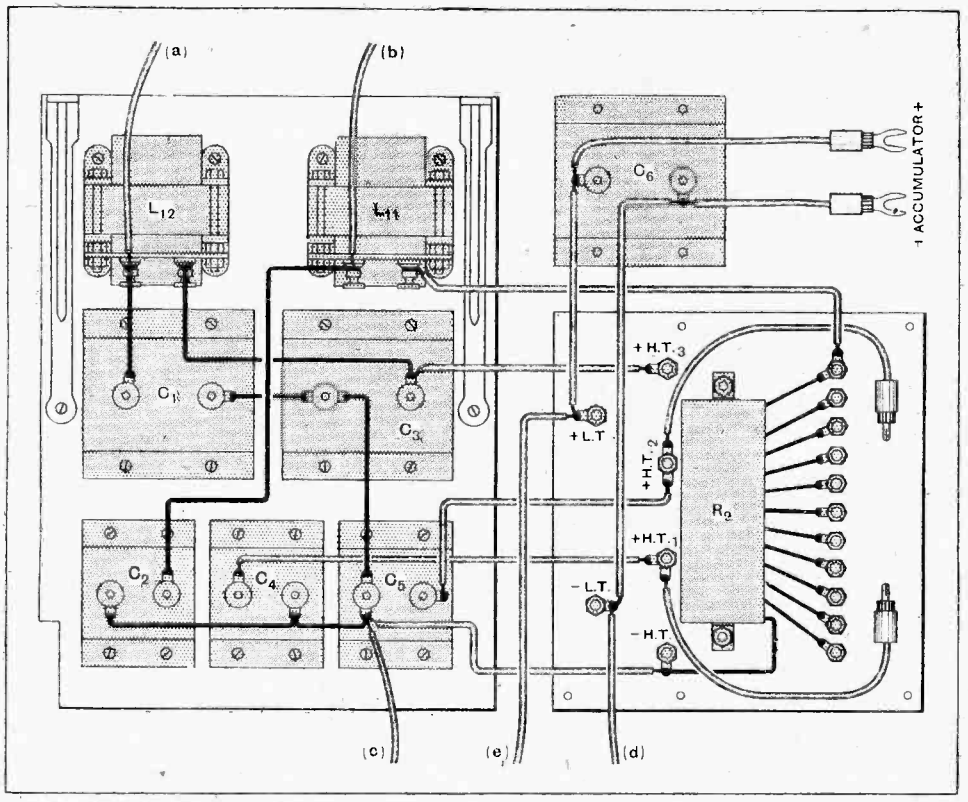
The output terminals, as well as the tapped resistance, are accommodated on an ebonite front panel which also serves to strengthen the vertical board which carries the chokes and condensers and the board which serves as a barrier between the smoothing apparatus and the acid spray from the accumulator. As a potential divider can be purchased quite cheaply, this component scarcely warrants the trouble of construction. It is wound to a resistance of 10,000 ohms, and in addition to the ends of the wire has 10 tappings at even intervals, so that 11



THE WOODEN FRAMEWORK. The right-hand vertical barrier and accumulator platform are added after the smoothing equipment has been wired. In view of the weight of the components it is best constructed of oak.

The Complete Eliminator.—sockets are required for plugging in on to the various potentials. It is secured to the panel by means of two 4BA screws and nuts, while in addition to the sockets at the tapping points two others are provided immediately over terminals H.T. + 1 and H.T. + 2. Flexible leads are used to connect the panel with the condensers, so that it can first be wired and then screwed back into position. Two sets of flexible leads connect to the L.T. terminals, which pass straight down through the base, one pair connecting the transformer unit, and the other with the L.T. smoothing condenser continuing on to a pair of tags for joining to the accumulator.

A useful addition to the eliminator, as shown, is the provision of a milliammeter reading to 100 mA. in the high-voltage output, and a charge and discharge meter reading to 2 amperes in either direction in the L.T. circuit. These instruments may well be accommodated side by side on the terminal panel, which can be extended to reach to the lower edge of the baseboard The brackets can then be dispensed with, and if the meters are of the flush type the entire smoothing equipment may be shifted back $\frac{5}{8}$in. The drawing of the panel can still be followed and the instruments accommodated above the potential divider. The charge and discharge meter is merely connected in one of the battery leads.



WIRING THE SMOOTHING EQUIPMENT. Flexible leads are distinguished from the stiff wiring. The leads passing from the transformer unit are identified by the reference letters.

Nothing that is in any way optional has been included in the eliminator, though in the design of the transformer and chokes, as well as in the size and break-down voltage of the condensers, a liberal margin has been allowed. Although possessing an inductance of over 20 henries, the smoothing chokes are capable of passing 300 milliamperes without saturation or appreciable heating. On the low-voltage H.T. circuit the condensers are of the 300-volt grade only, as the resistance permanently across the output prevents the peak voltage rising beyond 100 volts. On open circuit well over 200 volts will be developed on the high-voltage rectifier, and the actual peak voltage as set up by the alternating current through the rectifying valve will be appreciably higher. It is essential, therefore, to adopt condensers rated to withstand 600 volts.

Modifications.

As there is very little scope as regards the making up of battery eliminators, it is probable that those readers not requiring such a liberal H.T. output will readily comprehend the modifications necessary for constructing an eliminator to their own particular requirements. Transformer manufacturers can supply this component with windings for any input and output voltages on stating the types of valve to be used, As the rectified output potential varies so considerably with the load and the type of rectifying valve employed, only a rough estimate can be made of the potential required from a transformer H.T. winding. When using a full-wave rectifying valve of the U.5 type on a load not exceeding 20 mA. the transformer voltage should be about 10 per cent. greater than the required output, remembering that the two H.T. sections of a full-wave rectifier are virtually in parallel. The valves used in this instance are the Phillips type 329 with the corresponding resistance, together with two Marconi or Osram U.5 type valves.

No provision has been made for supplying grid biasing potentials as the additional cost so far exceeds that of maintaining a dry battery, grid bias cells giving possibly over a year's service without attention.

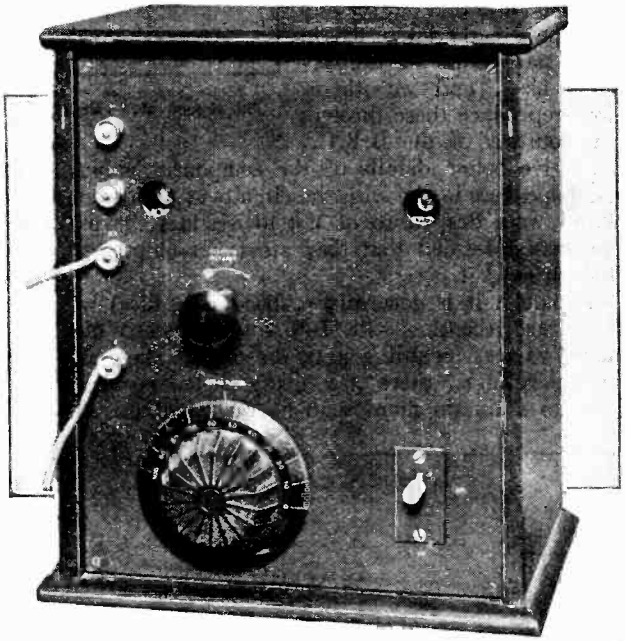
This eliminator can be relied upon to give continuous service without attention and is intended for running a set fitted with one or more power amplifying valves. It is particularly suitable for use with a receiver in which the output is distributed to various rooms, as it is brought into operation by the closing of a single-pole switch in the transformer primary, and this can be readily adapted for remote control. When quality is the first essential this eliminator will be found to be one of the best methods of deriving the necessary plate potentials.

B 14

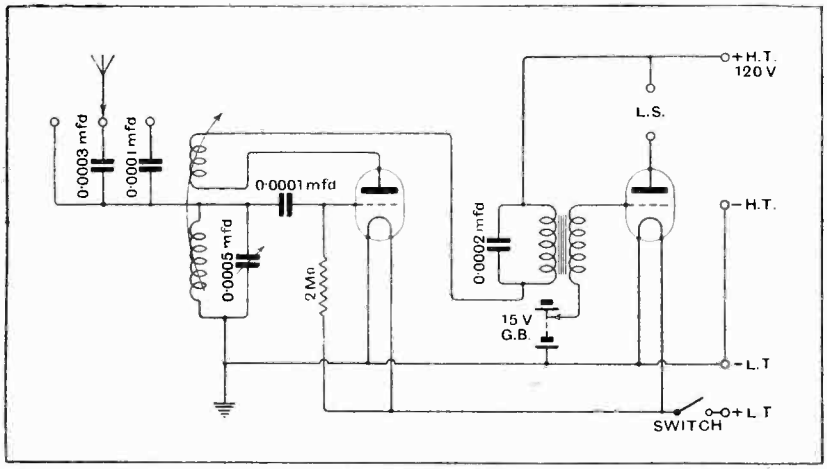
Range of Receiving Sets Recommended by the B.B.C.

FROM the point of view of the wireless visitor to the *Daily Mail* Ideal Home Exhibition at Olympia, no doubt the most interesting exhibit is that of the British Broadcasting Corporation in the Gallery. Excellent scale models are shown of the Daventry station, the control room at 2LO, and a typical studio at the B.B.C. headquarters; but, although these exhibits attract a great deal of interest, and should certainly not be missed by those who have not had the opportunity of seeing the real thing, they are not of such outstanding importance as the demonstrations of broadcast reception, which are conducted during broadcasting hours by means of three sets specially built and installed by engineers of the Corporation.

Readers will remember that in our issue dated February 16th we made a special appeal for a campaign for quality, the purpose being to educate the non-technical public to a proper appreciation of what could be attained in the way of first-class reproduction of the broadcast transmissions, and we concluded with a recommendation that the British Broadcasting Corporation should take steps to arrange demonstrations of this nature. Under these circumstances we naturally feel that what has been done at Olympia is of outstanding importance, and we hope that it is only the forerunner of many other, perhaps even better, demonstrations to be conducted whenever opportunity occurs all over the country.



Two-valve demonstration receiver. The control above the tuning condenser adjusts the reaction coupling, and the key on the right is the "on and off" switch.

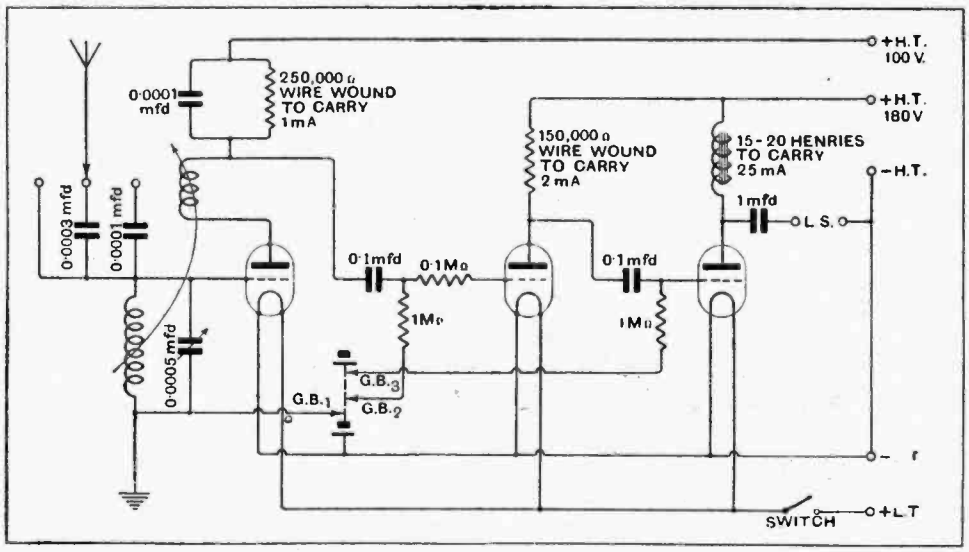


The inexpensive two-valve broadcast receiver. Plug-in coils are used to permit of tuning to Daventry. Grid rectification with reaction, series aerial condenser and transformer coupling are adopted.

For the purpose of the demonstrations at Olympia the three receivers available are two-valve, three-valve and four-valve sets, and, whilst the values and the circuits are disclosed, the

B.B.C. Quality Demonstration. — B.B.C. point out that they cannot give information nor allow details to be published to indicate the actual make of components in use. The reason for this, of course, will be obvious: the B.B.C. must act in an entirely impartial manner towards manufacturers of wireless apparatus, and the selection of any particular components in a demonstration set might be regarded as an act of favouritism on their part, giving undue publicity to an individual manufacturer.

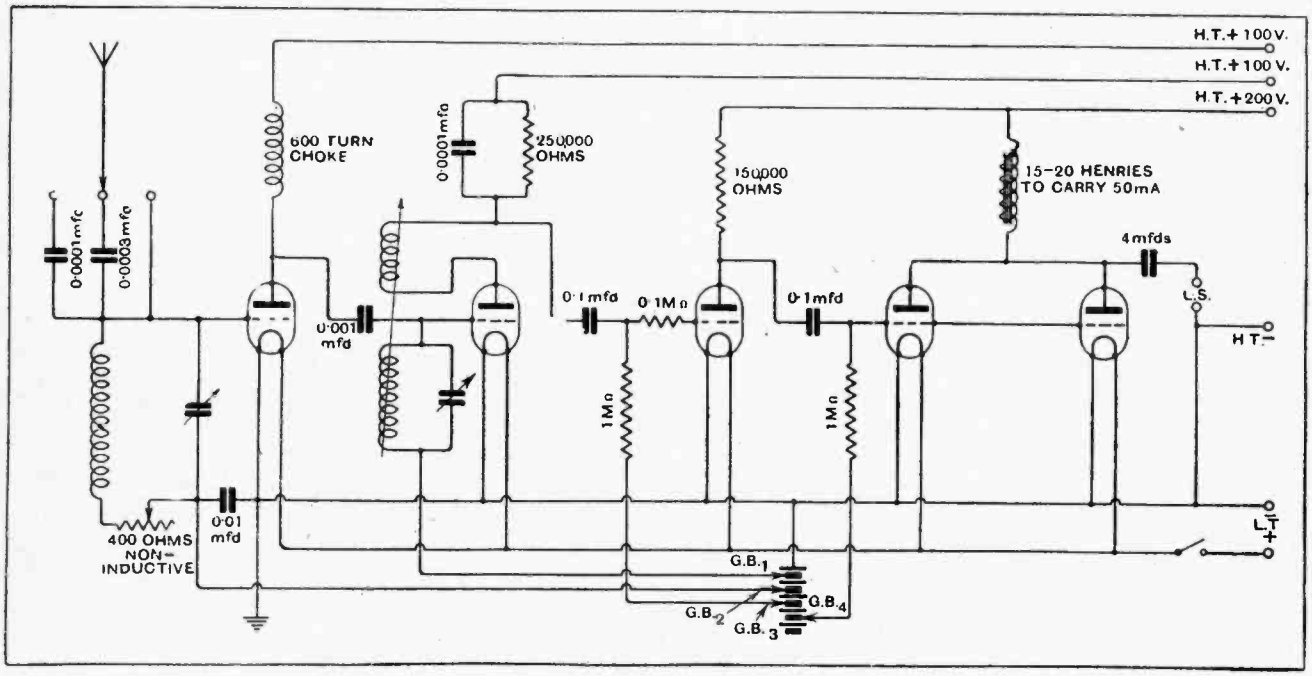
We believe that our readers will be greatly interested to have particulars of the circuits used, and we therefore reproduce these through the courtesy of the B.B.C., and give below details of the component values. The loud-speakers in use with the circuits at the demonstration stand were draped so as not to disclose the make, but we were informed that they are types at present on the British market.



The three-valve receiver makes use of an anode bend detector valve followed by two resistance-coupled low-frequency stages.

Although it is generally realised that ideal quality in broadcast reception with full volume means the use of many valves, including a power output stage with high anode voltage, there are many listeners who are unable to maintain more than a two-valve set. It is the two-valve set that is the most popular, the valves being used in such a way as to render the set sensitive and to provide a satisfactory signal strength for operating a small loud-speaker. Some sacrifice of quality is unavoidable when the receiver is limited to only two valves.

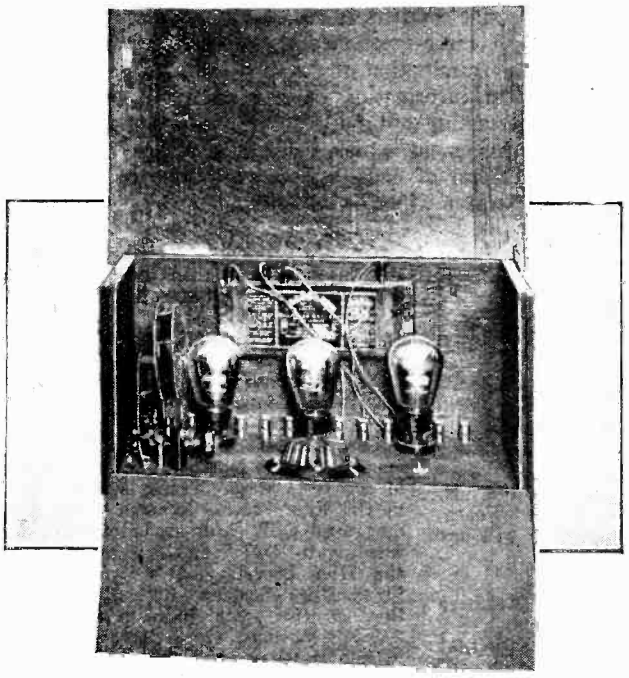
The two-valve circuit shown represents the best arrangement for obtaining maximum range and signal strength with reasonably good quality. The aerial circuit is tuned by means of a parallel connected inductance and condenser, while, to compensate for differences in aerial capa-



It is interesting to note the method by which self-oscillation is controlled in the four-valve receiver, a variable resistance being connected in the tuned aerial circuit, and adjustable reaction coupling is provided in the high-frequency amplifying stage. The low-frequency amplifiers are resistance coupled and parallel connected valves are used in the output stage.

B.B.C. Quality Demonstration.—

city, series condensers may be introduced. Apart from the use of reaction, the selectivity is controlled by connecting the aerial tapping through one of the series condensers, which has the effect, moreover, of adjusting the aerial load and the tendency of the circuit to break into oscillation. The aerial tuning inductance is a plug-in coil, and reaction is applied by a second coil mounted in a two-coil holder. The circuit, of course, is a well-known arrangement, but it is to the values of the various components that attention has been given with a view to



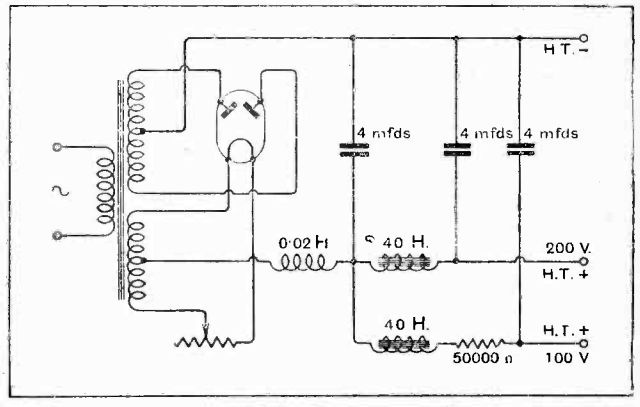
The three-valve receiver fitted with a single tuning control and adjustable reaction coupling.

obtaining the best results with convenience of adjustment. It is interesting to note, for instance, that the grid condenser has a capacity of 0.0001 mfd. in combination with a grid leak of the usual value of 2 megohms. Across the primary of the intervalve transformer is a condenser having a capacity of 0.0002 mfd., while the anode voltage applied to both valves is 120, and provision is made for negatively biasing the L.F. valve up to a potential of 15 volts.

Circuit Values.

Fearing that the use of certain components might be taken as a recommendation for their adoption in preference to others, no information is available as to types of valves, transformers, tuning coils, or condensers. As the circuit arrangement is usually designed for use with particular types of valves, some of the information to be gleaned from the circuits is of little value. One should make a careful examination, therefore, of the available data concerning valves when selecting suitable types.

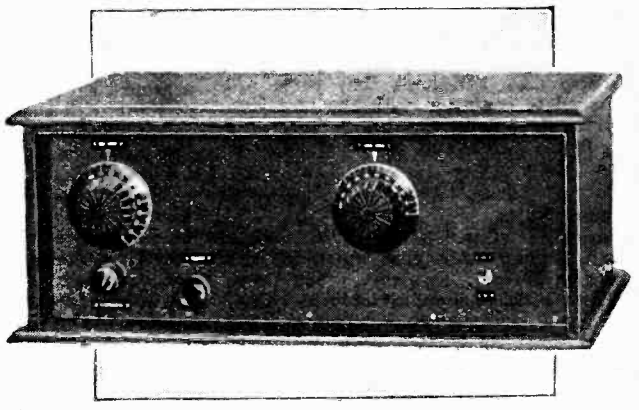
The two-valve receiver is a one-dial set with on-and-off switch; it is easy to handle, and will give good loud-speaker results up to a range of eight miles' radius from



A.C. battery eliminator for providing the high anode potentials required for operating the four-valve set.

a broadcasting station. It requires only a single H.T. potential, which is an advantage when a battery substitute is employed.

The three-valve receiver comprises a detector valve with reaction, provided by plug-in coils, followed by two resistance-coupled stages. Here, again, it is interesting to note the values chosen for the various components. The anode resistance in the plate circuit of the detector valve, although rated to carry only 1 mA., is wire-bound to a resistance of 250,000 ohms, and the by-pass condenser which bridges it is smaller than is sometimes advocated. The interstage coupling condensers have a value of 0.1 mfd., and are used in conjunction with 1-megohm grid leaks, while, to prevent the passing of high-frequency currents to the low-frequency amplifier, a resistance is inserted in the lead to the grid of the second valve. A choke-feed output is arranged consisting of a 20-henry choke in the plate circuit to the output valve, while the loud-speaker is connected in series with a 1-mfd. condenser. The first valve is an anode bend detector, and is negatively biased to the extent of 1.5 to 3 volts. A similar type of valve to the detector is used in the first L.F. stage, while the second L.F. valve is a special power amplifier. Two anode voltages are required, and the method by which these two outputs may be obtained from a battery eliminator is also shown.



The controls of the four-valve receiver comprise the dials of the two tuning condensers, variable resistance for oscillation control, adjustable reaction coupling, and "on and off" switch.

B.B.C. Quality Demonstration.—

It is to be assumed that in the four-valve receiver there are no limitations as to cost. The aerial tuning is as in the other sets, while a stage of high-frequency amplification has been added.

The constant anode current of the high-frequency valve is fed through a H.F. choke coil, partly for the purpose of rendering the amplifier selective and also to permit of the use of anode bend detection. It is interesting to observe that reaction is applied to the tuned intervalve coupling to improve the operation of the detector, the inductances being in the form of plug-in coils in a two-coil adjustable mounting. A critical control by way of limiting self-oscillation is obtained by the introduction of a variable resistance in the tuned aerial circuit, the winding of a potentiometer being found convenient for this purpose. In the output stage are two parallel connected power valves fed through a 20-henry choke, the loud-speaker being connected in series with a condenser of 4 mfds. A H.T. voltage of 200 is recommended for the last two L.F. stages, the H.F. and detector valves working on 100 volts.

That the use of a battery eliminator for H.T. supply can be recommended when quality is a first consideration is indicated by the exhibition of a valve rectifier. The circuit arrangement is an orthodox one, except that a filament rheostat controls the potential applied to the filament of the rectifier, though unfortunately the type of valve employed is not stated. The maximum voltage output is given as 200 on normal load, and a second voltage is obtained by the use of a series-connected high resistance. The smoothing inductances are of liberal size, and the three shunt condensers necessary have each a value of 4 mfds. A radio-frequency choke is also introduced.

From an examination of the sets, the listener can obtain much useful information on the points to be observed when constructing a broadcast receiver, though it is the circuit arrangement which is of importance rather than the actual form of construction which has been adopted in the apparatus which is exhibited.

Russian Amateurs.

We understand that licensed amateur transmitters in Russia are allotted a call-sign composed of two numerals followed by the letters RA, *e.g.*, 05RA.

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Belgian Amateurs.

Mr. Louis Era (EB 4BC), 46, Avenue Van Put, Antwerp, a photograph of whose station appeared in our issue of December 15th, 1926, is now transmitting on 19.50, 32.50, and 45.20 metres, with an input of 50 watts, obtained from a 500-volt D.C. accumulator. He has lately been in two-way communication with AI DCR, in Rawalpindi, on 45.20 metres, and with NU 1SW, at Andover, Mass., U.S.A., on 19.50 metres; he intends carrying out a regular schedule of tests with the latter station at 1815 G.M.T. He was also in communication with F 8ARM, Second Q.M. Radio du Croiseur, Lamotte Picquet of Lorient, who was on a short holiday at Rozerette, near Vittel, and he says that amateurs who wish to practise reading rapid transmission will find 8ARM a useful station to listen for.

A number of Belgian amateurs have now been officially licensed since February 20th, and we hope soon to be able to give a complete list of their call-signs and addresses. They will use the signals 4AA to 4ZZ, and hope that these will not lead to confusion with the new German amateur call-signs, which consist of the figure 4 followed by three letters—4AAA to 4ZZZ.

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General Notes.

Mr. E. H. Capel (G 5FQ), 32, College Road, Harrow, states that his station was heard in Hobart, Tasmania, when transmitting with an input of only 3½ watts. The signal strength was reported as R3-4.

The American amateur station U 3VF, owned and operated by Mr. O. F. Grapp, 1743, North Taney Street, Philadelphia, Pa., is working every evening between 2300 and 0100 G.M.T. on 38.2 metres with an input of 45 watts, and is anxious to get into touch with British amateurs.

TRANSMITTING NOTES AND QUERIES.

QSL cards may be sent via Mr. N. Thompson, Old Shotton Water Works, Castle Eden, Co. Durham, who will forward them to 3VF.

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Radio Transmitters' Union (Northern Ireland).

At a recent well-attended meeting of the Radio Transmitters' Union of Northern Ireland, held in Belfast, arrangements were made for a series of tests with amateurs in Denmark and France. A week is to be set apart for tests between Northern Ireland and Denmark, commencing at 2300 G.M.T. on Sunday March 13th. On each night of that week the hours of work will be from 2300 to 0100. On Sunday, March 20th, the hours will be 1000 to 1300, 1400 to 1500, 1830 to 2000, and 2300 to 2400, when these tests will finish.

The date of the French tests will be arranged shortly and will follow the lines of those with Denmark. No restriction is to be placed on the power used except the usual one embodied in the operator's licence, which limits the input to the minimum necessary to effect communication. Most of the "GI" stations will, however, be testing on quite low powers, and it is hoped to add considerably to the experience gained during the recent low-power tests of the R.S.G.B.

The Ulster transmitters are steadily increasing in number and doing good work. Twenty radiating stations are now licensed by the P.M.G., including the Municipal College of Technology, Belfast (2BX), and the City of Belfast Y.M.C.A. (6YM). The R.T.U. is co-ordinating its work to a large extent, and membership in that body is limited to holders of radiating licences who are members of the T. and R. Section of the Radio Society of Great Britain. All members use the nationality prefix "GI," as the prefix "EG," proposed by the I.A.R.U., of Hartford, Connecticut, is forbidden by the Postmaster-General.

The greatest cordiality exists between members of the Northern Union and those of the Irish Radio Transmitters' Society in the Free State. Foreign associations may send QSL cards in batches for forwarding to "GI" stations, addressed to the Hon. Secretary, R.T.U. (N.I.), 22, Stranmillis Gardens, Belfast. Should they at the same time have any for "GW" stations, these may be included in the envelope, and will be forwarded without delay to the Irish Free State. The I.R.T.S. will reciprocate with cards sent to them in Dublin for forwarding to amateurs in Northern Ireland.

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New Call-signs Allotted and Stations Identified.

G 2WT	J. W. Wroth, 5, Hennington Road, Tottenham, N.17. (This call-sign was formerly owned by H. Chadwick, at Bolton.)
G 6HP	(ex-2BYN) H. D. Price, 12, Hillcrest Road, Sydenham, S.E.26.
2BHS	K. C. Wilkinson, Jnr., 113, Half Moon Lane, Herne Hill, S.E.24.
F 8KZ	Leon Vandystadt, 64 bis, Rue Vauban, Roubaix; transmits on 45 metres.
LA 10	Akademisk Radioklubb, Trondhiem, Norway, transmits with 40 watts input at week-ends and will welcome reports.

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We are indebted to M. A. Wust (EB 4AG) and M. Louis Era (EB 4BC) for the following amateur transmitters in Antwerp whose stations are officially licensed :—

4AA	R. Verstrepen, 23, Rue Van Straelen, Antwerp
4AG	A. Wust, 99, Avenue Elisabeth, Berchem-Antwerp.
4BC	L. Era, 46, Avenue Van Put, Antwerp.
4BX	W. J. F. Stevens, 8, Rue Joseph Lies, Antwerp.
4DA	M. Jorssen, 15, Rue de Witte, Berchem-Antwerp.

We understand that they will use the nationality prefix EB, suggested by the I.A.R.U., of America.

HINTS and TIPS for NEW READERS

A Section Devoted to the Practical Assistance of the Beginner.

TRACING A CIRCUIT.

The task of checking the wiring of a receiver, which at first sight may appear to be a confused tangle of connecting leads, is facilitated if we have a fixed point to start from. In a multi-valve set it is as well to begin with the aerial circuit, and then to take the filament, grid, and plate circuits (in this order) of each valve in turn, always returning to or starting from—it matters little which—the negative side of the filament, which

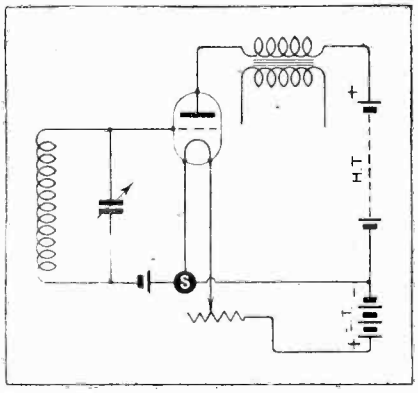

Fig. 1.—The "starting point" of the filament, grid, and plate circuits associated with a valve circuit is marked S in this diagram.

accordingly may be regarded as an imaginary "point of departure."

This plan is particularly helpful when examining an unfamiliar receiver, and is also useful when wiring up a new one. It will depend on circumstances whether it is easier to work from the grid and plate outwards to the filament, or *vice versa*.

Fig. 1 is the skeleton diagram of an anode bend detector valve, in which S is the zero point.

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A TESTING DEVICE.

When testing for faults in such components as anode resistors, grid leaks, intervalve transformers, etc., which normally have a high resistance, there is often a need for something a little more positive than the popular "dry battery and phones" method, which, although excellent in its way, has several shortcomings. Notably, it is difficult, without continual practice, to estimate the relative intensities of the clicks heard when carrying out tests. Failing accurate measuring instruments, the use of a buzzer connected up as shown in Fig. 2 (*b*) can be recommended. This arrangement affords a convenient source of pulsating voltage.

The instrument, preferably with its dry battery (one or two dry cells or a 4½-volt flashlamp battery should be sufficient), an on-off switch, and four well-insulated terminals or plug sockets, should be mounted on a small wooden baseboard. The two pairs of terminals are connected as shown. All buzzers are arranged more or less as in the diagram (*a*), and in any case it will not be a difficult matter to pick up connection with the ends of the magnet windings, one of which will generally be joined to the frame.

To make a test, a pair of head telephones are joined to the terminals marked "Tel.," while two flexible leads, which should for convenience be fitted with electrodes having an insulated sleeve (the so-called "pin terminals" will serve), are connected to the remaining terminals. The buzzer is put into operation by connecting the battery, or closing the switch, if one is fitted, and the testing leads are applied across the part of the circuit or the component under suspicion. One must rely largely on comparison between the intensity of sound heard when testing various values of resistance; all those used in a receiver are hardly likely to fail at the same time. It will be clear, for example, that a louder "buzz" in the phones should be heard when they are connected in series with a 100,000-ohm anode resistor as compared with a 2-megohm (*i.e.*, 2,000,000-ohm) grid leak. The primary of a step-up transformer should, under test, show a lower resistance than the secondary.

An arrangement of this sort is useful as a rough indication of the value of condensers; it is impossible to mistake the difference in sound intensity

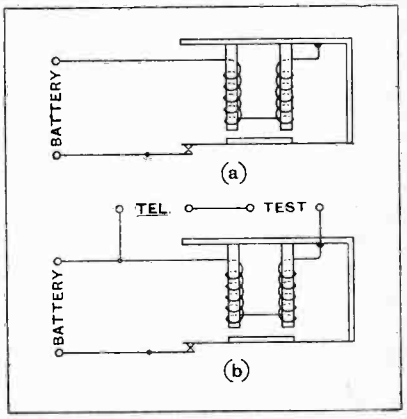


Fig. 2.—(a) The connections of a typical buzzer. (b) The connections of a testing circuit across the magnet windings

when testing across capacities of, say, 0.0001 and 0.0002 mfd. The buzzer used in this way will not, however, indicate the insulation resistance of a condenser; this must be checked by other means.

Circuits in which there is appreciable capacity must be tested with some care, or results may be misleading. For instance, a faint "buzz" may be obtained through the broken winding of a transformer due to the capacity existing between the sections which are intact.

Ohmic resistances of up to at least 10 megohms may easily be tested.

DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 63.—A "Single-coil Reinartz" Receiver with L.F. Amplification.

The present series of diagrams is intended to show in an easily understandable manner the various points to which special attention should be paid in designing typical wireless receivers. The simplified Reinartz receiver shown below is extremely popular, and is particularly adapted to reception of wavelengths from 600 metres downwards.

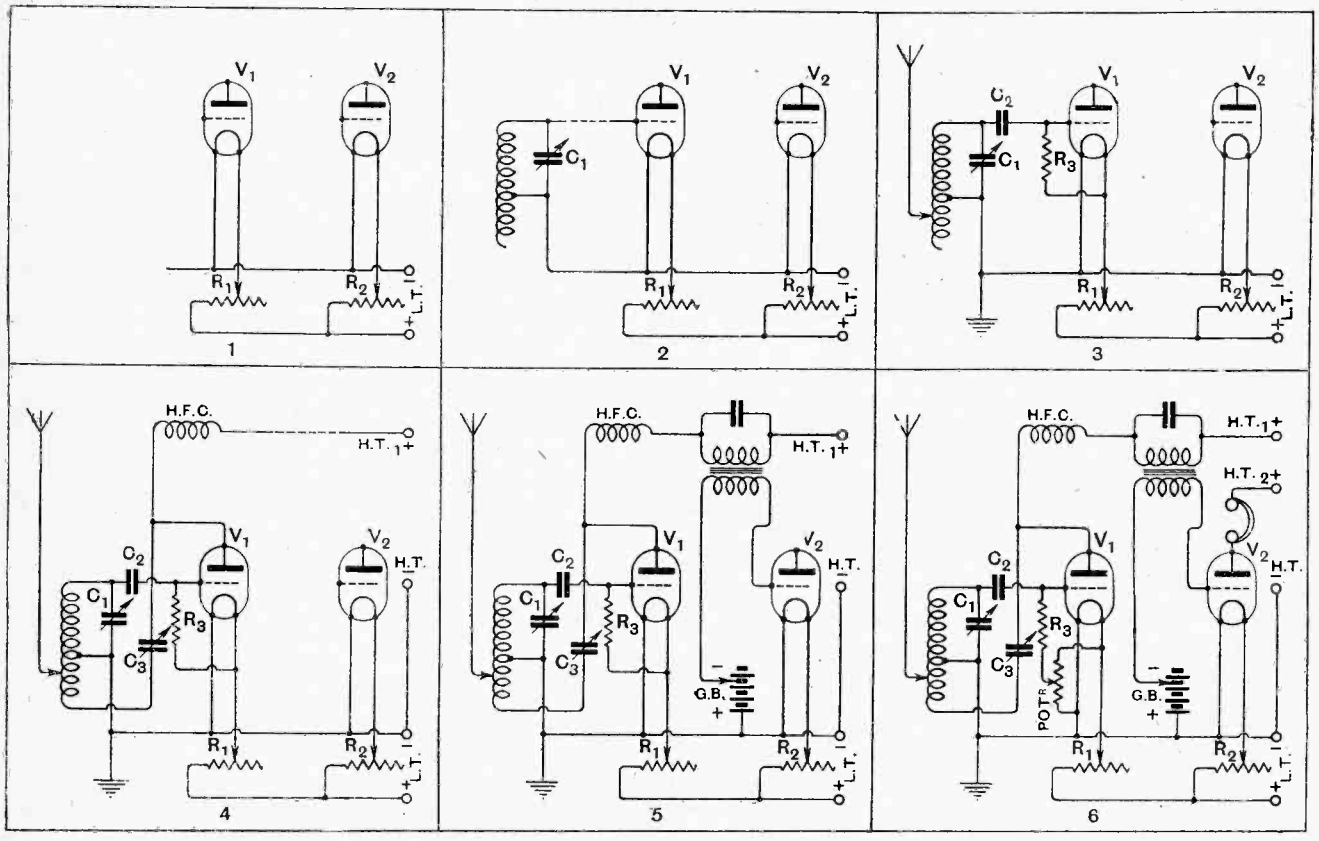
THE valve V_1 is to act as a detector, so it should have a moderately high amplification factor; consequently, its impedance will be about 20,000 ohms. V_2 is an L.F. amplifier and at the same time the output valve, so a low-impedance pattern is required. The filament rheostats R_1 and R_2 should be chosen by applying the rule already given.

In Figs. 2 and 3 the tuning condenser C_1 may conveniently have a value of 0.0005 mfd., and the conventional grid condenser (C_2) and leak (R_3) of 0.0003 mfd. and 2 megohms respectively are suitable.

Although the coil (Fig. 4) may consist of a single continuous winding, it is really divided up into three sections—grid, aerial, and reaction. The part of it in the aerial circuit is that between the aerial and filament tappings, while the reaction winding comprises that between the lower end of the coil and the filament tapping. For the broadcast waveband 65 turns of No. 22 D.C.C. may be wound on a 3in. former. This forms the grid section. The aerial and reaction windings are wound as a continuation, and may have a total of 40 turns. From considerations of space this may be of finer wire—No. 30 D.C.C. is suitable. The aerial will be joined to a point about 10-15 turns below the filament tapping. The H.F. choke may be of a commercial pattern; it should have high inductance, low self-capacity, and preferably a restricted external field, which means in practice that its diameter will be small. The reaction condenser C_3, through which H.F. impulses are fed back to the grid circuit, may have a value of 0.00025 mfd. Its insulation resistance should be high, as it must withstand the voltage of the H.T. battery.

The recommended modification to the grid circuit of the detector valve, shown in Fig. 6, which allows of fine control of grid voltage, is to be recommended.

Various modifications of the Reinartz circuit will be shown in next week's issue.



(1) The conventional connections of the filament circuit, with separate controlling rheostats for each valve. (2) The tuned grid section of the coil is connected between grid and filament of the detector valve. (3) A condenser and leak are interposed for rectification. Aerial and earth are connected. (4) The two parallel anode circuits are completed; the first through the H.F. choke and H.T. battery, and the second through the reaction condenser C_3 and the lower part of the coil to the negative battery connection. (5) The primary of an L.F. transformer, usually shunted by a by-pass condenser, is inserted in series with the anode of the detector valve. The secondary is connected between grid and filament of V_2, a bias battery being interposed. (6) The anode circuit of the L.F. amplifier is completed through the phones or loud-speaker and the H.T. battery. A potentiometer for the detector valve has been added to provide a control of the grid voltage.

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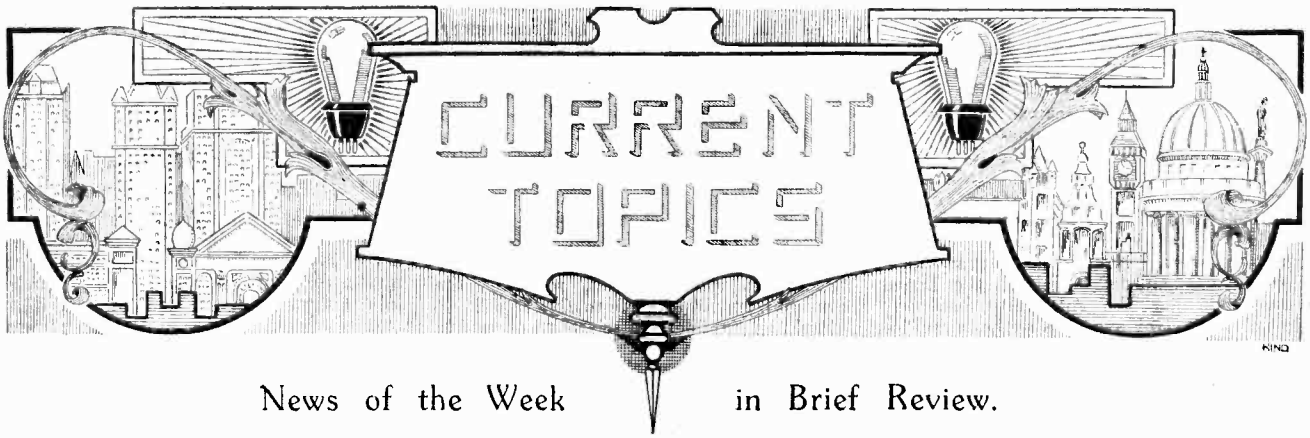

News of the Week in Brief Review.

BROADCASTING ON THE AMAZON.

At Manaos, situated several hundred miles up the River Amazon, a broadcasting station is to be erected having a power of 1 kilowatt and operating on 100 metres.

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'PHONING TO CUBA.

On Friday last the Post Office Transatlantic telephony service was extended to the island of Cuba. The charge is £17 8s. for the first three minutes when speaking to Havana, and £18 for other places in the island.

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GERMAN BROADCASTING PROGRESS.

Herr Schätzel, Minister of German Posts, announces that the number of licensed listeners in Germany during 1926 was approximately 1,500,000, representing an increase of a quarter of a million in the year. German broadcasting is at present carried out by ten companies from 22 stations.

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WIRELESS OPERATOR KILLED IN STORM.

Mr. George Reynolds, aged 24, wireless operator on the British steamer *Seistan*, which was caught in a cyclone near Madagascar on March 3rd, was killed while preparing to send out a distress message. It appears that in the confusion occasioned by the storm he accidentally came in contact with a high-tension wire.

CHANCE FOR BRITISH EXPORTERS.

The arrival of a single British-made wireless set in Honduras is reported to have created a sensation. Hitherto Honduras has depended solely on American wireless gear.

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WELSH STATION STILL IN DEMAND.

Following the example which is being set by several Welsh towns, the Swansea Education Committee is supporting a motion in favour of erecting a broadcasting station catering solely for Wales in order to maintain Welsh individuality and culture.

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CHEAPER BEAM PLEA.

A plea for a cheaper tariff for beam wireless is being made by the commercial community in Australia. The rate of 2s. per word for beam communication between Australia and England was originally fixed when high-power stations costing over £1,000,000 were to be used, states Mr. James M. Dunlop, president of the Associated Chambers of Commerce in Australia. Meanwhile, the cable companies are lowering their rates and are proposing to make further reductions, which will bring the cable rate down to 2s. a word. One of the supposed advantages of the beam system is its cheapness, but the indications are that the cables will easily compete.

NEW TRANSATLANTIC TELEPHONY STATION.

Preliminary experiments, it is understood, are now being carried out at the new Post Office Transatlantic telephony receiving station at Kembach, near Cupar, Fife. The land line linking the station with the Cupar Post Office has been completed.

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TELEVISION IN BRADFORD.

Mr. Charles Baxter, a young Bradford engineer, claims to have invented a system of television superior to any other method now being attempted. He dispenses with special illumination and relies upon a rapidly moving beam of light playing on the subject to be transmitted. Unfortunately, Mr. Baxter is meeting with the same obstacle as other workers, viz., a blurring of outlines in the reproduced image.

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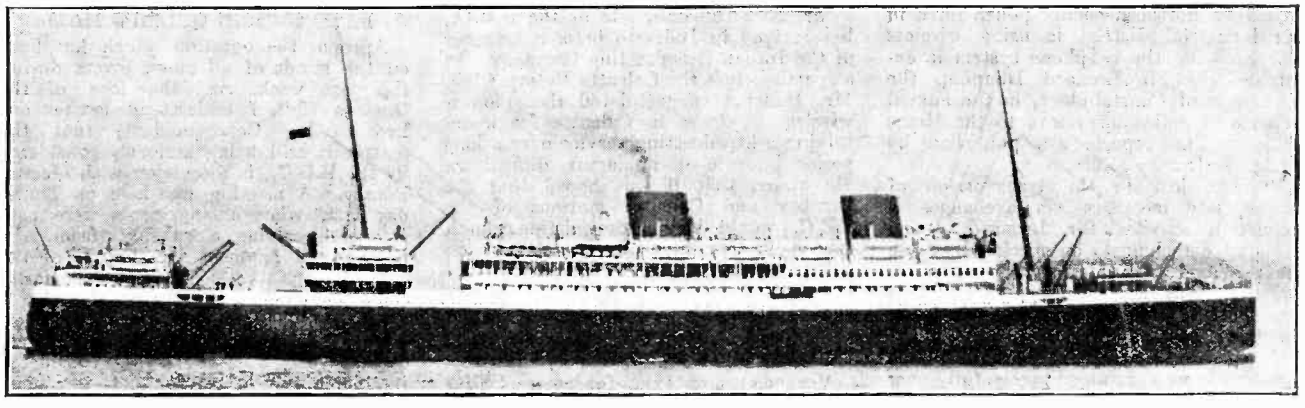
THE "EVERYMAN FOUR" BOOKLET.

The popularity of the "Everyman Four" constructional booklet recently issued by our publishers may be judged by the fact that the first edition is completely sold out. A second edition is now available.

The booklet has been prepared to meet the demands of a large number of amateurs who have been attracted by the excellent performance of this "set of the



THE LAST WORD IN MARITIME WIRELESS. The world's latest and largest motor liner, the "Alcantara," which has left Southampton on her maiden voyage to South America. Besides possessing the most up-to-date wireless installation for communication with land stations and ships, the "Alcantara" owns a complete music and speech distribution equipment, together with a broadcast receiver.

season." It is obtainable from all newsagents and booksellers, price 1s., or post free from our publishers at 1s. 2d.

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RADIO "LIGHTHOUSES."

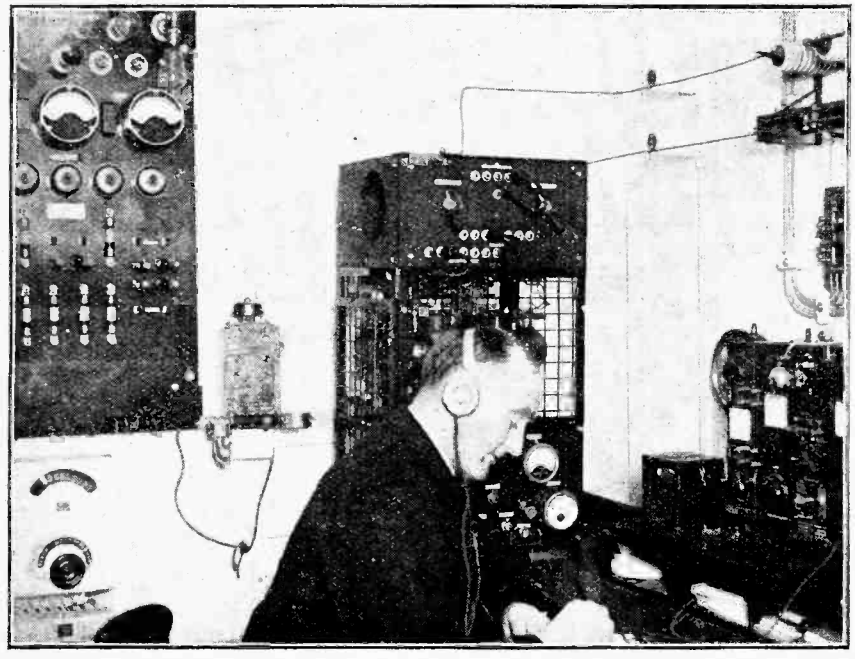
The Liverpool Steamship Owners' Association, in their annual report for 1926, draw attention to the fact that, although the introduction of wireless has been of the greatest importance in the protection of shipping routes, the extent to which radio "lighthouses" can replace general lights has never been properly considered. Neither the Board of Trade nor the Admiralty has any effective control over the authorities now charged with the administration of the lighthouse services, all such matters having to be brought under the review of Parliament

THE MARCONI COMPANY.

At the time of going to Press uncertainty still exists regarding the future control of Marconi's Wireless Telegraph Co., Ltd. The shareholders have to choose between a definite plan based on the recommendations of an independent accountant, Sir Gilbert Garnsey, and a proposal to appoint a new board of directors.

Sir Gilbert Garnsey's recommendations include a capital reduction involving a cut of 10s. per ordinary share, the preference to remain intact, reducing the capital from £4,000,000 to £2,374,954.

Opinion in financial circles appears to be in favour of the board's proposals, i.e., the adoption of the recommendations referred to above. The choice rests with the shareholders.



IN THE "ALCANTARA'S" WIRELESS CABIN. The Marconi operator is seen receiving a message. Note the C.W. transmitter in the background. The cabin contains a miniature "S.B." switchboard providing for the control of the music distribution equipment installed throughout the ship.

WIRELESS AND COUNTY POLICE.

How a northern county police force in an industrial district is using wireless for relieving the telephone system is explained by Sir Leonard Dunning, the Inspector of Constabulary, in the annual reports of police inspectors to the Home Office. The reports are published by H.M. Stationery Office.

"Time lost in the transmission of appropriate messages *via* exchanges is obviated," writes Sir Leonard, "and isolated detachments on special duty can be provided with means of communication. I have been surprised to find that transmitting and receiving sets can be so inexpensively established.

"Communication by wireless telephony has also been maintained successfully over shorter distances. In my opinion, this development has great police possibilities for use in wide districts."

INDIAN LISTENERS TO WAIT?

Mr. Eric Dunstan, late of the B.B.C., has arrived in India to become manager of the Indian Broadcasting Company. In a speech before the Calcutta Rotary Club, Mr. Dunstan congratulated the pioneer wireless amateurs in Calcutta for maintaining a broadcasting service over a long period in spite of numerous difficulties. He stated that it was hoped that the Bombay and Calcutta stations of the I.B.C. would begin transmitting simultaneously, though, owing to delay in the shipment of necessary materials, the first broadcast might not take place until the end of the year.

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VACANCIES FOR FLYING OFFICERS.

Vacancies now exist for at least fifty young men between the ages of 18 and 25 to be trained as pilots for the Royal Air Force. Entrants who are selected and pass the medical examination will be gazetted to commissions in the reserve of pilot officers on probation. Full particulars are obtainable from the Secretary (S.7 Reserves), Air Ministry, Adastral House, Kingsway, London, W.C.2.

WIRELESS AT WESTMINSTER.

By Our Parliamentary Correspondent.

Amateur Broadcasting in Manchester.

Last week, in the House of Commons, Mr. Day enquired whether the Postmaster-General was aware that the wireless transmitting station of the Manchester Radio Scientific Society, known as 2HD, was broadcasting on a wavelength of 440 metres; whether that was in accordance with the instructions laid down by his Department; and, if not, what action was being taken in the matter.

Sir W. Mitchell-Thomson said he had asked the society to make certain alterations in the class of matter transmitted and to refrain from using the 440-metre wavelength for wireless telephonic transmission. The original licence for the station had been withdrawn and a fresh licence, embodying the revised conditions, had been issued.

Broadcast Licences.

Answering a further question put by Mr. Day, Sir W. Mitchell-Thomson said that the number of wireless receiving licences issued in January was 440,712.

The number of licences issued during the year 1926 was 2,178,000, compared with 1,602,000 in 1925.

Photo-telegraphy.

Mr. Day asked the Postmaster-General whether he had received any requests asking for permission to broadcast pictures by the means of photo-telegraphy; if any experimental tests or demonstrations had been carried out; and, if so, with what result?

Sir W. Mitchell-Thomson replied that experimental wireless licences had been issued to several persons to enable them to undertake experimental work in the direction of the broadcasting of both still and moving pictures. Several systems had been suggested, but the matter was not yet out of the experimental stage.

FATE OF THE QUEEN'S HALL.

Apropos the question which has been on the minds of all music lovers during the past week, viz., the fate of the Queen's Hall, I understand (writes our Broadcasting Correspondent) that the matter is still being seriously considered by the B.B.C., in discussion with Messrs. Boosey. A meeting was held on Thursday last, when arrangements were considered involving a subsidy from the B.B.C. and payment for the use of the hall on each occasion when a performance is relayed.

As to the sums mentioned, I understand that the earliest demands were quite beyond what the B.B.C. considered justifiable. Whether or not the good angel of compromise will put in an appearance is still, at the moment, open to conjecture.

A TOUR ROUND SAVOY HILL.

Part VI.—Arrangements for Simultaneous Broadcasting.

By A. S. ATTKINS.

THE process of linking the various stations by trunk lines to give the facility of rapid switching from one station to another, and at the same time give good quality reproduction at all musical frequencies is one of the most difficult problems which the B.B.C. have had to face.

The circuits handed over by the Post Office for the transmission of music are of the overhead type, and are designed for speech frequencies only, and if a line cuts off at 2,000 cycles per second it is quite good for the commercial work for which the circuits were designed. But, as is well known, this figure is useless for the transmission of music. Fortunately, however, by using main trunk routes composed of a heavy conductor, frequencies of 8,000 cycles pass readily.

These circuits are unfortunately not composed of the same size of conductor throughout their entire length. For instance, all trunk lines from Savoy Hill leave by underground cable for about two miles, and are then joined to loaded underground cables which run to points several miles from the centre of the City, where they finally join the overhead routes. This joining of different size conductors, together with the change in the type of the circuits, gives rise to certain irregularities.

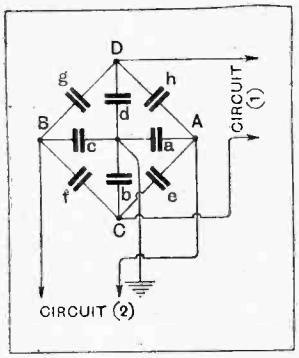


Fig. 24.—Electrical conditions in a two pair core cable.

Sections of several miles of loaded underground cable frequently occur in the composition of the "music" lines. The object of loading a circuit is to increase the efficiency by adding inductance (to a certain limit) to the natural inductance of the line. In some cases the transmission value is improved in the ratio of 4 to 1, in other words, the attenuation is diminished to one-fourth.

Loading Coils.

There are two methods of adding this inductance in actual practice:

1. By the insertion of loading coils at regular intervals.

2. By continuously loading, *i.e.*, by winding over each copper conductor with a close spiral of fine steel wire or thin steel ribbon.

While the overhead line has a high-frequency cut-off, it suffers from instability, owing chiefly to atmospheric conditions. The loaded underground line has the undesired effect of increasing the liability to cross-talk, or interference between neighbouring circuits in a cable. Primarily, cross-talk is due to an out-of-balance condition of the two wires of a circuit in respect of resistance, capacity, self-inductance, and leakage. It is therefore necessary that loaded cables

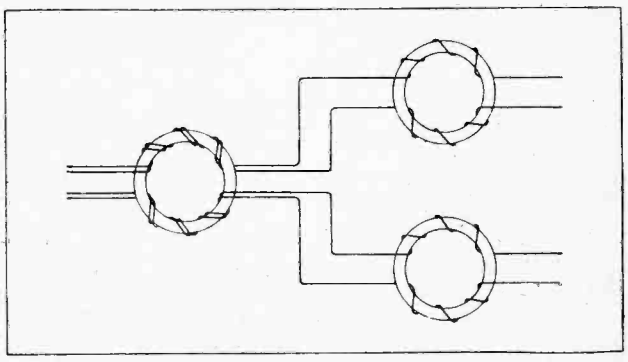


Fig. 25.—Method of inserting loading coils for phantom working.

have the two wires of each pair accurately balanced electrically. By using multiple twin cables, it is possible to simplify the procedure for securing freedom from cross-talk. The wires of these cables possess sufficient balance with regard to resistance, self and mutual inductance, to avoid cross-talk by balancing the electrostatic capacity of the circuits. When any circuit in the cable is liable to be earth-connected, each separate capacity has to be considered in respect to the resultant capacities.

Balancing Capacities.

Fig. 24 shows the electrical conditions existing between a two-pair core in cross-section. Each of the wires A, B, C, and D has a capacity to earth in addition to the wire-to-wire capacity. Hence for a condition of no

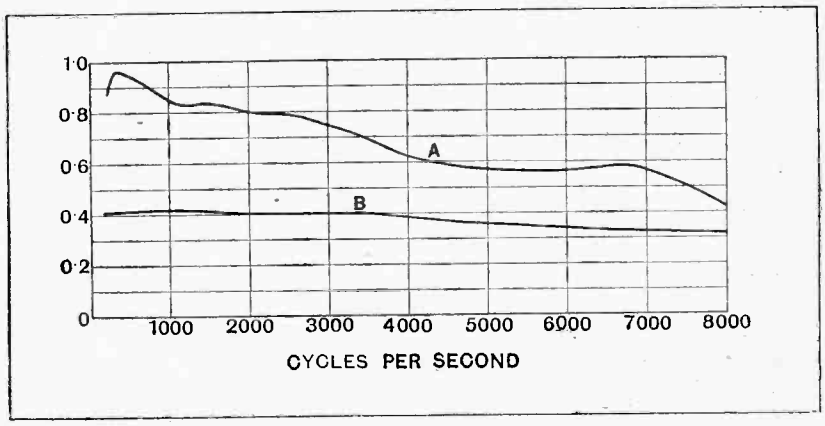


Fig. 26.—Frequency characteristic of a line (A) before correction and (B) corrected for frequencies between 50 and 8,000 cycles by a suitable line network.

A Tour Round Savoy Hill.—

cross-talk or overhearing between circuits (1) and (2), $a=c$ and $b=d$, also $e=f=g=h$. The method adopted in balancing these capacities is as follows:—

The wire-to-wire and wire-to-earth capacity unbalances are measured on each length of cable (about 176 yards)

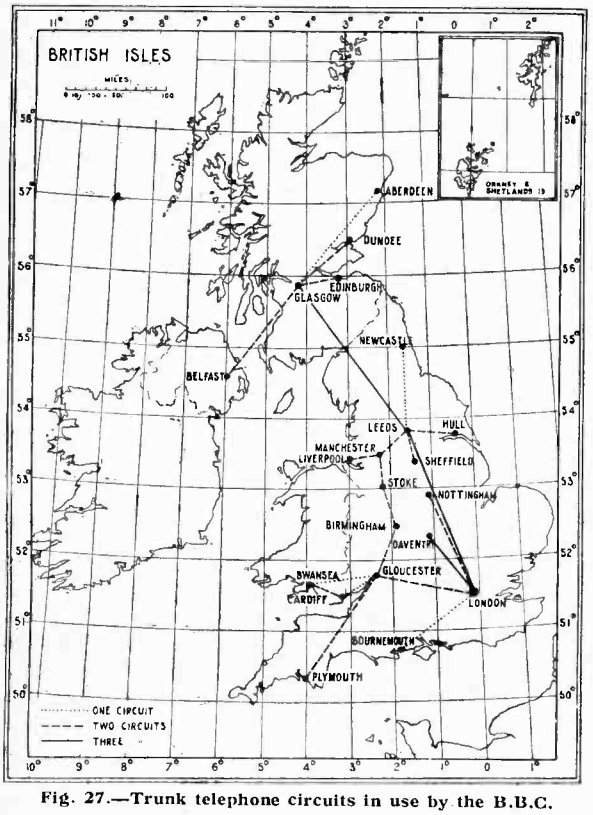


Fig. 27.—Trunk telephone circuits in use by the B.B.C.

before jointing, and from these results crossed pairs are arranged in the joint between the two cable lengths, so chosen as to diminish these out-of-balance capacities. So that between two loading coil points (about twelve lengths) the wire-to-wire unbalances $e-f$, $h-g$, $e-h$, $f-g$ and the wire-to-earth unbalances $a-c$ and $b-d$ will become negligible.

The efficiency of a telephone circuit for transmission purposes is governed by

(1) Capacity.
(2) Inductance.
(3) Resistance.
(4) Insulation.

The inductance in an unloaded cable circuit is practically negligible. The capacity attenuates the amplitude of the speech currents, and the object in adding inductance is to neutralise the capacity effect, leaving only the resistance component. The adding of inductance to a line, however, also adds resistance, therefore there is a limit to the amount of inductance which can be added.

A loading coil consists of a ring of soft steel over which are wound two coils of insulated copper wire, one winding being placed in each line of the circuit. When a cable is required for "phantom" working, the coils are wound as in Fig. 25. In the standard loading coils the inductance varies from 60 millihenries to 250 millihenries, and the resistance from 1.82 to 20 ohms. The loading coils are inserted in a circuit at regular intervals, and it is vitally important that this spacing should be adhered to within, say, 10 yards. The spacing varies from 1.1 mile to 2.6 miles.

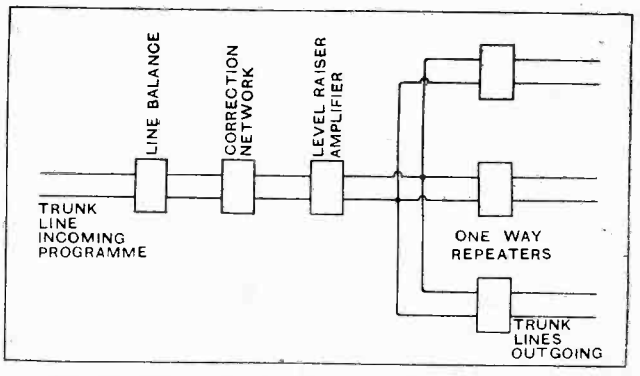


Fig. 28.—Schematic diagram of S.B. distribution system.

All trunk lines before being used for incoming programmes are first corrected by the insertion of a line network composed of inductance, resistance, and capacity, and the effect of this network can be best understood by reference to Fig. 26. Curve A shows the frequency characteristic of an actual line, while curve B shows the effect of the combination of the line, together with its correct network, giving for all practical purposes a straight-line characteristic from 50 to 8,000 cycles.

The linking-up system can best be studied from Fig. 27, and has resulted in the erection by the B.B.C. of four repeater stations at London, Glasgow, Leeds,

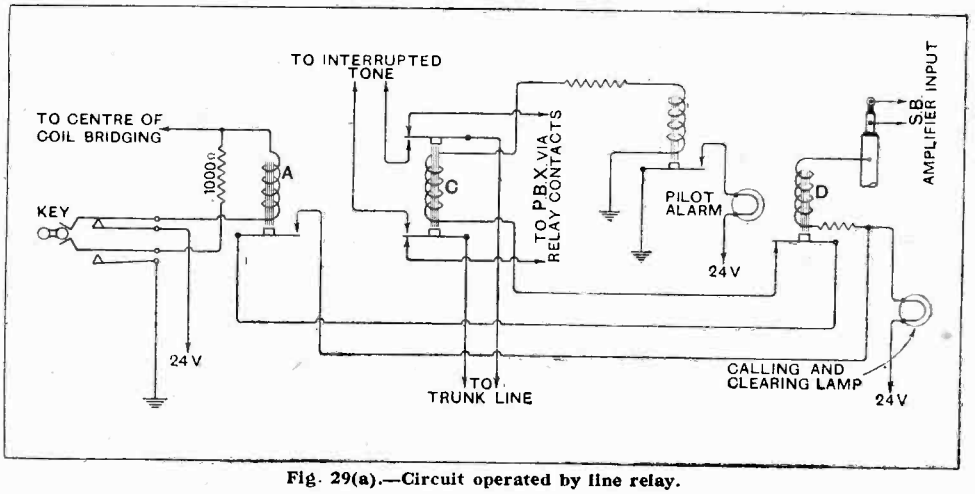


Fig. 29(a).—Circuit operated by line relay.

A Tour Round Savoy Hill.—and Gloucester. It will be seen that in the event of a serious breakdown of the trunk lines between London and Leeds an alternative route is provided *via* Gloucester, Birmingham, Stoke, and Manchester. These repeater stations not only provide convenient switching points, but also points for correction and amplification in an endeavour to maintain a straight-line characteristic throughout the whole system and also to keep the ratio of signal strength to cross-talk level to such a degree as to ensure that the received signal is not marred by cross-talk.

The repeaters used at the repeater stations are of the one-way, two-stage, resist-

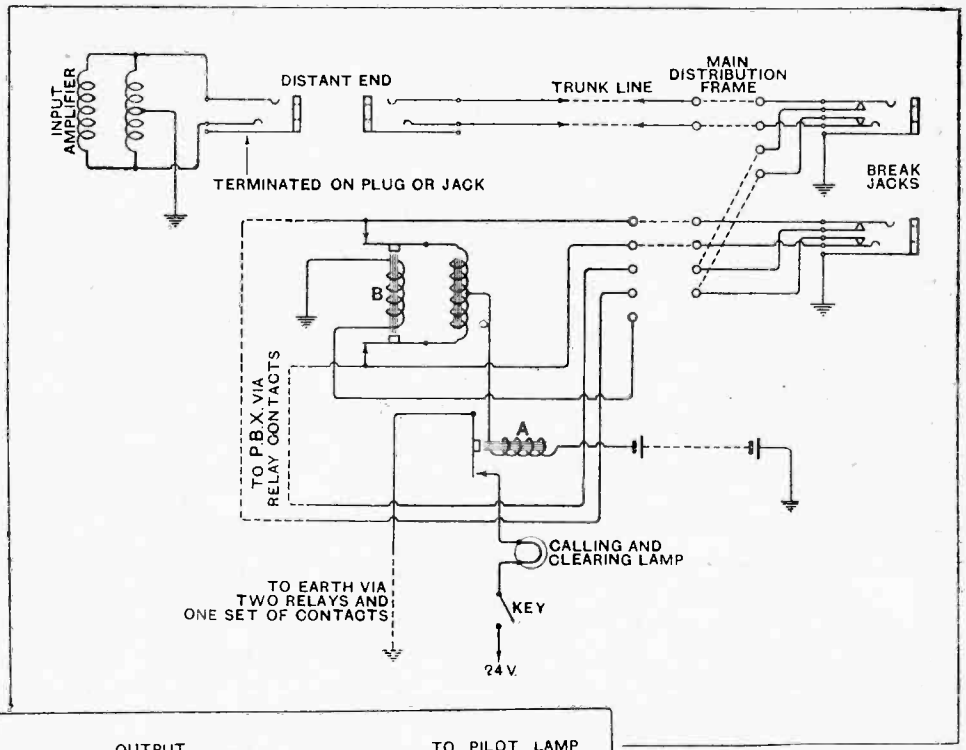


Fig. 29(b).—Trunk line connection to line relay

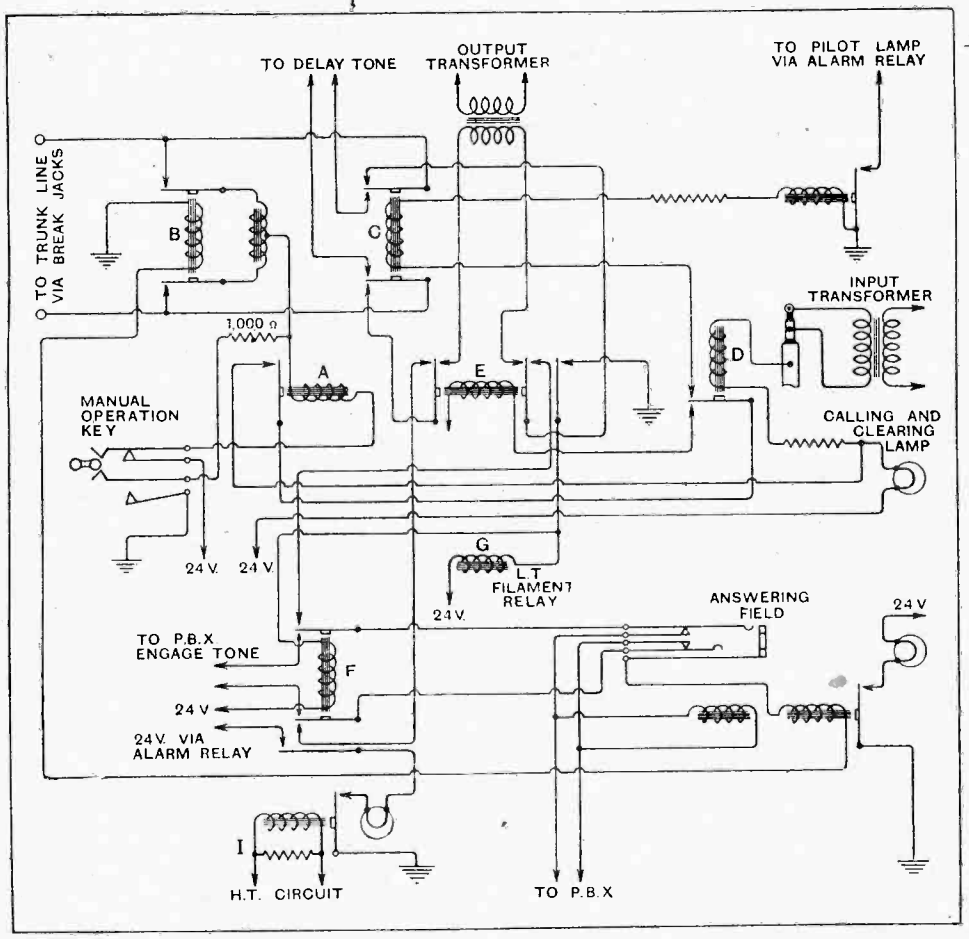


Fig. 29(c).—Theoretical line circuit diagram

ance capacity coupled type, and are so designed as to give a straight-line characteristic at all frequencies. The outputs are choke-fed transformer-coupled to line, and the transformers are designed to match the mean impedance of the line. The maximum gain obtainable by these repeaters expressed in telephony units is twenty standard miles.

The S.B. System.

An essential of the broadcast service is that any circuit becoming faulty during transmission should be substituted by a good circuit in a minimum period of time, and in order to do this special attention is given at the S.B. centres by officers of the General Post Office.

A schematic diagram of a repeater station is shown in Fig. 28. The trunk line passes to a line balance circuit, which corrects the wire-to-earth out of balance, through the level raiser

A Tour Round Savoy Hill.—

amplifier *via* the correction network. This amplifier makes up for cut-down in the network. The output of the level raiser amplifier is connected to bus-bars, where distribution takes place to other stations and into the next repeater station *via* the one-way repeaters, the line balance, correction network, and level raiser amplifier being brought into operation automatically only when the programme is incoming to that centre, and not when outgoing. The switching arrangements are so designed that the time taken from changing over from taking a programme incoming on a given trunk line to feeding another programme outgoing need not take longer than $1\frac{1}{3}$ seconds. This may be often noticed, particularly during a "Round the Stations" programme.

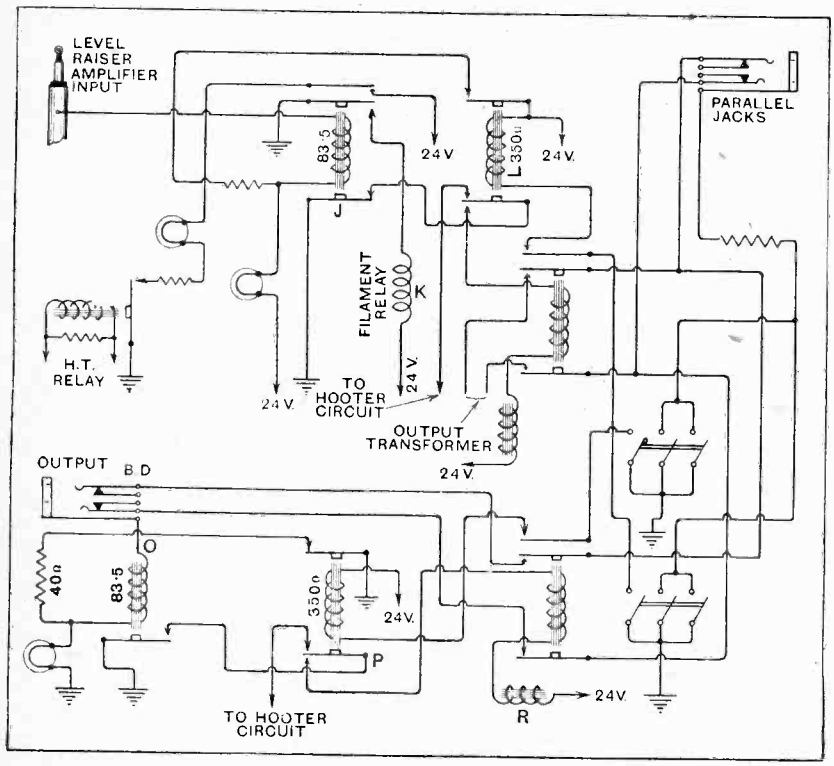


Fig. 30.—Lines from "B" output boards to S.B. board and level raiser amplifier.

The operations at the repeater stations are semi-automatic, the operators only controlling the inputs to the level raiser and the repeater amplifiers. At London and Leeds all the apparatus is controlled from two desks. One contains valve oscillator, amplifier, A.C. bridge, and a bank of jacks on which is terminated all incoming trunk lines, while the other desk is the S.B. operator's position containing a D.C. line test set, together with the plugs and cords which are the flexible input connections to the various amplifiers.

Fault Clearing.

A valve oscillator and amplifier are used as the tone source for obtaining the frequency characteristic of the trunk lines, while a D.C. test set is used for testing for low insulation, earths, loops, and disconnections. The termination of the test set is by a plug and cord, in order that it may be readily inserted into any of the trunk lines, which terminate on jacks. A capacity test gives at once an idea of the distance to a disconnection fault and its location.

Semi-automatic Apparatus.

The operation of the semi-automatic apparatus is commenced by the distant station inserting a plug in the trunk line giving a balanced earth connection as in Fig. 29. It will be seen from the line circuit diagram that with the distant end connected for receiving S.B. a current flows to line *via* the line relay "A," the contacts of the cut-off relay "B," and the break jacks passing to earth *via* the centre point of the choke at the distant end. The line relay now being energised, the armature operates, lighting the calling lamp and energising relay "C" and the pilot alarm relay. This relay is common to all line circuits and operates what is known as the pilot lamp, together with a buzzer alarm. The function of relay "C" is to connect to the line an interrupted tone *via* a transformer indicating that either the S.B. centre is not ready to send S.B., or that the plug connected to the input transformer of the line amplifier has not been inserted. In normal operation, however, it is usual to insert the input plugs beforehand, and it will be as well to follow the circuit from that operation.

An S.B. Call.

The programme is always fed to the S.B. board on strips of parallel jacks, from the output of a "B" or a level raiser amplifier. The actual operation of plugging up to the S.B. board automatically earths the sleeves of a strip of parallel jacks. Now assume that input plug has been inserted in one of these jacks. It will now be seen that a current flows *via* the clearing lamp, the resistance spool relay "D," the sleeve of the plug and jack to earth giving a clearing signal. The sleeve relay "D" has now operated, closing the contacts. If the new circuit brought into operation is followed it will be found that relay "E," whose function it is to connect the output transformer to line, cannot operate, owing to the non-operation of the line relay "A." Further, the trunk line is left through to the P.B.X. and the S.B. answering field *via* the back contacts of relays "C," "E," and "F." The distant end now takes the line for S.B. operating the line relay "A." The input plug being inserted, relay "E" must now operate *via* the contacts of relays "D" and "A," connecting the output transformer to line. If the circuit is followed closely it will be seen that relay "E" is now in parallel with the calling and clearing lamp, and the lamp ceases to glow, indicating the line has been taken. Further, the operation of relay "E" operates *via* the spare contacts two local circuits—one being relay

A Tour Round Savoy Hill.—

"G," which connects the L.T to the valve filaments, and the other relay "F," whose function is to put a tone on the P.B.X. line, indicating to the telephonist that the line is in use for S.B.

A double position key is provided on the one side giving manual operation, and on the other cutting off the line battery which is used when an earth fault appears. Relay "I"—the H.T. feed relay—is in the positive H.T. lead feeding the amplifier, and should the H.T. feed fail, then the armature drops back, making a local circuit *via* the contacts of relay "F" lighting an alarm lamp and ringing a bell. Upon the line current being broken at the distant end, relays "A" and "D" cease to operate; the shunt is taken off the lamp, and the S.B. engineer receives a clearing signal.

There now remains the connecting link between the output of the "B" amplifiers mentioned in a previous article and the S.B. board. In order to reduce the number of strips of paralleled jacks, a circuit has been designed which will accept either the output from a "B" amplifier or a level raiser, but not both, thus reducing the total number of strips by 50 per cent.—Fig. 30.

Assume a programme is being sent from a "B" output board to the S.B. board. All the sleeves of the plugs on the output boards are connected through a resistance to an earthed 24-volt battery. Upon inserting a plug in the S.B. jack on the output board, relay "C" will operate, lighting the signal lamp. The bottom contact of this relay now completes a circuit *via* relays "D" "E," and the back contacts of the master relay "B." Relay "E" operating connects the output board to the parallel jacks, and relay "D" puts an earth on the sleeve of the parallel jacks and also on the master relay "H." If the level raiser amplifier input plug associated with the same strip of parallel jacks is now used, it will be found that, upon relay "F" operating, the bottom contact of this relay cannot operate relays "D" and "E," which connects the output transformer of the correction amplifier to the parallel jacks, owing to the master relay "H" already being operated, but instead closes a local circuit marked hooter circuit, which is an audible alarm indicating dual connection.

Trunk lines for long-distance outside broadcasts are treated in a similar manner to lines between stations, only instead of the lines passing through repeater stations portable repeaters are sometimes placed in the trunk lines at convenient points in order to maintain the correct ratio of the music level to the cross-talk level as constant as possible.

In conclusion, be the broadcast from Aberystwyth, Marazion, Pewsey, or Loughborough, the liners *Majestic* or *Mauretania*, Croyland Abbey or from distant cathedrals, the programmes continue to be transmitted successfully, each bringing its own particular line, termination or repeater problem, and no real complaint can be made regarding the quality of these transmissions when all the difficulties are considered.

The next and final article of this series will describe the routine at Savoy Hill with regard to artists, rehearsals, studios, and transmissions, from the programme point of view.

CALIBRATING A SHORT-WAVE WAVEMETER.

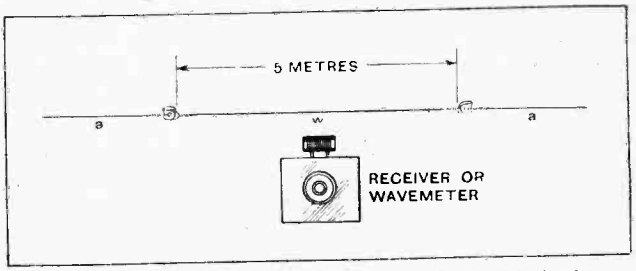
WHEN it is wished to calibrate a receiver or wavemeter for the shorter wavelengths, i.e., 10 or 20 metres, the accuracy of the harmonic method leaves much to be desired, while, when the experimenter has only a rough idea of the wavelength of the coil he is using, the reception of such standard frequency stations as NKF, WWV, etc., is rather a tiresome business.

It is proposed here to show a way which involves little time or trouble, at the same time being reliable.

The method about to be described is based on the fact that a horizontal, non-earthed wire, provided that it is free which such objects as tin roofs, lighting wires, etc., which are liable to affect its capacity, has a natural wavelength of twice its actual length in metres.

We will assume for this example that it is desired to calibrate a receiver for ten metres. The procedure is as follows:—A taut, horizontal wire W (No. 18 or 20 S.W.G.), five metres (16.4 feet) in length, is erected, held by a piece of dry string, *a*, at either end, the string being connected to the wire by means of small insulators. It would be best to do this in the garden, away from surrounding objects, for the reason stated above. The wire itself is suspended four or six feet above the ground. When all is in readiness the oscillating receiver which, in most cases, must temporarily be made portable, is held so that the coil is about a foot away from the wire, the axis of the coil pointing in the same direction as the wire, near the centre.

The condenser is then varied until a click in the telephones indicates the resonance point, and the condenser scale reading is noted. A graph, scale reading against wavelength, may be plotted for the particular coil in the receiver by varying the length of the wire to give such wavelengths as 8, 12, 15 metres, and so on.



Direct measurement of wavelength with a horizontal wire resonator.

It is then comparatively simple to calibrate an absorption meter from the receiver by the "click" method.

If the experimenter is in possession of a heterodyne wavemeter so much the better, as it can then be calibrated direct, the only other essential being a galvanometer or pair of telephones in the plate circuit for resonance indication.

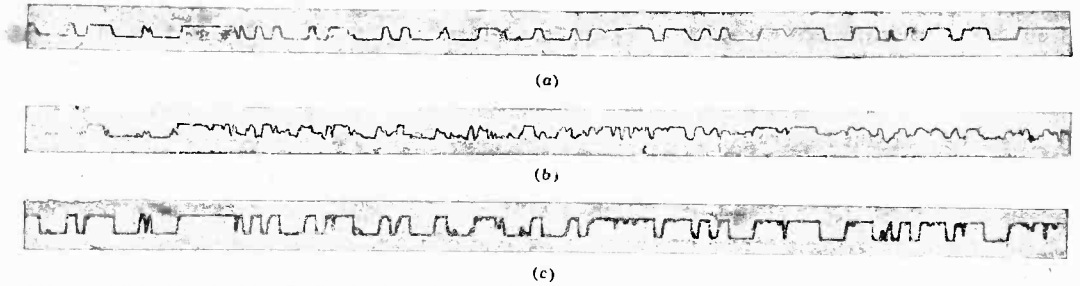
C. W. P.

THE RANGE OF ATMOSPHERICS.

Evidence from Simultaneous Records taken in Different Parts of the World.

FOR several years there has been evidence that atmospheric disturbances are frequently received simultaneously, say, in America and Europe.

In order to study this phenomenon more closely, investigations were carried out by M. Bäumler at the Berlin Telegraph Technical Department, in conjunction with the Radio Corporation of America, upon stations separated by still greater distances. Rocky Point served as transmitter on a wavelength of 17,500 metres. The signals of this transmitter were simultaneously recorded in Berlin, California, and the Hawaiian Islands, with mechanical recorders which could be run at the same speed. In order to fix the times the signals were sent according to a definite scheme, so that it was always possible to recognise those parts of the records which were heard at the same time.



Simultaneous records of transmission from Rocky Point (a) at Marshall, California, (b) at Cocohead, Hawaiian Islands, and (c) at Berlin Speed of tape 150 cms. per minute; rate of transmission 30 letters per minute.

The rate at which the strip was allowed to run was 150 cms. per minute, so that at a sending speed of 30 letters a minute there would be a space of 5 cms. between two letters.

The receiver at Cocohead in the Hawaiian Islands always had the strongest atmospherics, while the reception at Marshall, California, and at Berlin was generally very good. The agreement of numerous disturbances, which arrived at Berlin and Marshall practically simultaneously, is at once evident from the record strip, while the agreement with disturbances at Cocohead can only be proved with certainty occasionally. With certain particular disturbances, however, it is unquestionable that they were recorded simultaneously at all three places, with a distance of nearly 12,000 km. between Berlin and Cocohead.

It is thus demonstrated that the range of powerful atmospherics equals that of a large transmitter, and so it is not remarkable that with us in Europe atmospheric disturbances never completely cease, even in the absence of thunderstorms. The actual cause of atmospherics is certainly not elucidated by this investigation. One might almost entertain the supposition that particularly strong atmospherics, which can apparently be heard all over the earth at once, have their source outside the earth, and are in some way related with sun-spots. It is neither proved nor disproved, however, that powerful lightning discharges give rise to disturbances which are propagated over the entire earth's surface.

Further researches on the part of the Berlin Telegraph Technical Department aim at a closer study of atmospherics, and in particular it is hoped that a new procedure will permit the disturbances to be analysed by means of determining their "waveform." Possibly this will provide a means of deciding whether all such disturbances, or only a portion of them, are of atmospheric origin and whether some of the phenomena are not of cosmic origin.

H. K.

The "Amplion" Public Speech Equipment.

Messrs. Graham Amplion, Limited, have produced a fascinating art brochure, copiously illustrated, dealing with the "Amplion" Public Speech and Band Repeater Equipment. The Company is now in a position to supply a complete public speech outfit at the low price of £125. The brochure describes how successful the equipment has been when employed, not only for public ceremonies, but at cinemas, restaurants, and dance halls in the distribution of speech and music. One of the most impressive occasions on which the "Amplion" equipment was used was in May, 1925, during the Canonisation Ceremony at St. Peter's, Rome.

TRADE NOTES.

Building the K.1. Three Valve Set.

In a new and attractive brochure issued by the Marconiphone Co., Ltd., of 210-212, Tottenham Court Rd., London, W.1, full details are given, with diagrams and illustrations, for the construction of the K.1. three-valve receiver for A.C. mains. This receiver, of course, makes use of the new K.1. valves, and consists of a detector with reaction into the aerial tuning circuit and two transformer-coupled L.F. stages; it is combined with a unit supplying both high and low tension from the A.C. mains. A very clear wiring plan and layout printed in three colours make the task of construction extremely simple even to a beginner. The book, known as publication No. 452, is priced at 1s.

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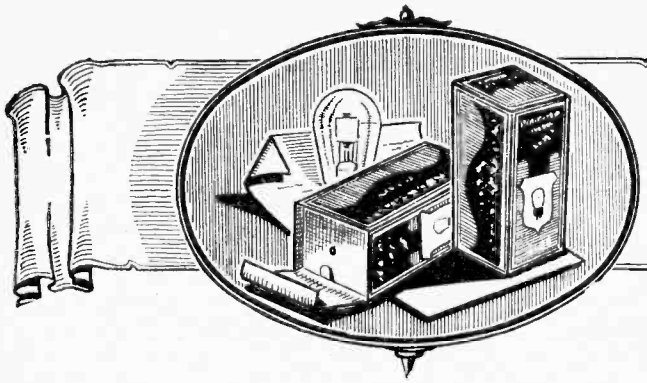
Gifts for Blind Listeners.

In connection with the introduction of the "Hear-Easy" Rubber Headphone Pads, Messrs. Electradix Radios, 218, Upper Thames St., E.C.4, are offering one pair free to any blind listener for 2d. in stamps to cover postage. Hospitals will be supplied with one free pair for each pair ordered. The "Hear-Easy" pads are being issued at the sale price of 6d. per pair. They are soft and comfortable and are specially designed to exclude extraneous noises.

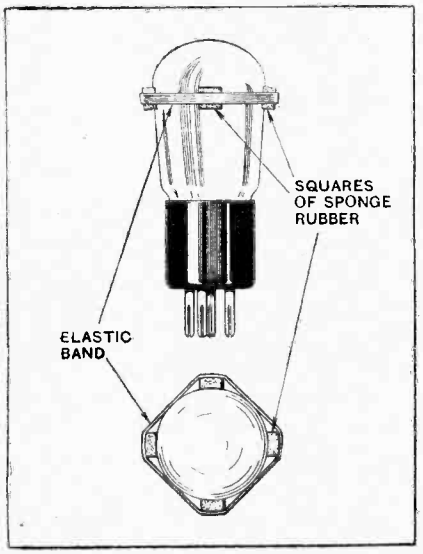


NOVELTIES FROM OUR READERS

A Section Devoted to New Ideas and Practical Devices.

VALVE VIBRATION.

Microphone howling in the loud-speaker is sometimes caused by vibration of the glass walls of one or more of the valves in the receiver or amplifier. When the trouble is traced to this cause, a cure can generally be effected by damping the bulb of the valve with rubber pads, as shown in the diagram. In this case four pieces of sponge rubber are held against the glass with an elastic band, which



Damping out valve vibration.

should be as strong as possible in order that the rubber may press firmly against the glass.

A few experiments should be tried to ascertain the best position for the rubber pads, as the vibration will be unevenly distributed over the area of the bulb, some parts vibrating more vigorously than others.

H. H. S. J.

TESTING FOR CONTINUITY.

It is useful to know that continuity tests can be carried out with a pair of telephones without any other apparatus. As is well known, a telephone earpiece will generate a small current if the diaphragm is tapped; indeed, this was the principle used by Graham Bell in his original microphone.

Since the earpieces of a pair of telephones are in series, a sound will be heard in one if the other is tapped, provided that there is electrical continuity between the telephone tags. These tags are, therefore, applied to the circuit to be tested, and one earpiece is placed to the ear while the other is lightly tapped or placed over a ticking watch or other source of sound. If a corresponding sound is heard in the other earpiece continuity is indicated. H. J. S.

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ALUMINIUM PANELS.

In many of the more modern sets in which shielding is employed, an aluminium panel can be advantageously used instead of one made of ebonite. This metal is much cheaper than ebonite, and is almost as easy to work. The best thickness for panels is about $\frac{1}{8}$in.

Some constructors might experience trouble in obtaining a pleasing finish with aluminium, the usual shiny surface looks cheap, and emery paper imparts a rough appearance.

A frosted finish is by far the most elegant. This effect can be easily and rapidly obtained by the following process. Lay the panel flat, and wet its surface with a strong solution of caustic soda or caustic potash. Leave for twenty minutes, then wash well and wet with nitric acid. This process should be repeated several times, the panel being finally rinsed for several minutes, dried, and finally lacquered if desired.

One should be careful not to let either the alkali or the acid come into contact with the hands or clothes as both are very corrosive. A piece of sponge rubber can be used for spreading the caustic soda, and a piece of wood for spreading the acid.—C. H. R.

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"QSL" CARDS.

It is the custom among transmitting amateurs to use their "QSL" cards as "wallpaper" to decorate the immediate vicinity of their transmitting gear.

Possibly some amateurs may have other ideas regarding mural decoration, in which case the question of the disposal of cards is at once raised. Besides constituting a valuable record of the work of the station, a collection of cards is a thing to be proud of and to show to one's friends.

Quite an effective and unobtrusive way of displaying them is to file them in a picture postcard album. The best type of album is that in which the leaves are slotted for the corners of the cards. C. S. B.

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."

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 Talk on Detectors.

Mr. E. A. Hannay, A.M.I.E.E., read a paper on "Detectors: Their Effect on Quality in Reproduction" at the last meeting of the Sheffield and District Wireless Society. The lecturer first dealt with the functions of an ideal rectifier in transforming the H.F. currents into audio or L.F. currents, and giving faithful reproduction. The crystal detector received special attention and it was clearly demonstrated that any rectifier relying upon a curved characteristic for its detecting properties must necessarily cause some distortion in the L.F. output. Mr. Hannay gave a very clear description of the two popular methods of valve rectification, viz., the cumulative grid and the anode bend, and he recommended the latter for comparative freedom from distortion.

Hon. Secretary: Mr. R. Jakeman, 129, Ringinglow Road, Sheffield.

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R.-K. Loud-speaker Demonstrated.

A demonstration of the Rice-Kellogg loud-speaker at the February meeting of the Institute of Wireless Technology evoked the general opinion that the instrument was a great advance in loud-speaker design. The loud-speaker was described in a paper read by Mr. H. W. Gambrell, A.M.I.R.E. The musical reproduction was of very high quality, particularly in regard to the lower frequencies.

Particulars of forthcoming meetings of the Institute may be obtained from the Hon Asst. Secretary, Mr. Harrie J. King, 71, Kingsway, W.C.2.

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Television Campaign at Hounslow.

On March 1st members of the Hounslow Wireless Society held their first meeting in the new headquarters at the Church Hall, Hounslow.

Prof. A. M. Low, the President of the Society, addressed a large audience on the subject of "Television: Its Difficulties and Possibilities," and the ensuing discussion showed how keenly the subject appealed to the many members present. The Society has decided to begin a series of experiments in television.

Owing to the increased accommodation the Society now has a few vacancies for new members. Applicants should communicate with the Hon. Secretary, Mr. W. R. Collis, 7, Algar Road, Isleworth.

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Experiments with the Heaviside Layer.

The fascinating subject of the Heaviside layer was the theme of Mr. M. G. S. Bennett's lecture before the Bristol and District Radio Society on Friday, March 4th. Having referred to the early attempts to gauge the height of the Heaviside layer, the lecturer dealt with the experiments of Prof. E. V. Appleton and Mr. M. A. E. Barnett. These workers applied the principle of interference in light waves to the solution of the problem by means of signals of known wavelength transmitting over a known distance. With the use of a recording galvanometer to measure signal strength, it had been found possible to determine the interference bands between the direct and reflected waves. This phenomenon apparently explained the fluctuation of signal intensity from nearby stations at night and the fading of more distant ones.

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Wireless Films in Bristol.

Cinematograph films of interest to all wireless listeners will be displayed under the auspices of the Bristol and District Radio Society this evening (Wednesday) at the Central Hall, Old Market Street, under the patronage of the Lord Mayor or Bristol and the director in charge of the Cardiff Broadcasting Station. Tickets of moderate price may be obtained from any member of the Society or from any local wireless dealer. The proceeds will be divided between the Lord Mayor's "Wireless for Hospitals" Fund and the 5WA "Sets for the Sick" Fund (Bristol Branch).

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

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Points about Amplification.

Another lecture under the "individual research" scheme organised by the Radio Experimental Society of Manchester was delivered at the meeting on March 4th by Mr. R. MacKay, who dealt with "Some Theoretical Considerations of Amplifiers." Among the interesting and often neglected points dealt with by the speaker were tuning the "blocking or coupling" condenser in H.F. amplifiers, tuning the "by pass" condenser in L.F. amplifiers, and determining the correct kind of transformer to use in any given set. Mr. MacKay also dealt with the methods of preventing internal reaction in sets, and concluded with an interesting reference to the problem offered by the diminution of the amplification factor in multi-stage H.F. amplifiers. The lively discussion which followed dealt particularly with the various means of measuring amplification.

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

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Plotting Valve Curves at Home.

The practical demonstration in the making of valve curves given by Mr. R. Kirlew at the meeting of the North Middlesex Wireless Club on March 2nd was in reality a continuation of his lecture given at the Society's meeting reported recently in *The Wireless World*.

The lecturer had brought some large sheets of graph paper and, after drawing a diagram of the actual connections of the apparatus, he proceeded to plot curves from the data obtained from the instruments. For example, after ascertaining the actual voltage applied to the plate of the valve, the plate current was measured for various grid potentials, the plate voltage and filament current remaining constant. The instrument used for measurements was the multi-range meter recently acquired by the Club for loan to members.

On March 30th, a lecture entitled "Broadcast Engineering and Breakdowns" will be given by Mr. J. H. A Whitehouse of the B.B.C. Visitors will be welcomed.

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

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 16th.

North Middlesex Wireless Club.—At 8 p.m. At Shaftesbury Hall, Bowes Park. Annual General Meeting.

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

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Lecture: "The Trend of Valve Design," by Mr. F. E. Henderson, A.M.I.E.E.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. "Three Valves." by Major Gill, R.E.

Bristol and District Radio Society.—At the Central Hall, Old Market Street. Display of Wireless Films (see letterpress).

THURSDAY, MARCH 17th.

Golders Green and Hendon Radio Society.—At 8 p.m. At the Club House, Willifield Way. Lecture (with experiments): "A Journey into the World of Science," by Mr. G. G. Blake. M.I.E.E.

FRIDAY, MARCH 18th.

Radio Society of Great Britain.—Informal Meeting. At 6 p.m. At the Institution of Electrical Engineers, Savoy Place, W.C.2. Lecture: "The Moullin Voltmeter" (with practical demonstration), by Mr. W. B. Medlam.

Radio Experimental Society of Manchester.—Lecture by Mr. Blake, of Messrs. Radion.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street, Leeds. Lecture: "Crystals," by Mr. R. E. Timms.

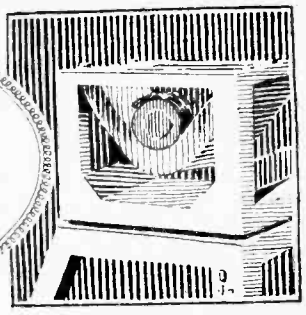
Sheffield and District Wireless Society.—At the Dept. of Applied Science, St. George's Square. Lecture: "The Design of an A.C. Mains Unit." by Mr. L. H. Crowther, A.M.I.E.E.

MONDAY, MARCH 21st.

Southport and District Radio Society.—At 8 p.m. At 20, Scarisbrick Street. Lecture: "L.F. Amplification as Applied to Public Demonstration Purposes," by Messrs. F. and L. Hough.

Northampton and District Amateur Radio Society.—At 8 p.m. At Cosmo Café. Lecture: "The Ferranti Transformer," by Mr. Garside (of Ferranti, Ltd.).

Broadcast Brevities



Savoy Hill Topicalities: By Our Special Correspondent.

The P.O. Vans.—Broadcasting from Aintree.—From Putney to Mortlake.—A Wrong Theory.—Co-operation in Spain.—A New York Move.

In Quest of the Oscillator.

Two or three months ago the listening world, and particularly the oscillating section thereof, was shaken by the announcement that the Post Office had equipped a van with direction-finding apparatus for the purpose of tracking all kinds of offenders. Oscillators, "pirates," ether hogs, and the like were all to be brought to book, and the ether was to be finally purged of all disquieting elements.

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A Fleet of Two.

And yet Savoy Hill is receiving more complaints of oscillation than ever before. I hear that the Post Office will soon have another wireless van on the road, making a total of two to cover an area of approximately 60,000 square miles, even if their activities are to be restricted to England and Wales. One may suppose that the authorities know what they are about, but a fleet of two seems rather small.

The original van is at present roaming the Midlands.

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An Accountable Crackle.

The Wigan reader who suspected a faulty grid leak when he tuned in to Aberdeen the other Sunday was relieved to learn afterwards that he had been listening to a service in Gaelic.

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A Horrible Feature.

Fortunately there seems little likelihood that the B.B.C. will emulate the prowess of a certain American station in putting a physician on the programmes to answer health questions addressed to him during the week. Anything more dreary and morbid than a recital of the week's aches and pains would be difficult to imagine. Long may we be spared it.

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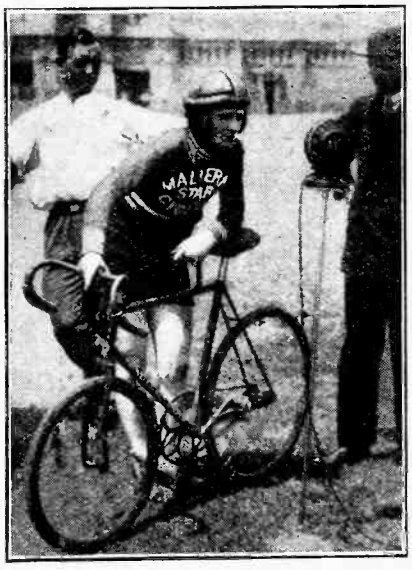
On April 1st.

An All Fools' Day programme is to be broadcast on April 1st; it will be called "April Fooling," and the cast is to include Norman Long, Marjorie Fulton and Wish Wynne.

Co-operation in Transatlantic Programmes.

What distinguished Keston's American relay on Tuesday of last week from those which have gone before was the fact that WGY arranged the programme to suit British listeners. The announcer addressed his English hearers more than once, remarking that the programme



HOW IT'S DONE IN MELBOURNE. Hubert Opperman, Australia's champion racing cyclist, giving a talk from the track. The microphone is connected to 3LO, the well-known station in Melbourne.

was designed for their edification in accordance with a letter received from the "British Broadcasting Company."

The signals were picked up from 2XAF on 32.79 metres.

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Kismet.

Edward Knoblock's "Arabian Night" play, "Kismet," will be broadcast on March 28th. The play is in three acts and nine scenes.

To-morrow's National Concert.

The tenth of the B.B.C. national concerts will be relayed from the Albert Hall to-morrow, when Arthur Honegger's Symphonic Psalm "King David," conducted by the composer, will form the first part of the programme. The narrator will be Mr. Robert Loraine. In the second portion the first performance will be given of "The Morning of the Year," a choral dance by Gustav Holst. The other item in the programme is "Pacific 231," conducted by the composer, Arthur Honegger. The Wireless Choir will take part in the programme and will be augmented by the choir of Lloyd's. The soloists are Elsie Suddaby (soprano), Phyllis Archibald (contralto) and Frank Titterton (tenor).

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The Grand National.

Arrangements for broadcasting a running commentary on the Grand National at Aintree on March 25th are now complete. This will be the first occasion on which a broadcast description of a horse race has been given in the British Isles. The provisional arrangements comprise the use of five microphones: (*a*) in a private stand alongside the Press stand; (*b*) overlooking the paddock; (*c*) in front of the private stand; (*d*) over the unsaddling enclosure; (*e*) a portable microphone.

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Describing the Race.

Mr. Meyrick Good, who has been a member of the staff of *Sporting Life* for some 30 years, will take charge of the microphone in front of the stand (*a*), and from this point will describe the race, including the parade and the line up for the start. Mr. Meyrick Good's commentary will give the first three horses past the post and the remaining finishers, and he will continue until the first three are back in the paddock. Throughout this period the microphone in front of the stand (*c*) will be used to provide as a background the noises associated with the race; subsequently microphones (*a*) and (*c*) will be faded out and the microphone overlooking the paddock and that over the unsaddling enclosure (*b*) and (*d*) will

be brought into use. From microphone (b) a description of the scene in the paddock will be transmitted, with the reception of the winner, previous achievements, etc. The microphone over the unsaddling enclosure will be used for effects.

The portable microphone will, it is hoped, be brought into use subsequently for broadcasting an interview with the winning jockey.

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Behind the Crews.

The running commentary on the boat race on April 2nd promises to be a thrilling affair, barring breakdowns! The commentator will follow the crews on the launch *Magician*, with the microphone in the bow and the short-wave transmitter in the stern. Two temporary receiving stations will be employed, one at the Radio Communication Co.'s works at Barnes and one at Castelnau owned by Mr. W. Secretan. The latter will be a stand-by station. The apparatus on the launch will first be tried out on the Thames at Henley.

There is a probability, I believe, that the commentator will be Mr. Guy Nickalls, the well-known rowing "Blue."

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Laughing Hyenas.

Surely there is something profoundly gratifying in the fact that the B.B.C., with all its faults and foibles, had the healthy sanity to reject the nonsensical, monstrous and barbaric proposal for "Community Laughing."

The idea germinated in America and was actually carried into effect at a certain well-known broadcasting station; but Americans will sometimes respond to stimuli which leave Englishmen cold. (For instance, there are soda fountains.)

Some learned writer has propounded the theorem that laughing at nothing is a manifestation of inferior intelligence. Let us rejoice that the B.B.C. refuses to cater for the no-brows, imbeciles, and similar organisms.

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Short and Not Sweet.

The main fault of the programmes is still their scrappiness. A few evenings ago I switched on to 2LO at the not unreasonable hour of 8.30 in the hope of getting my teeth into a programme which I could digest. The fag-end of a good concert from Sheffield came through well—so well, in fact, that we were switched off for fifteen minutes' dance music from the London studio. This was followed by the news bulletin, and quarter of an hour later I could have heard a talk.

Fifteen minutes of dance music! Could any hostess organise a wireless dance to last fifteen minutes? "Dancing will begin at 8.45 p.m.; carriages at nine." No, thank you; I would prefer to save my boiled shirt.

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A Wrong Theory.

A correspondent in a contemporary has propounded a theory which may be very comforting to the hard-worked and hard-kicked B.B.C., but which is hardly likely to receive widespread acceptance. He suggests that people complain of the quality of the broadcast programmes simply because their receivers, and especially their loud-speakers, give poor reproduction.

FUTURE FEATURES.

Sunday, March 20th.

LONDON.—Studio Service arranged by the National Brotherhood Movement.
BIRMINGHAM.—Light Classical Programme.
GLASGOW.—A Popular Bach Programme.

Monday, March 21st.

LONDON.—"My Programme," by a Barrister.
BOURNEMOUTH.—Orchestral Concert relayed from the Winter Gardens.
CARDIFF.—"Voices," a light comedy in one act by Bernard Newman.
GLASGOW.—A Selection of Scottish Songs.

Tuesday, March 22nd.

LONDON.—"Fidelio," an opera in two acts by Beethoven.
MANCHESTER.—Tuesday Mid-day Society's Concert from Houldsworth Hall.

Wednesday, March 23rd.

LONDON.—Beethoven Sonatas played by Lamond.
BELFAST.—"The Deserter."

Thursday, March 24th.

DAVENTRY.—An Evening at Bath.
BIRMINGHAM.—City of Birmingham Police Band.
CARDIFF.—An Evening at Bath, relayed from the Pump Room, Bath.
NEWCASTLE.—From Tyneside to America.
GLASGOW.—Orchestral Concert relayed from St. Andrew's Hall.

Friday, March 25th.

LONDON.—Recital of Popular Ballads by Ruby Helder.
BOURNEMOUTH.—Popular Operatic Programme.
ABERDEEN.—"The Constant Lover," a Comedy of Youth by St. John Hankin.
BELFAST.—Concert by Belfast Philharmonic Society.

Saturday, March 26th.

LONDON.—Beethoven Centenary Concert relayed from Bishopsgate Institute.
MANCHESTER.—The Westminster Singers.

So that's it. Next time you quail before the accents of Professor Sisan Grohns console yourself with the reflection that a properly adjusted grid bias might have transformed the item into dance music from the Savoy Hotel.

No, sir. Try again.

Bad Times Abroad.

The *Manchester Guardian* tells the moving story of three Hungarian listeners in Czecho-Slovakia who tuned in Budapest on their loud-speaker. Passing the house at the time were three policemen, who, hearing the strains of a Hungarian national air proceeding from the dwelling, dashed in to arrest the offending orchestra for daring to play Hungarian music in a Czecho-Slovakian village.

They could not arrest the loud-speaker so they smashed it to fragments, and the luckless listeners were arrested!

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Co-operation in Spain.

A considerable amount of inter-relaying is taking place this month between the Madrid stations, one of which (Union Radio EAJ 7) is, in addition, relaying, and being relayed by, Radio Barcelona. In all cases these retransmissions take place between 10 p.m. and 12.30 a.m. (G.M.T.). Union Radio and the new station, Radio Iberica EAJ 6, are on Fridays giving the same programme, while on Sundays Radio Espana EAJ 2 and Radio Madrilena EAJ 12 are showing mutual co-operation. Readers may have picked up Barcelona's relays of Union Radio after 10 p.m. and heard the latter returning the compliment when EAJ 1 has operatic or other special transmissions.

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Activity in Madrid.

There are now no fewer than five Madrid stations "on the air," and a very careful general broadcasting schedule is officially arranged every month for the various stations in order that listeners shall not be troubled with interference. Radio Castilla EAJ 4, not previously mentioned, is a "Union Radio" station, and transmits from the same studio as EAJ 7. It often relays dance music from the Ice Palace.

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A New York Move.

Planned to be the foremost broadcasting station in the world, a new WEAF will soon spring up and supersede the present station in New York, according to Mr. M. H. Aylesworth, President of the National Broadcasting Company of America.

The present WEAF, it appears, is seriously interfering with the research work of the American Telegraph and Telephone Company, necessitating a removal to a more suitable spot on Long Island. It is expected that the new location will have the additional advantage of avoiding the "shadows" created by the immense steel buildings in the City. According to Dr. Alfred N. Goldsmith, one of the consulting engineers, "the new station will represent the complete application of the principle of remote control of transmitting stations situated a considerable distance from broadcasting stations."

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Tuesday as Dance Night.

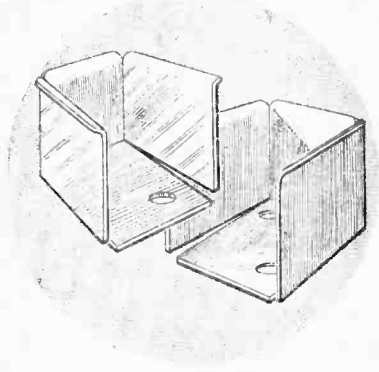
In future Tuesday is to be a special dance night with the B.B.C., dance music being broadcast continuously from 9.30 to 11 p.m.

A Review of the Latest Products of the Manufacturers.

GRID BATTERY CLIPS.

It is always a difficult matter to secure a grid biasing battery to the baseboard of a receiver. A usual method of fixing is to bind the battery in position with pieces of No. 16 wire, though a battery secured in this way cannot be readily changed.

Messrs. A. H. Hunt, Ltd., H.A.H. Works, Tunstall Road, Croydon, Surrey, have introduced a useful form of clip which can be screwed down to the baseboard to provide a fixing for the battery, a pair of clips being suitably spaced for securing either a 9-volt or 15-volt unit.



For securing grid bias batteries A. H. Hunt, Ltd., have introduced this useful form of clip.

The clips are made of brass to prevent corrosion and nickel plated, the top edge being turned over to facilitate insertion of the battery.

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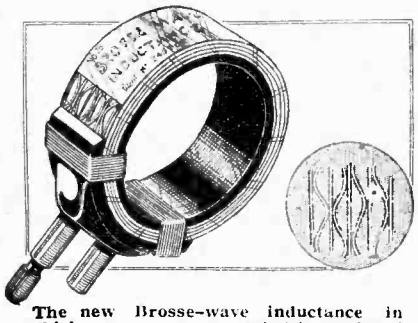
THE BROSSE-WAVE COIL.

An ingenious method of limiting the turn-to-turn capacity has been adopted in the new Brosse-wave Minor coil made by the B. & J. Wireless Company, 2, Athelstane Mews, Stroud Green Road, London, N.4.

Each successive turn in the layer is bent to a wave formation so as to produce a liberal turn-to-turn spacing. By this process a winding of only about 20 turns to the layer is obtained, whilst in the case of the No. 200 coil the ten layers, which are spaced with strip paper, are accommodated in a depth of winding of just under ½in.

By using an ebonite centre former and moderately stiff spacers between the layers a particularly robust coil is produced. It is rendered durable and damp-proof by a wrapping of oiled silk. The pin and socket mount is well designed, the connectors being carried on a small moulding of insulating material.

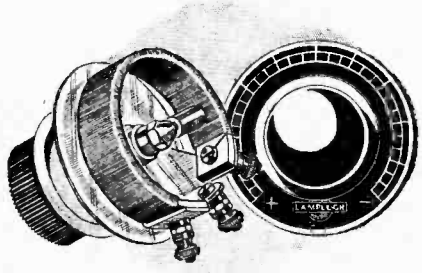


The new Brosse-wave inductance in which a turn-to-turn spacing is produced by a number of wave-shaped bends in alternate turns.

A NEW POTENTIOMETER.

A reliable form of potentiometer of improved design has been recently added to the range of wireless components manufactured by S. A. Lamplugh, Ltd., King's Road, Tyseley, Birmingham.

The winding is carried on the usual fibre strip which, being liberal in width, permits of the use of a fairly heavy gauge of resistance wire, so that under the action of the rubbing contact a break occurring in the winding is unlikely. The rubbing contact, instead of being arranged to travel around the edge of the winding, makes contact on the inner face. Contact is made by a smooth-ended plunger pressed in position by a light coiled spring. An attractive bronzed dial is supplied having a chemically engraved scale.

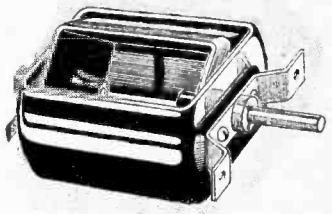


Lamplugh potentiometer. A reliable form of rubbing contact is employed pressing against the inside face of the winding.

THE G.R.C. VARIOMETER.

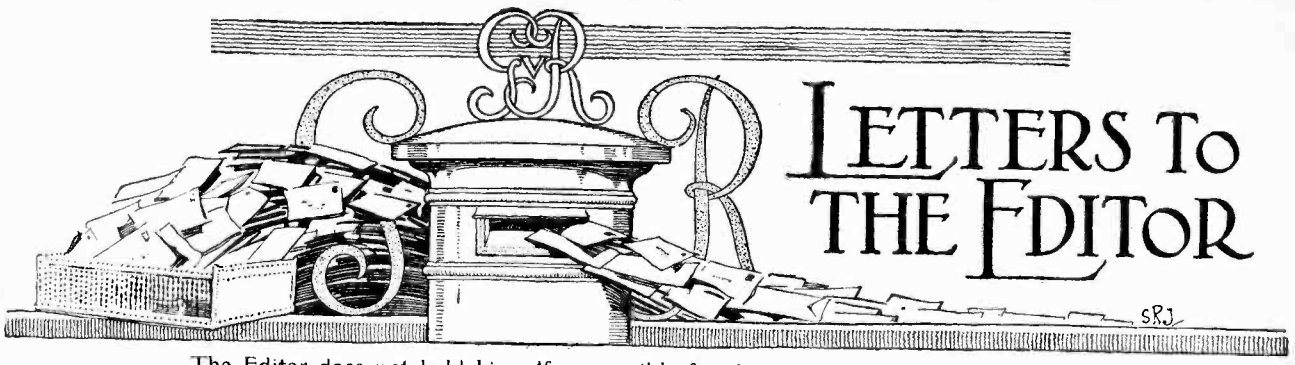
Although the use of variometers in constructional articles is rarely advocated, there have recently arisen demands for this form of tuner. Many of the variometers which have been available in the past, it must be admitted, have been of poor construction, giving only a limited change of inductance value from maximum to minimum. The G.R.C. variometer is a particularly well made component, and a specimen was recently requisitioned from Claude Lyons, 76, Old Hall Street, Liverpool, the agent for General Radio apparatus in this country.

Although wound with No. 24 gauge wire and possessing a maximum inductance value of 600 microhenries, the variometer occupies quite a small panel area, while the revolving action of the rotor does not sweep space occupied by other components. The windings are carried on Bakelite formers, the stator being secured to the inside face so that the windings are well protected. Both windings are separately brought out to connecting tags to permit of the use of the variometer as a vario-coupler.



The G.R.C. variometer with protected windings. It is compact and tunes up to about 550 metres.

When used as a variometer the inductance change is from 60 to 600 microhenries, and is obtained by rotating the spindle through 180°. The maximum wavelength, therefore, is about 550 metres when tuned with a 0.0005 mfd. condenser. The exact tuning range depends upon the parallel capacity bridging the variometer terminals, and when used without a variable condenser a fixed condenser having a value of about 0.0001 mfd. should be connected across the winding.



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

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

AMATEUR TRANSMITTERS IN JERSEY.

Sir,—It might interest your readers to have a few facts regarding low-power transmission on this island.

Of the five active stations here all use the tuned anode or Armstrong circuit, and three of us have rebuilt our sets to Mr. Exeter's design in *The Wireless World*, October 27th, 1926, for 45 metres. With this set on low power I personally have had astonishingly good results. Some of us, by the way, use a tuned R.F. choke. Using H.T. accumulators (max. 220 volts) I have on this set worked practically all Europe, Algeria, Morocco, and two districts of America, and I have a report from French Indo-China confirming a working I had with an Italian. In no case did the power exceed 8 watts, and apart from this FI report, which was on Christmas Day, the other workings have been during January and February, 1927.

I find using an aerial on harmonic gives me better results than Hertz, and an earth better than counterpoise.

Jersey. A. M. HOUSTON FERGUS (G2ZC).
March 1st, 1927.

MICROPHONIC NOISES.

Sir,—In common with most people who have experimented with modern low-frequency amplifiers I have observed the resonance effect between the loud-speaker and the valves recorded in Mr. Tyer's article entitled "Microphonic Noises" in the March 9th issue.

I cannot agree with Mr. Tyers, however, that the fault lies with the valve holder. There can be no doubt that the resonance effect is due to vibration of the electrodes inside the valve and not to vibration of the springs in the valve mounting. This can be quite easily proved by substituting different types of spring valve holders which have no effect on the pitch of the note in the loud-speaker.

Mr. Tyers has drawn the correct conclusion from his experiences with the five-valve amplifier, but I venture to think that the cessation of howling with the substitution of one of the valve holders must have been a coincidence. In any case, is it wise to generalise on the results of a single experiment?

Observation of this effect over a long period has forced me to the conclusion that acoustic energy is collected by the glass walls of the valve and transmitted to the electrodes irrespective of the type of valve holder in use, and that the only remedy possible is to enclose the valve in a thick wooden box lined with felt or other sound absorbing material.

In order to isolate the set from sounds transmitted through the table upon which it rests it is not necessary to use non-microphonic valve holders. The set, as a whole, should rest on sponge rubber feet fitted at each corner.

March 9th, 1927. "HOWLER."

THE "EVERYMAN'S FOUR" RECEIVER.

Sir,—The letter from Mr. S. Lambert in your issue of March 2nd re valves used in the "Everyman's Four" prompts me to describe a somewhat unusual fault I experienced with this set.

About a fortnight after completing the set, that is, after about fifty hours running, it began to suffer greatly from the microphonic tendencies of the detector valve—a "Cosmos" SP18/G. In another week this was so bad that a continuous howl was set up whenever I moved about the room. I got another SP18/G valve, but this was as microphonic as the other at the beginning.

I tried all the usual cures but they were of no avail, and was on the point of writing to you when I noticed that the microphonic tendencies were increased as the voltage across the filaments was reduced by means of the 2 ohm rheostat R_1. I therefore removed the 7.5 ohm resistor R_4 and replaced it by one of 2 ohms. This has completely cured the trouble, and I have now run the set successfully for five months.

For V_3 I am using a PM5 valve. Curiously this valve cannot be used at V_1 as neutralisation cannot be effected.

The last valve is a Burndept LL525 used with a negative grid bias of 25 volts and an anode voltage of 140 from H.T. accumulators.

The loud-speaker is an 18 inch "Kone," and the reproduction is really splendid.

I have received some forty stations on the "Kone"—no phones used for tuning—but interference limits me here to about four alternative programmes. G. G. S. CLARKE.

Cardiff,
March 4th, 1927.

B.B.C. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—I have noted with interest the letters in your March 2nd issue from Messrs. Rossiter and Islip regarding the B.B.C.'s transmission of pianoforte music.

May I mention that at a recent meeting of a radio society the lecturer, a very responsible engineer of the B.B.C., was questioned by two or three of his audience with regard to the same matter, viz., the distortion of the pianoforte transmissions.

His reply was to this effect: That the lower frequencies in the piano scale are usually lacking in strength when reproduced on the loud-speaker, and to attempt to balance up this deficiency they (the B.B.C. engineers) decided to increase the modulation of these lower frequencies by about 10 per cent. (I am not sure of the amount, but this is approximately correct) and this was done.

Therefore, it is quite obvious that whereas the last valve of the amplifier of a receiving set was originally working within the limits of the straight portion of its curve, the extra modulation (which was about double the original amount on these low notes) would cause an enormous increase in the grid voltages on the last valve and so cause the blasting and the distortion complained of. The same engineer claimed that this process improved the quality of the transmissions, so Mr. Islip can now account for the reply he received from the B.B.C. I might add that even a "super" power valve can very easily be overloaded when receiving signals of only moderate intensity. A. L. ROYER.

London, N.19.
March 6th, 1927

Sir,—I should like to add my little bit to your correspondents' experiences of the B.B.C. pianoforte transmissions. The point has been vividly brought to mind, or ear, as you will, in the last few minutes.

The interval piano music at 9.10 p.m. this evening was harsh and rattly over most of the musical scale. I have just heard Jan Kiepura's magnificent rendering of "La Donna e Mobile" from the National Concert from the Albert Hall with pianoforte accompaniment. This accompaniment, even in the forte passages, was perfect. As the set is in one room and the speaker in another and no one has been near the set all the evening, it can only be the transmission.

This is not an isolated instance, for we (three of us) have noted differences between the quality of the piano recitals during the evening programmes (those 15-minute studies of famous musicians) and the incidental stop-gap piano music between local news and resumption of the evening programme.

Quite often one has been good and the other bad, with no regularity: that is, one day the study, another the incidental music has been bad. Rarely are both bad, though sometimes both are good.

If both are bad I look to my set, which is 1-v-1, neutralised tuned anode, and Marconiphone 4 : 1 L.F. transformers.

Bridport. R. T. ALSTON.
March 3rd, 1927.

PROPOSED B.B.C. HIGH-POWER STATIONS.

Sir,—Regarding the Editorial in *The Wireless World* for March 2nd I was glad to see you voicing disapproval of the B.B.C.'s plan to use unnecessarily high power. If the new stations are going to be "super-Daventrys" it seems to me that instead of giving a choice of programmes these stations will be more likely to tie down to one station every one who does not use two sharply tuned H.F. stages or its equivalent. It may even make the oscillation nuisance worse, for reaction is a very cheap and easy way of getting selectivity. If these high-power stations must be built, they ought to be designed with some consideration for the people living within twenty miles or so of them. No stations have been built in this way as yet, but the thing is theoretically possible, and there is no reason why England should not lead the way.

The problem has three possible methods of solution. First, the radiating aerial could be surrounded by auxiliary earthed aerials to cast a "shadow" over densely populated districts in the neighbourhood of the station. Secondly, a horizontal Hertz aerial could be used which sends out a horizontally polarised wave sideways and a circularly polarised wave endways. All radiation, however it begins, is circularly (or elliptically) polarised at a distance so that this method would not effect distant reception, but the horizontally polarised wave in the neighbourhood of the station would have a comparatively small effect on the ordinary vertical receiving aerial. Lastly, there is what seems to me the most likely solution, radiation from an elevated horizontal loop. Such an aerial sends out a horizontally polarised wave outwards and a circularly polarised wave upwards. D. F. VINCENT.

Reading,
March 2nd, 1927.

Calls Heard.

Extracts from Readers' Logs.

Rawalpindi, India.

Great Britain :—G 2AO, 2OD, 2IH, 2JP, 2LZ, 2DX, 2CC, 2RG, 2SR, 2NH, 2VR, 5BY, 5UP, 5TZ, 5XY, 5LF, 6CI, 6UZ, 6QH, 6YV, 6KO, 6NX. Northern Ireland :—GI 6MU. Irish Free State :—GW 18B. France :—F 8EI, 3YOR, 8JJ, 8GI, 8BP. Denmark :—D 7BX, 7ZM, 7FJ, 7BD, 7MT. U.S.A. :—NU 6DCQ, 6CKU, CPU.

R. J. Drudge-Coates (AI DCR).

Edinburgh.

Great Britain :—G 2XY, 2NM, 2CA, 2CB, 2SR, 2BM, 5KU, 5JW, 5PC, 5DC, 5KZ, 5SZ, 5MS, 5FJ, 5TR, 5XH, 5UW, 5DK, 5BY, 5US, 5ZA, 6TD, 6NH, 6KK, 6UZ, 6QL, 6QH, 6VP, 6KO, 6IA, 6TW, 6TX, 6YV, 6NX, 6TG, 6FT, 6ZA, 6JV, 6CL, 6RD, 6QD. North Ireland :—GI 2IT, 6QD, 5NW, 6NX, 5NW, 6NX. North Ireland :—GI 2IT, 5WD, 6MU. Irish Free State :—GW 11Z, 18B, 3XO, 3AR. France :—F 8KM, 8EZ, 8A, 8TIS, 8JC, 8ZB, 8GDB, 8SS, 8PRI, 8NN, 8GI, 8OLU, 8ARO, 8XU, 8DNX, 8FY, 8CP, 8NOX, 8UT, 8HO, 8IU, 8KO, 8UDI, 8EO, 8KZ, 8OEO, FW. Germany :—K 4YA, 4PX, 4XY, 4XR, 4AB, 4XU, 4YS, 4KA, 4MC, 4SAR, 4WL, AGB, AGC. Holland :—N OTS, OHB, OTH, OWM, OPM, OCMX, OWE, OKO. Belgium :—B 4YZ, 4AA, A2, 4AR, K6. Austria :—Ö JI, PY, Italy :—I 1CE, 1NA, 1BD. Denmark :—D 7EW, 7XU, 7BX, OXZ. Yugo Slavia :—YS 7KK, 7LL. Poland :—TP AI, AJ. Sweden :—SMUA, SMSH, SMRU, SMUK. Spain :—EAR19, EAR18. Portugal :—P 1AF. Finland :—S 2BS. Algeria :—FA 8FWB, 8RRA. Congo :—CB F2. U.S.A. : U 1CH, 1AWE, 1ABA, 2MD, 2AYJ, WIZ. Miscellaneous :—VNRR, GSLO, OHK, OCDJ, IRT, PCRR, SUC, 9XZ, TLA2XA.

(0-v-0 Reinartz) all below 60 metres.
Alex. M. Robertson.

Bishopston, Bristol.

U.S.A. :—NJ 1AIR, 1AC, 1AIR, 1AMD, 1AOF, 1ASV, 1AVL, 1BEL, 1BES, 1BEZ, 1BHM, 1BV, 1CE, 1CH, 1DM, 1EJ, 1HJ, 1KR, 1LJ, 1NQ, 1VC, 1WL, 1XI, 1XH, 1XM, 2ABN, 2AKZ, 2BAD, 2BBB, 2BVH, 2BM, 2CVJ, 2CXL, 2DM, 2FO, 2HP, 2KX, 2OR, 2QU, 2WU, 3AK, 3AHL, 3BN, 2BWT, 3CK, 3CGP, 3CKL, 3JO, 3KR, 3LN, 3OQ, 3RM, 3SN, 4CU, 4FA, 4FT, 4IZ, 4TR, 8ADG, 8AZY, 8AFQ, 8CNH, 8IX, 8PL, 9FU, 9TF. Italy :—I 1BD, 1CE, 1CN, 1DM, 1MT. Scandinavia :—SMXV, SMUK, SMYG, S 2NQ, S 2BS. S 2CO. Miscellaneous :—K 4MCA, 4DBS, 4OAJ, 4OAH, 4UHU, 4SA, BZ 1IC, 1AW, 1AB, 1CO, 1AM, GULV, NISQ, WTT, NUQG, SDK, P 1AJ, 1AO, HZA, DNSC, C 8AW, 8AF, 2BE, 1AC, 1AR, R SB8, Y 2AK, Z 4AC, A 5BQ, 5HL, FI 8QRT.

(0-v-0 Reinartz) on 12-50 metres.
J. Monckton, Jr. (G6XS).

Rugby.

(January 1st to February 5th.)

U.S.A. :—U 1AX, 1AHV, 1AD, 1AIR, 1ARE, 1ANB, 1ASF, 1ARF, 1AMB, 1AXO, 1AAC, 1ANI, 1AXA, 1AXX, 1AVL, 1AIM, 1AFP, 1AAO, 1BA, 1BJK, 1BXL, 1BBX, 1BZ, 1BHS, 1BKE, 1BUX, 1BEZ, 1BLB, 1CC, 1CH, 1CMF, 1CLB, 1CJB, 1CMX, 1CRA, 1DEZ, 1DL, 1FL, 1GA, 1GI, 1GJB, 1IS, 1JZ, 1LC, 1LJ, 1LR, 1NQ, 1QV, 1RD, 1RF, 1RR, 1RW, 1SW, 1TN, 1UZ, 1XV, 1XM, 1XAM, 1XG, 1YB, 1ZN, 1ZS, 2AXA, 2AU, 2AGN, 2AHM, 2ARE, 2ALM, 2ATK, 2AQW, 2ARP, 2AAS, 2BW, 2BZ, 2BQH, 2BUY, 2BAD, 2BV, 2CTF, 2CXL, 2CUQ, 2CDR, 2EM, 2FO, 2LI, 2QU, 2SU, 2XT, 2XG, 2XS (14.6m.), 3AJC, 3ANC, 3BJ, 3BOF, 3BWT, 3CAH, 3CKL, 3CK, 3GP, 3HQZ, 3IF, 3IUV, 3JO, 3PF, 4FT, 8AL, 8ADE, 8CTL, 8TUV, 8XE, WIWY, NRRG, WIK, WIZ, WQO, 2XAF, KDKA, UX, YUNB, UX, LW. Canada :—C 1AR, 1ED, 1DD, 2BE, 2FO. Philippine Islands :—PI 1HR, 3AC, WUAJ. Honolulu :—HU 6BBF, 5DF. Chile :—SC 1IA. Australia :—A 2NO, 3GW, 3BQ, 5JA, 5WH, 5MA, 7CW, ACRX. New Zealand :—Z 4AA, 4AC. Argentine :—R CB8, DB2. Brazil :—BZ 1AK, 1AL, 1AW, 2AM, 6QB, SQ1. S. Africa :—O A6N, A5X, A3B, VPS. Belgian Congo :—OCB, F2. French Indo-China :—FFQ, 1B. China :—HZA, HZA1, 9AB (Macua). Dominican Rep. :—HIK. India :—Y DCR. Jamaica :—NJ 2PZ. Japan :—J 1PP. Morocco :—FM 8MA, 8MB, 8MF, 8ST, OCMD, OCMB. Norway :—LA 1A, 1B, 1R, 1X, 5B, OSLO. Miscellaneous :—BAD GLKY, P 1AF, FA 8VX, YS 7ZZ, YS 7XX, CS 2YD, TL 1Z, TLA 2XA, TPAV, TPAI, KTC, GLSQ, OQS, VGJL, CH B82, OXZ, WSP, R 1FL, RDKK.

(0-v-1 Hartley), on 14-60 metres.
M. S. Woodham.

READERS' PROBLEMS.

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

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

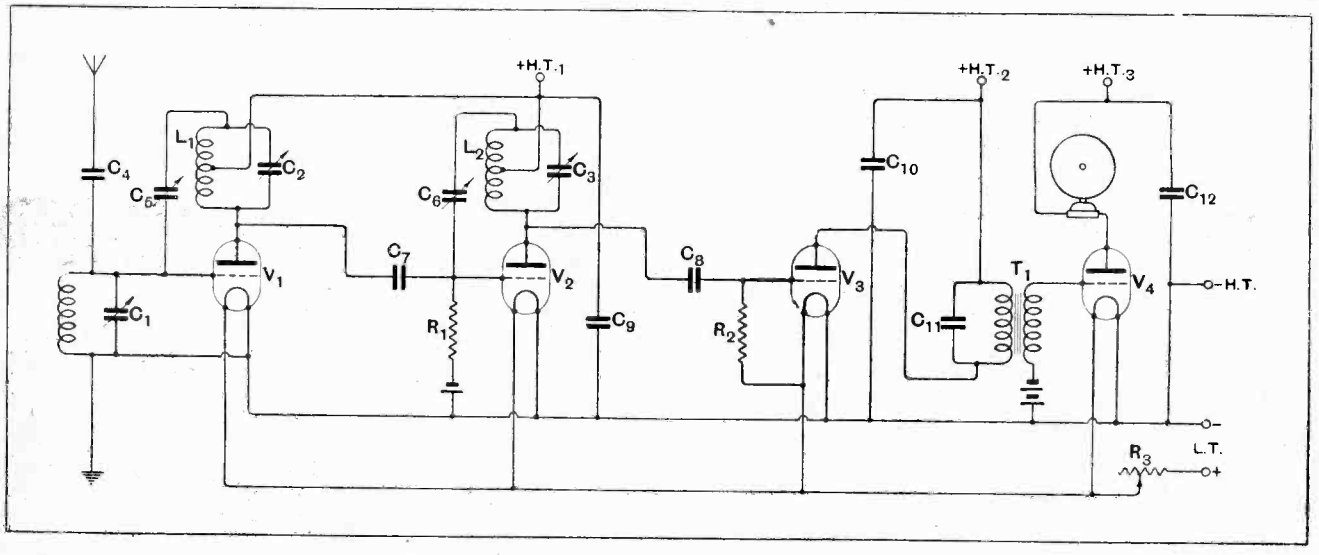
A Four-valve Long Range Receiver.

Will you please give me a diagram of a 4-valve receiver having two tuned high-frequency stages? I wish to tune over the short and long broadcast wavelengths and reaction is not required. G. N.

The diagram of the receiver is given below, and has, besides the two low-frequency stages, a grid current detector and one transformer coupled low-frequency stage. Such a receiver is not difficult to set up provided suitable components are used. For simplicity the three tuning coils can be of the plug-in type, having a centre tap, those known as "Dimic" coils being satisfactory. These coils are interchangeable and can be obtained for practically all wavelength ranges. The three coils are tuned by condensers C_1, C_2 and C_3, of 0.0005 mfd. capacity, and for a given wavelength their dials will be set at approximately similar readings because circuits L_1, C_2 and L_2, C_3 are practically identical, while the effect of the aerial capacity is considerably reduced by the fixed condenser C_4 connected in the aerial wire to the tuned circuit.

The two anode tuning condensers should be chosen with care as both sets of plates are connected to points having a high-frequency voltage to earth. A screen of some sort should be used to prevent hand capacity effects. Coils L_1 and L_2 are centre tapped, the centre point being taken to $+H.T._1$; one end of the tuned anode circuit is connected to the anode of the valve while the opposite end is taken to the balancing condenser C_5 or C_6 respectively. In the absence of stray magnetic and other couplings, condensers C_5, C_6, will completely neutralise the grid to anode capacities of valves V_1, V_2.

To avoid stray couplings the three tuning coils should be placed mutually at right angles and well spaced. The tuning condensers should also be well separated. C_4 may have a value of 0.0001 mfd., C_7 0.005 mfd., and C_8 0.00025 mfd. Condenser C_7 is merely a coupling condenser, but it has to have a grid leak and bias battery associated with it; R_1 may be of 1 megohm and the grid bias negative 1.5 volts. Resistance R_2 is the usual grid leak of 2 megohms. Valves V_3, V_4, are transformer coupled in the usual manner, and should, for the best results, be of low impedance and be supplied with ample anode voltage at $+H.T._3$ and appropriate grid bias. It is, of course, not satisfactory to use a low-impedance valve of, say, 2,000 or 3,000 ohms A.C. resistance at V_4 unless the anode battery or other source of power will supply the current necessary for economical working.



Four-valve receiver with two balanced high-frequency stages for all wavelengths.

C_9, C_{10} and C_{12}, of 1, 2 and 5 mfds. respectively, are provided.

It is very important to use the correct valves in a circuit of this type. For the high-frequency positions V_1, V_2, high-impedance valves should be used, and these should also have a high amplification factor. The detector valve may be one having an A.C. resistance of approximately 20,000 ohms, when T_1 has a primary inductance, under normal conditions, of 50 henries or more. Valve V_4, being connected to the loud-speaker

oooo

A Grid Bias Difficulty.

I have seen it stated that the negative grid bias applied to a valve is related to the anode voltage used and to the amplification factor of the valve; in fact, I have read that the correct grid bias is given by the value of H.T. used divided by twice the amplification factor of the valve. Does this not result in too large a negative bias? L. R.

In many instances application of the above rule results in too large a grid bias, although this depends essentially on the type of circuit associated with the valve. When the valve is connected to a loud-speaker it is often necessary, in the interests of good quality, considerably to reduce the amount of the negative grid bias found by the above rule, as can be seen by anyone who puts a milliammeter in the anode circuit of the valve. The rule is fairly reliable when applied to certain valve circuits but should always be used with caution; too much negative grid bias is, of course, definitely harmful to the quality. On the other hand, it is probably preferable to err on the side of too much negative grid bias. Too little grid bias shortens the life of the anode battery as well as impairing the quality, whereas too much grid bias, reducing as it does the current taken from the H.T. battery, results in economical working but naturally at the expense of quality.

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(14th Year of Publication)

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

THE MARCONI COMPANY.

PUBLIC interest has recently been focussed on the activities of the Marconi Company, particularly on the financial side, and it has been disclosed that the affairs of the Company have for some years past been tending towards a situation far from satisfactory. Matters have finally been brought to a head, and it is quite apparent that only by drastic measures in the way of capital readjustment, which have now been approved by the shareholders, can the Company once more be in a position to go ahead on sound foundations.

In the past the Company has gone through some very difficult times, and we can trace that in no small measure this has been due to continual technical progress which has rendered obsolete stations and apparatus almost as soon as completed. Similarly, an enormous amount of time must have been devoted to research work which, from similar causes, has been unproductive from the profit-making point of view.

The importance of the short-wave beam system to the Company at the present stage in its history cannot be overestimated, and the success of the stations already erected has undoubtedly exceeded the expectations even of those most intimately acquainted with the possibilities.

The latest development has come with the opening of the Grimsby and Skegness stations, which have successfully passed the official seven days' test by the Post Office for communication with Australia. The test required that the stations should be capable of a speed of 500 letters per minute each way during a daily average of seven hours.

With this excellent performance coinciding with the stabilisation of the financial position, it would seem that a better future now lies before the Company.

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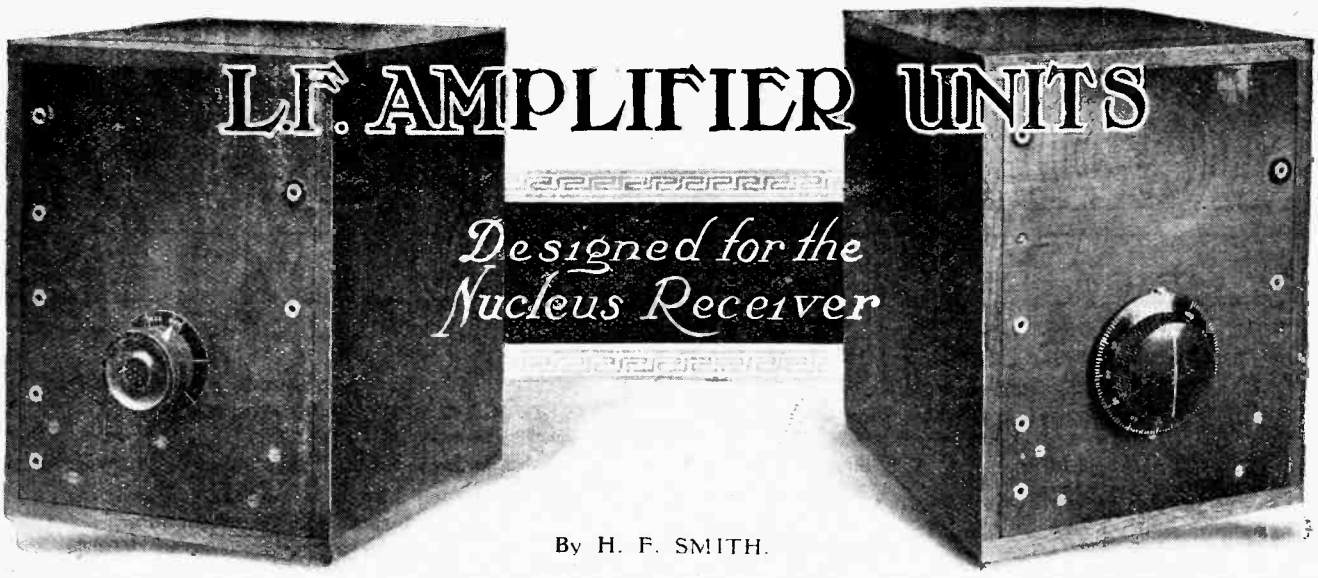
THE SILENT PERIOD.

OUR editorial note on the subject of the silent period in our issue of March 9th invited the opinions of our readers on this subject. In response we have had a great number of letters, a selection of which is published under "Correspondence" in the present issue. The conclusion which we are forced to come to is that whilst in theory the idea of a silent period may be regarded as highly desirable, yet in practice it seems doomed to failure, as conditions are at present, on account of the inevitable squealing and howling which would result the moment the silent period began, for listeners everywhere would be straining their sets to the utmost in the endeavour to pick up the foreigner. This great disability under which long-distance listeners would suffer during the silent period would outweigh any advantages which might accrue, and the only solution seems to be to adopt receivers sufficiently selective to eliminate the local B.B.C. station when desired; but long-distance listening may become the privilege of only a very few if the proposals of the B.B.C. for increasing the power of their stations go through, because of the swamping effect which would result.

CONTENTS.



L.F. AMPLIFIER UNITS

Designed for the Nucleus Receiver

By H. F. SMITH.

Resistance- and Transformer-coupled Note Magnifiers.

THE single stage of low-frequency amplification included in the basic unit of the "Nucleus" receiver is coupled by means of a resistance. There is no reason, however, why we should confine ourselves to this method when adding a subsequent note-magnifying valve, as a combination of this system with transformer coupling has many points in its favour, and is, indeed, included in many popular modern sets. Both types of amplifier will be described, and, although no attempt will be made to treat exhaustively on the relative merits and demerits of the two systems, a few words on this subject may help the amateur to come to a decision.

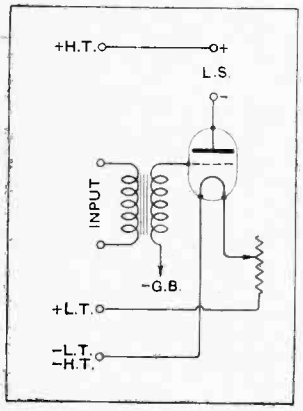


Fig. 1.—The circuit diagram of the transformer-coupled L.F. amplifier.

Alternative Methods.

In the first place, it cannot be denied that the transformer gives the greatest amplification, even taking into account the fact that special and greatly improved valves are now obtainable for the rival method. Its use also tends to minimise the bad effects of occasional overloading, as there is no coupling condenser to be charged up by grid currents, which are started when the grid is made momentarily positive, with a consequent "paralysing" effect which may persist over a comparatively long period before the charge can leak away through the grid resistance. Thus, even momentary overloads can hardly be tolerated in a resistance amplifier, but with a transformer their effects, as far as noticeable distortion is concerned, may hardly be evident. In practice, therefore, given output valves of equal power-handling capacity, the volume obtainable with the transformer method will be greater. Furthermore, a good transformer gives amplification of such a high degree of excellence that any improvement, as far as the vast majority of loud-speakers are concerned, would probably not be noticeable.

Resistance coupling, on the other hand, gives a uniformity of amplification which cannot be beaten by even the best transformer, and which is immeasurably better than the results obtainable from poorly constructed and badly designed instruments. It is cheaper, both in initial cost and maintenance; indeed, when coupling resistances of high value are used the current taken in both filament and plate circuits may be reduced to a figure which is almost negligible in comparison with that which will inevitably be required for the output valve. The use of high anode resistances will cause some attenuation of the upper range of audible frequencies, but this will not be noticeable as a rule, particularly if we do not go to extremes.

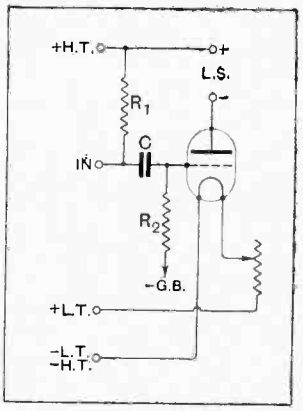


Fig. 2.—The resistance amplifier. C = 0·002 mfd.; R_1 = 0·5 megohm; R_2 = 3 megohms.

The two instruments described in this article are suitable for adding not only to the receiver for which they are primarily intended, but to almost any set, although only the transformer-coupled unit is really adaptable for following a crystal detector.

A similar containing case is used for each amplifier; its dimensions are as shown in the article describing a short-wave unit,[1] and are, for the sake of uniformity, slightly larger than is strictly necessary. In the resistance unit there is ample room for the accommodation of a choke-condenser filter if desired. The interconnecting

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

L.F. Amplifier Units.—sockets for the battery feed and input are arranged to join to the corresponding output sockets of the "Nucleus" receiver by means of short flexible leads fitted with plugs. In fact, the addition or removal of an amplifying unit takes only a few moments, particularly if the anode voltage applied to all the valves is the same; this arrangement is convenient, and, if it is adopted, there is no need for a separate condenser across the H.T. battery, which has accordingly been omitted. The raised baseboard used with the other units has been retained, again partly for uniformity and because some of the leads may be run underneath it, thus making for neater wiring.

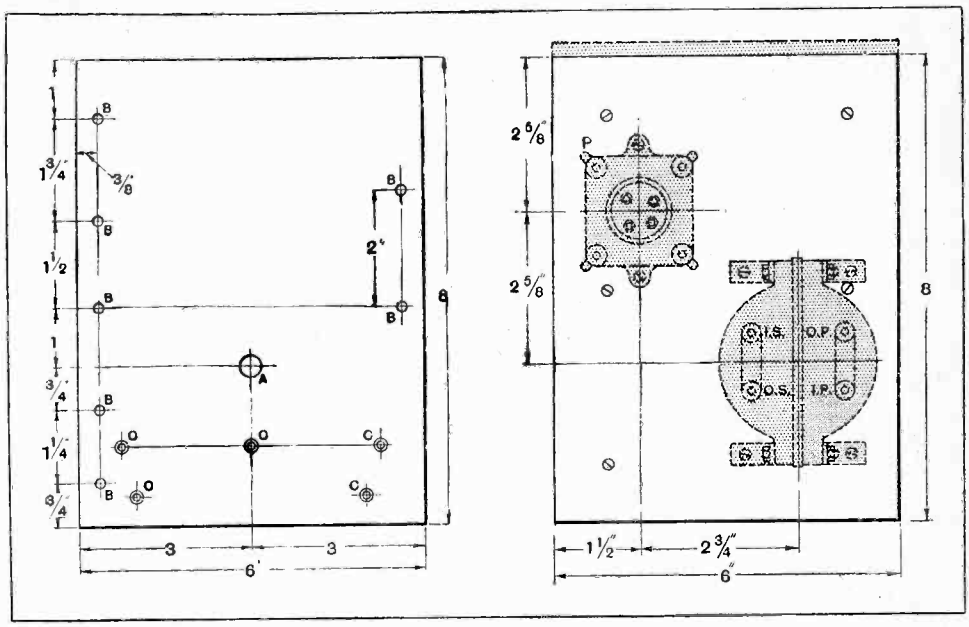


Fig. 3.—The transformer amplifier. Drilling details of the panel and (on right) layout of components on baseboard. A, ⅜in.; B, 1 B.A. tapped; C, ⅛in., countersunk for No. 4 wood screws.

The circuit diagram of the transformer-coupled unit is given in Fig. 1, from which it will be seen that the arrangement is conventional in every way. The input terminals are joined through the connecting links to the plate of the preceding valve (the L.F. amplifier of the "Nucleus" receiver) and to H.T. positive. A flexible lead, terminating in a wander plug, is passed through a hole in the back of the cabinet and is connected to a suitable negative point on the common bias battery, the positive terminal of which will already be connected to the common negative low-tension and high-tension lead.

No value has been assigned to the filament rheostat, as this will depend on the characteristics of the valve used; in the vast majority of cases one having a maximum resistance of 5 or 6 ohms will be suitable.

The drilling of the panel and the layout of components are clearly shown in Fig. 3. The arrangement of the wooden strips on which the baseboard is raised will be evident from the photograph. The panel is secured by wood screws passed through from the front into both the baseboard and its bearers, while the whole is fixed into the cabinet by suitably disposed screws through the upper edge of the panel (not shown) into a wooden fillet under the top of the case and by screws passed through the bottom into the supporting strips.

Choice of Valves.

All the wiring is carried out with bare No. 18 tinned copper wire, which is insulated with sleeving where it passes through the baseboard.

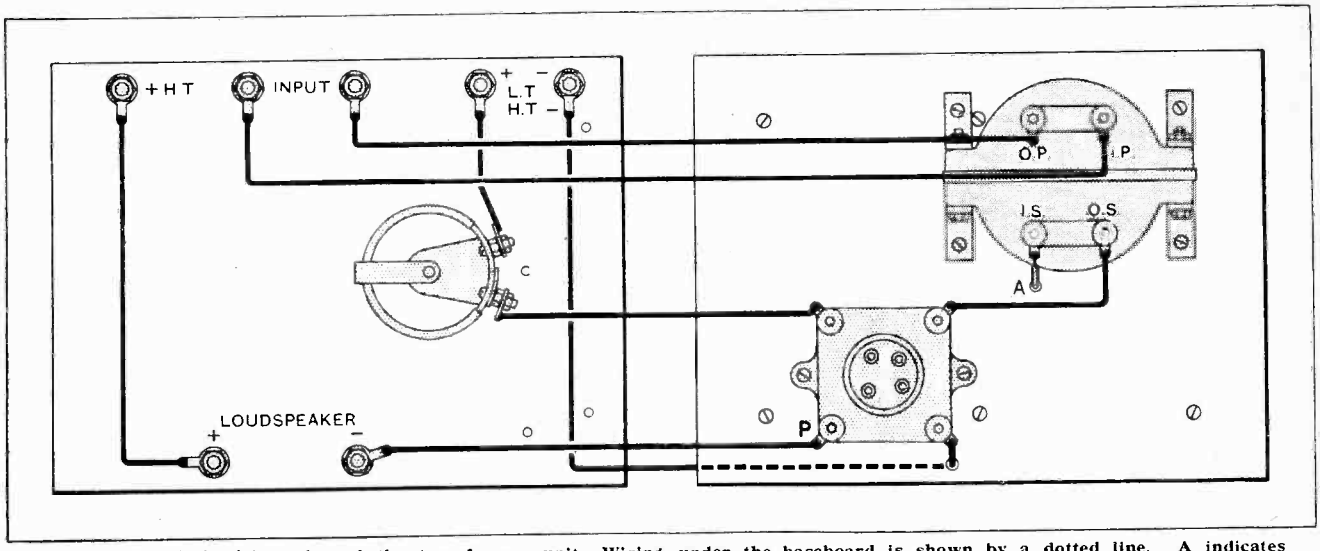


Fig. 4.—Practical wiring plan of the transformer unit. Wiring under the baseboard is shown by a dotted line. A indicates connection to the external grid bias battery.

LIST OF PARTS.

Transformer-coupled Unit.

1 Cabinet (Camco).
1 Panel, 6in. × 8in. × ¼in.
1 Filament rheostat (Peerless).
1 Valve-holder (Benjamin).
1 L.F. transformer, 2·7 : 1 (Marconiphone).
Sockets, screws, wood for baseboard, wire, etc.

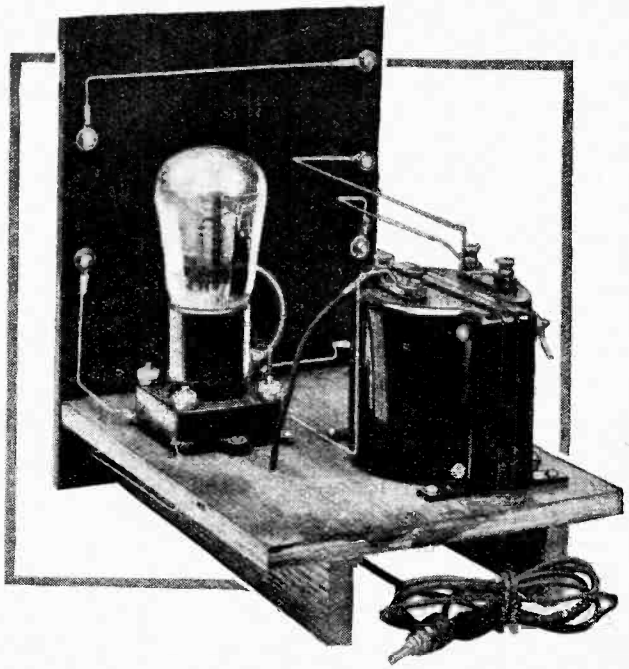
Total cost, including cabinet, approximately £2 7 6

A power valve should be used in this unit; or, much better, one of the "super-power" type, if the additional cost involved is not objected to. The maker's instructions regarding grid bias voltage should be observed. If maximum magnification is required, the preceding valve in the "Nucleus" set should be of the type having an amplification factor of from 15 to 20, with an impedance not greatly in excess of 25,000 ohms. Sufficient amplification for most purposes will, however, be obtainable with an ordinary power valve in the first L.F. stage, although with certain transformers it will be necessary to "over-bias" its grid to keep down the anode current which is flowing through the primary, to prevent saturation.

The Resistance-coupled Unit.

The circuit diagram of the resistance unit is given in Fig. 2. Only one input terminal (apart from battery connections) is provided, and this connects to the plate of the preceding valve, the circuit being completed through the anode resistance and the H.T. battery.

Although a high value of anode resistance is suggested, with consequently a comparatively small coupling condenser and a high resistance leak, there is no reason why this circuit and layout should not be used with the more conventional values of, say, 100,000 ohms, 0.1 mfd., and from 0.5 to 1 megohm, and a suitable type of preceding valve. The use of components as shown will, however, give equally good results with the best ordinary loud-speakers, and, as indicated above,



Rear view of the transformer-coupled unit.

they make for great economy in working and are in any case essential if a modern high-amplification valve is acting as the first-stage L.F. amplifier. A still greater proportional amplification of the lower audible frequencies will be obtained if the capacity of the coupling condenser C is increased to 0.005 mfd., but the result of any occasional overload (which is always so difficult to avoid) will be noticeably worse.

The majority of the constructional details already referred to in connection with the transformer amplifier apply also to this unit. An Athol porcelain base, as supplied for the reversible valve holder, is used as a support for the grid and anode resistances; the spacing between the holes happens to be approximately correct to take the necessary brass clips. A piece of sheet ebonite, of similar dimensions, could be used almost equally well.

The valve holder is mounted on a block of sponge rubber measuring 2⅜in. by 2in. by 1in. thick—not so much because shock absorption is specially necessary in

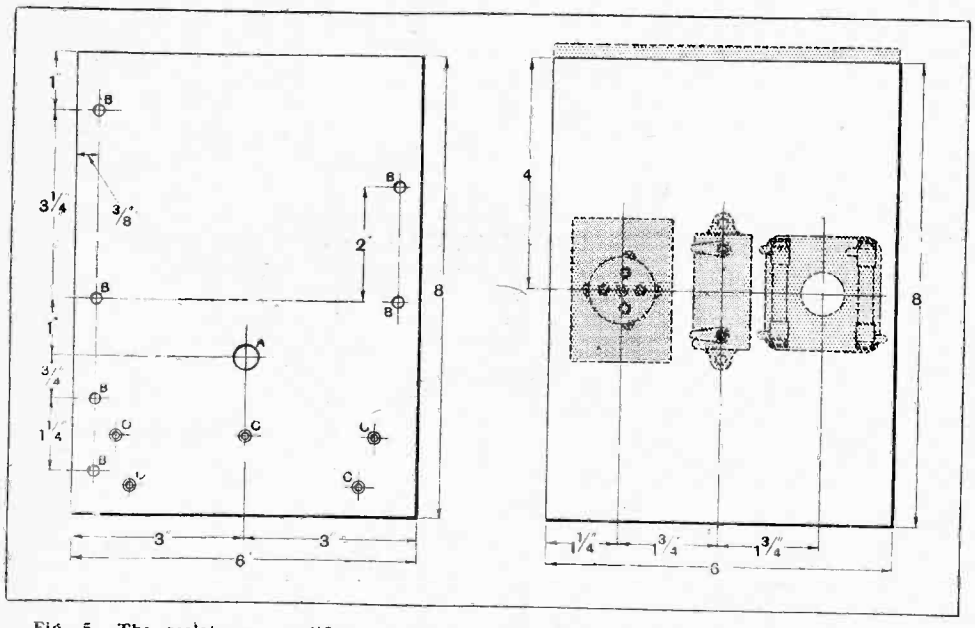


Fig. 5.—The resistance amplifier. Drilling details of the panel, and (on right) layout of components on the baseboard. A, 7/16in.; B, 1 B.A. tapped; C, ⅛in., countersunk for No. 4 wood screws.

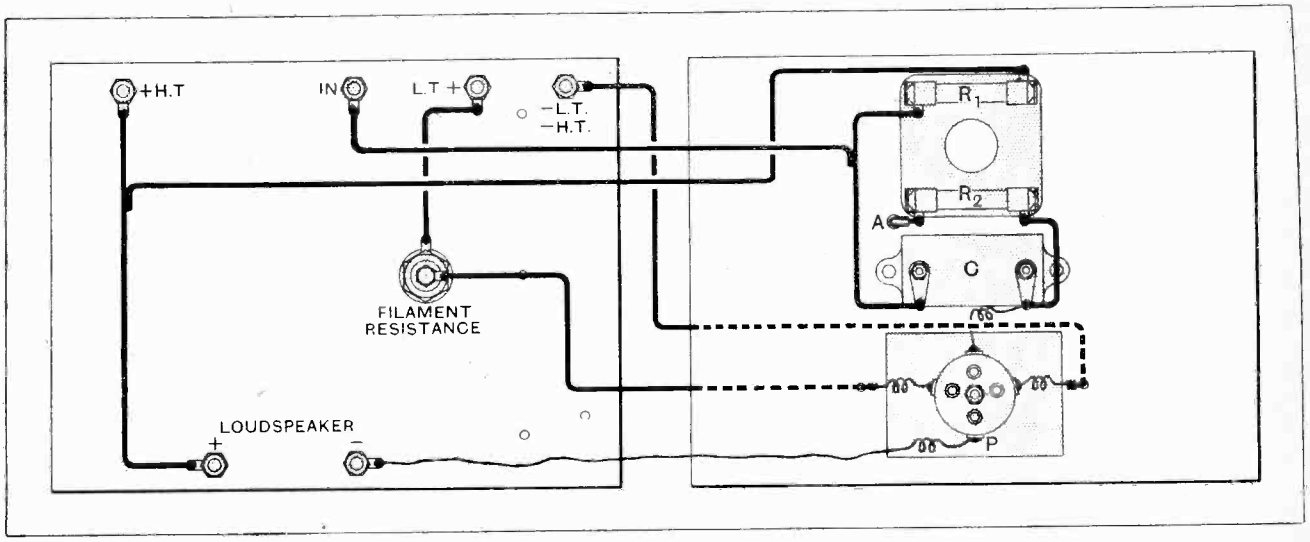


Fig. 6.—Practical wiring plan of the resistance-coupled unit. Wiring under the baseboard is shown in dotted lines. A indicates lead to the external grid bias battery.

the output stage (it is not), but to show the extreme simplicity of this undoubtedly effective method of suspension, which could well be more generally adopted. The sponge rubber, which should be of fairly fine texture, is cut to shape, and a hole is pierced through its centre. A screw, with a ½in. washer over its head, is now passed through it and the hole of the valve holder and its nut tightened up till the head sinks into the rubber in such a way that it will be clear of the baseboard, to which the block is affixed with rubber solution. The actual connections to the valve holder must be made with light flexible wire; spare pieces of Litz were actually used.

A power or super-power valve is necessary for this unit; the user's choice will again be largely determined by the amount he is willing to expend. The question of a suitable valve for the preceding stage is a little more involved, and really depends very largely on the amplification which is desired. If weak signals are to be expected, and also for distance work, a high-magnification pattern is clearly indicated, while very good amplification is obtainable with one with a "mu" of 20. For local work a power valve could be used, as even the small amount of magnification obtainable will possibly be more than sufficient.

LIST OF PARTS.

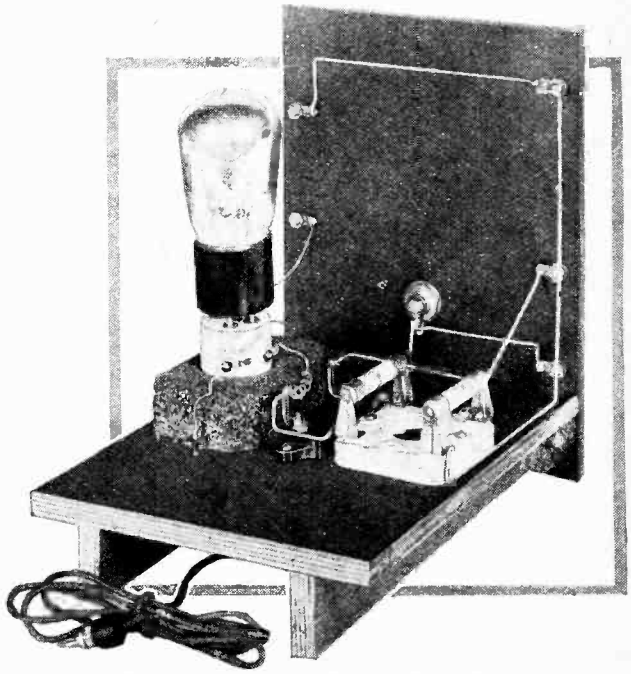
Resistance-coupled Unit.

1 Cabinet (Camco).
1 Panel, 6in. × 8in. × ¼in.
1 Filament rheostat (Benjamin).
1 Fixed condenser, 0·002 mfd. (Atlas).
1 Resistance, 1 megohm (Ediswan).
1 Resistance, 3 megohms (Ediswan).
1 Valve-holder (Athol Reversible).
1 Valve-holder base (Athol).
Sockets, screws, wood for baseboard, sponge rubber, wire, etc.

Total cost, including cabinet, approximately £1 9 0

The List of Parts included in the descriptions of "The Wireless World" constructional sets are the components actually used by the designer and illustrated in the photographs of the instrument. Where the designer considers it essential that particular components should be used in preference to others, these components are mentioned in the article itself, but alternatives for the remaining components may be used by the constructor, provided they are of equal quality and that he takes into consideration in the dimensions and layout of the set any variations in size of alternative components he may use.

It has come to our notice that many readers in making up their sets purchase components when they have others equally suitable on hand, or, alternatively, they may in some cases find it difficult to purchase locally some components listed.

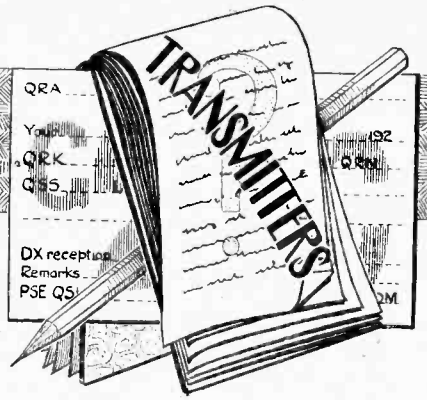


Rear view of the resistance-coupled unit.

IN PREVIOUS ISSUES.

December 1st, 1926	–	The Nucleus Receiver
December 22nd, 1926	–	H.F. Unit
February 2nd, 1927	–	Short-wave Unit

NOTES & QUERIES



Low-power Tests.

The report on the series of low-power short-wave tests conducted last November by members of the T. & R. section of the R.S.G.B. is now issued, and is published in the "T. & R. Bulletin" for March. The three most successful transmitters were (1) GI 6YW, Mr. T. P. Allen, Belfast, who was in communication with eight stations over 1,000 miles distant, and was reported by eight other stations equally distant; (2) G 5HS, Mr. M. Samuel, 16, Blenheim Road, N.W.18, who worked six distant stations and was reported as being heard by a similar number; (3) GI 6MU, Mr. E. Megaw, Belfast, with a total of six distant stations worked and four stations reporting.

Mr. G. A. Exeter (G 6YK), who undertook a great part of the work entailed in the organisation of these tests, states that though 92 stations signified their wish to participate, only 29 returned the log sheets. This was unfortunate, as several others were reported on by checking stations and these reports are naturally valueless without the log sheets for confirmation.

The beginning of the tests was marked by abnormally bad conditions, and little real "DX" was done, although one or two stations succeeded in pushing through. It was noticeable that daylight work was fair and the "blanket" only seemed to drop over things after the night "fade-out" took place.

Conditions improved gradually towards the end of the week, and the closing period of the tests was marked by one of the best "DX" nights we have had this winter. Although it was a "QSA" night, some of the reported signal strengths were extraordinary, but perhaps these depended upon the mood of the operator at the other end.

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International Relay Contest.

The Communications Manager of the American Radio Relay League, Hartford, Conn., U.S.A., asks us to draw the attention of British amateurs to a series of tests which will take place from May 9th to 22nd.

The object of these tests appears to be to discover the American or Canadian stations capable of two-way communication with the greatest number of foreign countries. Test messages will be issued to these competitors by the A.R.R.L. just before the contest begins, and one message only is to be transmitted to any foreign country. The messages will each require an answer, the text of which must be of eight or more words; each competitor is, therefore, allowed to send one message only to each foreign country and to receive one reply only from that country. Any wavelengths authorised for amateurs may be used. Full particulars may be obtained upon application to the A.R.R.L. at Hartford, Conn.

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General Notes.

Mr. J. Clarricoats (G 6CL), 107, Friern Barnet Road, N.11, states that a series of tests to study variations in signal strength will be conducted throughout Sunday, April 3rd. The calling stations will be Danish 7MT and 7EW. The co-ordination of Y DCR, SMWF, D 7JO, K 4CL, GI 5MU, GI 6YW, G 6QB, G 5MQ, G 2BYN, BRS41, LIT1B and D 7BZ is being obtained, and it is thought that possibly several other amateurs may care to assist with these valuable tests.

The tests will begin at 1000 G.M.T., wavelength 45 metres. Further information and log sheets can be obtained from D 7MT, whose address is 6, Virginiavej, Copenhagen, or from G 6CL.

Mr. F. J. Hughes (G 2NL), Ashdene, Wells Road, Bath, Somerset, informs us that he is still experiencing some trouble on account of letters to him being insufficiently addressed, owing to the unfortunate omission of part of his address in the *R.S.G.B. Diary and Log Book*. We drew attention to this error in our issue of February 9th, but as it has evidently escaped the attention of some of Mr. Hughes's correspondents we would ask readers who wish to send him QSL cards to note his proper QRA as given above.

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New Call-signs Allotted and Stations Identified.

G 6KM S. Kember, 34a, Albert Bridge Road, Battersea Park, S.W.11; transmits on 45 metres.

G 6RB R. A. Bartlett, 3, Chertsey Road, Redland, Bristol.

SC 2BL and **NAD**, Gustavo Vierling, P.O. Box 1653, Valparaiso, Chile, wishes to get into touch with British amateurs.

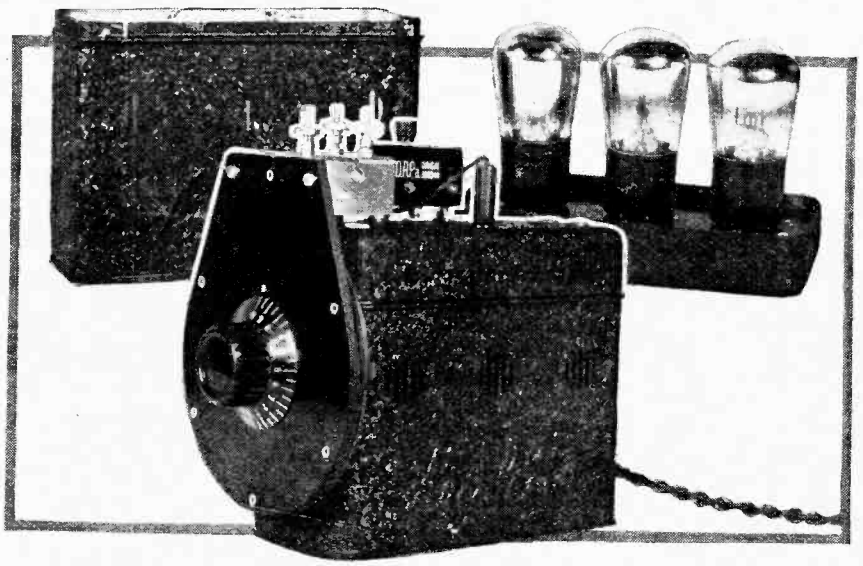
D 7XF E. Hyllested, 97, Strandvej, Copenhagen, Denmark; (change of address.)

K 4ABF Wilhelm Doering, Zähringerstrasse 114, Karlsruhe, Germany.

K 4UAH V. Gramich, Martiusstrasse 7-11, Munich, Germany.

Ö GP Georg Priechen Fried, Zehetnergasse 20, Vienna XIII, Austria. (Change of address.)

P 1AK Manuel Bivar, 247, Avenida da Liberdade, Lisbon.



THE ARCOLETTE RECEIVER made by the Telefunken Company and named after their chief engineer, Count Arco, is a three-valve set with a detector and two resistance-coupled amplifiers. Resistances and coupling condensers are incorporated in the valve-base panel and the layout is designed for mass production, the output being 1,000 to 1,500 sets per day.

LOUD-SPEAKER DIAPHRAGMS.

Influence of Diameter of Diaphragm on Interference Effects at High Frequencies.

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

IN applied acoustics, as in other branches of physics, there are always numerous problems on the waiting list which require solution before much further progress can be made. The science of acoustics, so far as relative developments are concerned, is rather old. Some fifty or more years ago principles were propounded which we are just learning to apply to modern loud-speakers. When I say "we," I ought to qualify the statement by saying that there are still a lot of misguided people who have not studied these principles. Otherwise there would be fewer misleading articles written on the subject of loud-speaker construction at home. But in spite of the inclusion of these old principles into loud-speaker construction, there still remains an enormous amount of experimental and theoretical work to be done before any serious advance in design can be made with certainty. Following the hit-and-miss principle of design leads to a *cul-de-sac*, for unless we can explain the effects due to certain improvements, there can be no scientific basis on which to work. It is imperative, therefore, to resort to some system of investigation which enables us to explain the behaviour of different features of a design.

Tendency of Modern Design.

In past articles I have discussed various aspects of loud-speaker design in a general way,[1] but it seems desirable to treat some particular part of the instrument in more detail without resorting to mathematical analysis. The modern tendency—on which I reserve judgment—is to design instruments of the large diaphragm type. Apart from acoustical considerations this may lead to economy of space and cost, for with a horn-type loud-speaker to reproduce the low tones in any appreciable degree a long horn is required. For example, if we desire to reach a point two octaves below middle C on the piano (64 cycles) the length of horn required is about 12 feet, and to get right down to the lowest note on the piano the length must be about 60 feet. Such sizes are somewhat beyond the average pocket and the average residence. Nevertheless, to show that the matter is to be taken quite seriously we have reproduced two photographs[2] in Figs. 1, 2. These show a 20ft. horn, capable of reproducing frequencies down to 40 cycles per second, enclosed in a specially built cabinet, and an experimental 40ft. horn.

Fig. 1.—Gramophone reproducer with 20ft. horn capable of reproducing frequencies down to 40 cycles.

Of course, the question of low tones is—so we are told by those unable to produce them—really a matter of taste. This, however, is hardly convincing. If the low tones are not required, then orchestras might as well consist of a few of the higher-pitched instruments, *e.g.*, the violin, flute, piccolo, cornet. I think the reader will agree that no orchestral conductor of any professional standing would preside over such an assembly. If, therefore, the 'cello, double bass, bass drum, bassoon, etc., are essential in an orchestra to give a correct musical balance, surely they are equally essential in the reproduced version. This being the case, it is clear that if we are to have a horn-type loud-speaker to yield a proper balance to the various musical instruments in an orchestra, or to reproduce the upper and lower registers of the piano, the length of the horn must be considerably in excess of that to which we have hitherto been accustomed.[3]

Fundamental Tones.

Another argument which I have heard advanced, and which has been displayed in cold print, is as follows: When the harmonics of a note are sounded, *e.g.*, imagine middle C on the piano to be played with the fundamental extinguished, the aural sensation is such that the listener *imagines middle C to have been played.* By some mysterious means the ear exerts a creative effort and interpolates the fundamental.

This being so, we are asked to believe that there is no necessity to reproduce the fundamental. Putting the argument into more concrete form, suppose middle C is played on a piano at the broadcasting studio. We listen to it with a loud-speaker the output characteristic of which is such that the fundamental tone of middle C is too weak to be heard, but the overtones or harmonics of the note are reproduced in full force. We then imagine—in fact, we are perfectly sure—that the note

[1] *The Wireless World*, November 4th, 1925; *Experimental Wireless*, March, 1926; *The Wireless World*, October 13th, 1926.

[2] *Journal of the Franklin Institute*, October, 1926.

[3] The usual length is about 2ft. This cuts off everything below middle C on the piano.

Loud-speaker Diaphragms.—

played was middle C. But should we with great daring play middle C on our own piano there will be a marked difference in aural sensation. The piano will sound perceptibly deeper in tone than the reproduction from the loud-speaker. The conclusion at which we arrive is simply this: When the fundamental of a note is weak there is a definite change in aural sensation compared with that when the fundamental is heard at its natural strength. Weakening of the fundamental gives the sen-

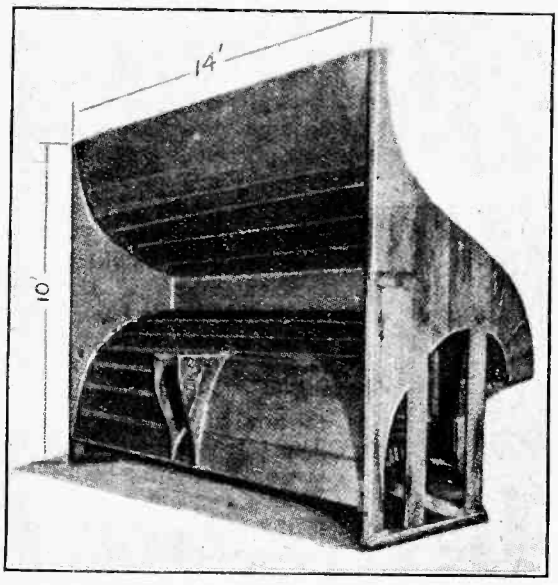


Fig. 2.—Experimental horn, 40ft. in length, used by the Victor Talking Machine Co. in America.

sation of a rise in pitch. The absence of the lower tones in orchestral reproduction is found to be aurally aggravating, especially at large intensities. Inserting the lower tones, although increasing the overall intensity, gives the necessary balance, for it is well known, so far as the ear is concerned, that low tones mask the effect of high tones. Hence we are driven to the conclusion that in the reproduction of musical sounds by loud-speakers all the tones from the top to bottom of the acoustic register should, as far as possible, be of the same intensities as the original.

Having established the necessity for the reproduction of low tones, and having for the time being ruled out long horns on account of size and expense, we proceed to a discussion of the action of a diaphragm when used as a reproducing agency. The properties of diaphragms as sound radiators have received little or no attention, and it is well to bring the matter forward at a time when the diaphragm or hornless type of loud-speaker is coming to the fore. To secure sufficient stiffness it is usual to make a diaphragm conical, pleated, etc., but for simplicity in explaining the action of a diaphragm we shall take the case of a flat disc which is perfectly rigid, *i.e.*, its natural frequency is well above the limit of audibility. Being perfectly rigid, the disc will move as a whole at all the audible frequencies at which it is made to vibrate.

Referring to Fig. 3, the disc is freely suspended at its circumference by flexible material such as thin rubber. The suspension is arranged so that it does not impede the motion of the disc on its axis X_1X_2, *i.e.*, the axial motion is quite free and there is no force *due to the suspension* which will bring the disc back to its central position. The suspension is mounted in a large wall which completely isolates the two sides of the disc, so that sound waves which are radiated from one side cannot interfere with those radiated from the other. From the symmetry of the arrangement it will be quite clear that the radiation on each side of the disc will be equal in amount and similarly distributed in the space beyond the disc.

Radiation from a Diaphragm.

We have now to drive the disc to and fro on its axis. For the present we will not stipulate any particular way of accomplishing this, but merely imagine an *alternating force of constant amplitude* to act axially upon the centre of the disc. This force will push and pull the disc on its axis alternately each half-cycle or alternation. Also we will suppose that the frequency of this constant alternating force can be varied over the entire acoustic range. The method of achieving this does not concern us at the moment. We merely desire to investigate the radiating properties of the disc in itself. When the disc is moved to the right it displaces a certain amount of air, whilst at the left there is an inrush of air to fill the space vacated by the disc. This displacement is felt throughout the air situated on each side of the disc. Now we might be apt to jump to the conclusion that there would be a much greater effect on the axis at P than on one side at Q. We must remember, however, that when a gas is compressed or rarified, the pressure charge is felt equally in all directions. Thus the effects at P and Q would be substantially the same provided these two points were about the same distance from the centre of the disc. From this simple axial motion of the disc to the right, we proceed to see what happens when the disc is made to vibrate. We know that the condensations and rarifactions due to the alternate increase and decrease in air pressure[1] at either side of disc causes sound waves to be radiated from the disc *in all directions*.

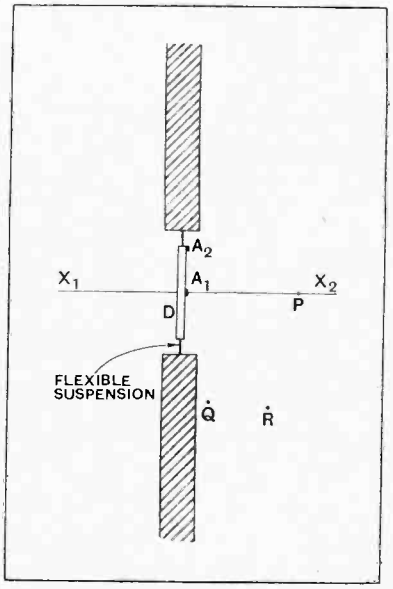


Fig. 3.—Simple disc diaphragm freely suspended in a wall of large dimensions to prevent interference of sound waves emitted from each side of disc.

[1] This increase and decrease is above and below the normal atmospheric pressure.

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Let us take a certain frequency of vibration, say, 500 cycles per second, and assume the disc to be 12 inches in diameter. We want to know what happens in the air space at each side of the wall when the disc executes 500 complete vibrations every second. We have already found

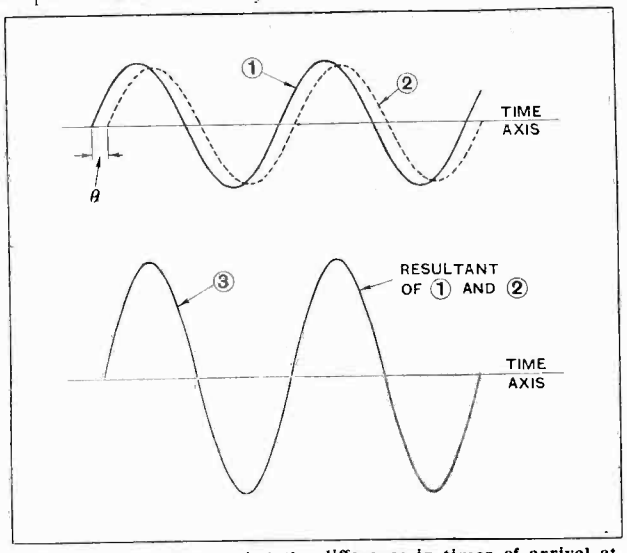

Fig. 4.—Curves illustrating the difference in times of arrival at P of waves from A_1 and A_2 in Fig. 3. The phase angle θ represents the lag of A_2 behind A_1.

that pressure waves spread out from the disc in every direction. At a point P on the axis (Fig. 3) we know that the air pressure increases and decreases by a small amount every time the disc vibrates. To go a step further, we imagine the disc to be divided into a very large number of extremely small areas. We can call these elemental radiators or elements. The effect at P is due to the radiation from all the small elements.

Now an element A_1 at the centre of the disc is nearer P than an equal element A_2 at the edge of the disc. This introduces two effects as follows: (1) the pressure at P due to A_2 is less than that due to A_1 because the latter is nearer to P; (2) since both sets of waves travel with the velocity of sound, those from A_2 arrive a little later than those from A_1 because they have further to travel. Thus the pressure at P is not double the pressure due to A_1 alone.

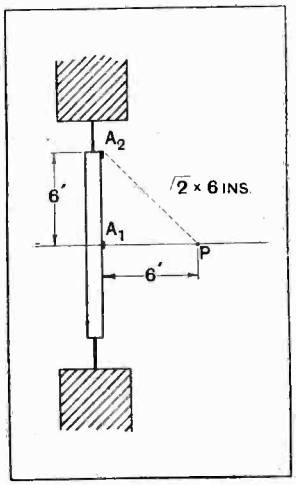

Fig. 5.—A particular case illustrating the difference in time of arrival at P of waves from A_1 and A_2.

In Fig. 4 is shown the two sets of waves displaced in time, as explained above. Curve 1 shows the waves from A_1, whilst curve 2 shows those from A_2. Curve 3 shows the resultant of 1 and 2—that is, the sum of the two waves. The maximum value of this resultant is less than twice the maximum of curve 1, because the wave from 2 is not so strong as that from 1. Since 1 and 2 are out of phase the resultant is less than the sum of 1 and 2 would be if they arrived simultaneously. For simplicity we considered only two elements on the disc, but it is easy to see that the pressure at P is the resultant of the waves from all elements on the disc. These reach P different in amplitude and in time of arrival (out of phase). The same argument applies to any point in space, say Q. In this case the distances from the various elements on the disc are different from those where the point is on the axis of the disc, *e.g.*, P.

A numerical example will make the action of the disc more easily understood. In Fig. 5 consider the action of the two elements A_1A_2 at the centre and the periphery

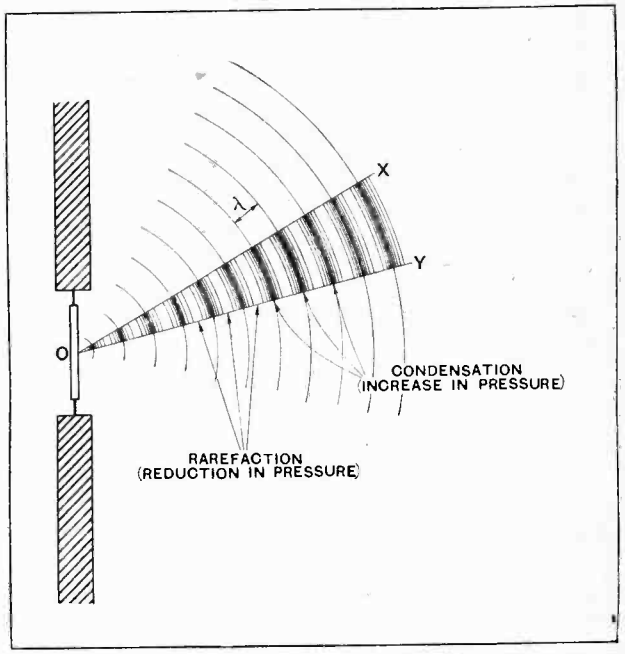

Fig. 6.—Portion of hemispherical wave radiated from one side of disc.

of the disc respectively. The time taken for a wave to travel from A_1 to P is

$$\frac{A_1P}{\text{Velocity of sound}} = \frac{6}{14{,}400} = \frac{1}{2{,}400} \text{ sec.}$$

since the velocity of sound is about 14,400 inches per second. The time taken for the wave from A_2 to travel to P is

$$\frac{A_2P}{\text{Velocity of sound}} = \frac{6\sqrt{2}}{1{,}200 \times 12} = \frac{\sqrt{2}}{2{,}400} = \frac{1.4}{2{,}400} \text{ sec.}$$

This means that the radiation from A_2 takes 1.4 times longer to travel to P as that from A_1.

To proceed further with our investigation we must consider the frequency of vibration of the disc, because the *effect* of the difference in arrival time at P depends upon the frequency. As an introduction to the subject, let us find the relation between the frequency and the velocity of sound. Fig. 6 shows a portion of a wave proceeding from the disc. It consists of spaces where the air is slightly compressed and alternate spaces where the air is equally rarified. This can be represented graphically by the curve of Fig. 7, which is a series of crests and troughs. The pressure wave travels with the velocity of sound, namely, 1,200 feet per second, and there will be

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3,000 crests and 3,000 troughs in a distance of 1,200 feet. But we define the distance between two consecutive crests or troughs as the wavelength of the sound. Thus the distance from crest to crest is $\frac{1,200}{3,000} = 0.4$ feet $= 4.8$ inches. This is the wavelength of a sound in air, the frequency of which is 3,000 cycles per second. In other words, the sound travels 4.8 inches in $\frac{1}{3,000}$ second, which is equivalent to 1,200 feet in one second.

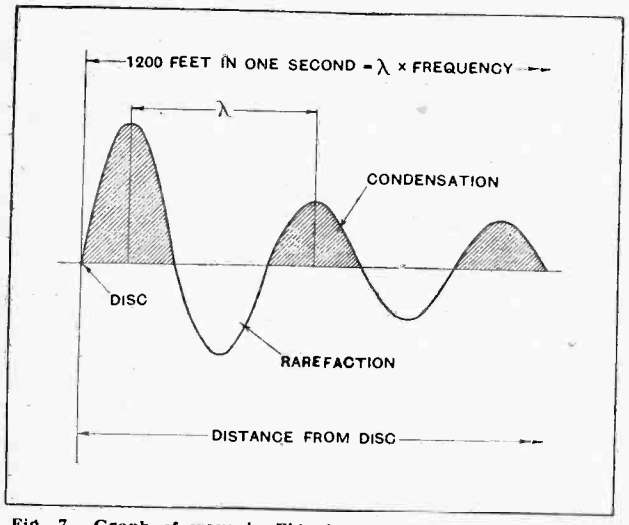

Fig. 7.—Graph of wave in Fig. 6 plotted on a distance base. Vertical distances from the base represent changes of air pressure above and below normal.

Returning to our problem portrayed in Fig. 5, we saw that the time taken to travel from A_2 to P was $\frac{1.4}{2,400}$ second, and from A_1 to P $\frac{1}{2,400}$ second. The wave from A_2 arrives, therefore, $\frac{1.4-1}{2,400}$ second late, *i.e.*, $\frac{1.4-1}{2,400} = \frac{0.4}{2,400} = \frac{1}{6,000}$ second. But at a frequency of 3,000 cycles per second the wave from A_1 *has travelled half a wavelength* in $\frac{1}{6,000}$ second *Hence the radiation from* A_2 *arrives half a wave behind that from* A_1. This is shown in Fig. 8, where the waves are drawn in their relative positions.

Interference.

The resultant pressure is the *difference* between the two because the waves are 180° out of phase (180° is equivalent to half a wavelength, the whole wavelength being 360°). This is a case of "interference" where the radiation from A_1 is partially neutralised by that from A_2. At frequencies higher or lower than 3,000 cycles the interference is different, excepting at 6,000, 9,000, etc., cycles. At frequencies less than 3,000 cycles the interference is less, *i.e.*, the resultant pressure at P is greater than at 3,000 cycles because the arrival from A_2 is *less* than half a wavelength behind. At a frequency of 50 per second the time interval $\frac{1}{6,000}$ second is negligible, so that to all intents and purposes the waves A_1A_2 arrive in the same phase and add up. We have already stated that the resultant pressure at any point in space, say Q in Fig. 3, is due to the radiation from all the elements into which we imagine the disc to be divided. Also it must be borne in mind that the pressure amplitude at Q depends upon the distance and the phase of arrival of the wave. At low frequencies the difference in time of arrival at various points in space from different parts of the disc is negligible. For all practical purposes the radiation from all points on the disc can be considered to arrive at the same time.[5]

Effect of Increasing Frequency.

Thus the alternating air pressure at all points equidistant from the centre of the disc is the same. In other words, if we imagine a hemispherical surface, porous or non-absorbent to sound waves, to rest on the wall (see Fig. 9), every point on this surface is at the same pressure due to radiation from the disc. Thus persons situated at various points—A, B, C, etc.—on the hemisphere would hear equally well when the disc was vibrating at low frequencies. As the frequency of the disc is increased, the radiation from different parts of the disc interferes in space and causes a reduction in pressure. The interference is greatest at points Q, R, to the side (see Fig. 3), and there are zones of minimum pressure where the pressure is small compared with that on each side. Apart from these zones of reduced pressure, the general effect at high frequencies is to cause a beam effect, as illustrated in Fig. 10. Outside the beam the intensity is very weak. The beam becomes narrower as the frequency is increased, because the wavelength gets so short as to be comparable with the dimensions of the disc. For example, as $f = 3,000$ cycles the wavelength

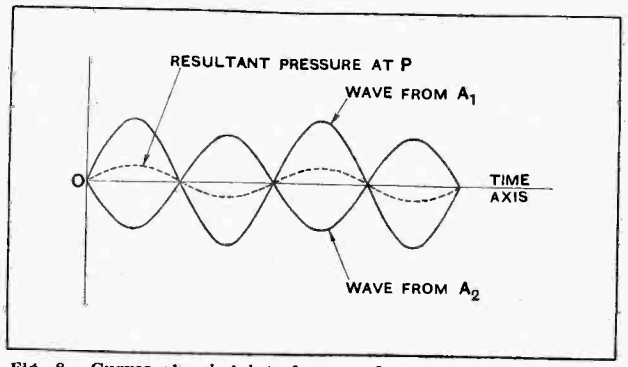

Fig. 8.—Curves showing interference of waves from A_1 and A_2 in Fig. 5 when the wavelength is 4 8ins. corresponding to a frequency of 3,000 cycles per second. Note that the curves represent pressure variations at P with time and not the waves in space, i.e., O is not the disc, but an arbitrary time origin.

is 4.8 inches, and the disc used by way of example is 12 inches diameter.

It is interesting to observe that at high frequencies there are points near the disc at which the pressure is zero. These are usually known as "nodes," or points of zero motion. At any point removed several diameters from the disc the pressure is almost constant at all fre-

[5] Unless the disc is large.

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quencies, provided the alternating force on the disc is constant. At low frequencies the mass of the disc is increased to an extent due to the inertia of the air which it moves to and fro. As the frequency increases the beam or focussing effect occurs, and the amount to be added to the mass of the disc due to air inertia decreases. This extra mass at low frequencies causes a reduced amplitude of the disc, which is accompanied by a reduction of pressure in the space outside the disc. If, however, the disc is sufficiently small, *e.g.*, 1 inch diameter, the pressure is constant at all frequencies when the driving force is constant. Hence we have the hypothetically perfect loud-speaker for vibrations of constant amplitude (the steady state) provided we listen at a point on the axis of the disc, but several diameters from it.

The last point for our consideration in the problem of the vibrating disc is the influence of its diameter. We have seen that the radiation from a vibrating disc is reduced in the space at each side due to interference, *i.e.*, the sounds from each element on the disc do not arrive at any point in space simultaneously. Also the interference increases with the frequency due to the wavelength becoming comparable with the size of the disc. Suppose we take the disc of Fig. 11 and imagine it to be 1 inch diameter. Then at points Q, R, etc., there is practically no difference in distance between them and the opposite edges of the disc. Thus even at high frequencies the difference in time of arrival would be small compared with the time taken to travel half a wavelength. The greatest difference would be at points on the wall, say S, where it would be the diameter of disc, namely, 1 inch. This means a half wave of 1 inch or a frequency of 7,200 cycles per second, which is fairly high. Moreover, the radiation from a small disc, say 1 inch diameter, is uniformly distributed throughout the space on each side over a band of frequencies up to about 5,000 cycles per second, *when the driving force on the disc is constant.*

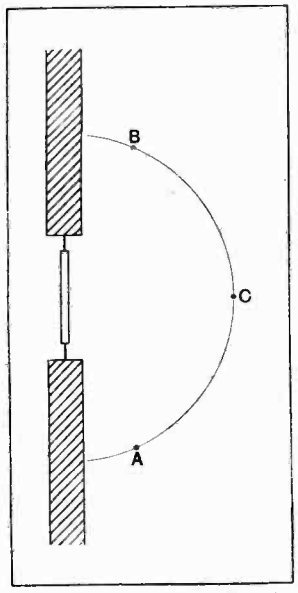

Fig. 9.—At points A, B and C on a hemispherical surface with the disc as centre there is equal pressure from waves emanating from the disc.

Large Diameter Discs.

For the other side of the picture we have to see what happens when the disc is, say, 24 inches in diameter. From Fig. 12 we see that there is an appreciable difference in distance between P and the opposite edges of the disc (BC). This distance is many times that in the case of the 1 inch disc. Thus at a comparatively low frequency the waves from opposite sides of the disc will differ in arrival time by half a wavelength. Taking the simple case of point S on the wall, the difference in distance is the diameter of the disc, namely, 24 inches. This being the half wavelength, the whole wavelength is 4 feet. Now, sound travels 1,200 feet per second, so that this wavelength represents a frequency of $\frac{1,200}{4} = 300$ cycles per second.

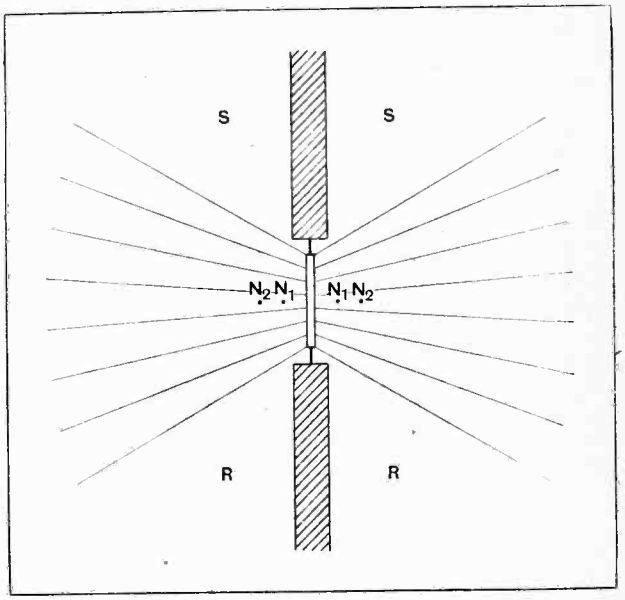

Fig. 10.—Beam or focussing effect at high frequencies due to interference in the regions R and S. N_1, N_2 represent nodes or points of zero pressure.

Thus at frequencies above 300 cycles the interference will be perceptible and will increase with the frequency. This, of course, means that the beam effect will occur at much lower frequencies with the 24 inch than with the 1 inch disc. Thus over a wide frequency band the radiation from the larger disc will be *less* than that from the smaller disc. On the other hand, the 24 inch disc will move through a much smaller distance than the 1 inch disc, and this is important where loud-speaker design is concerned.

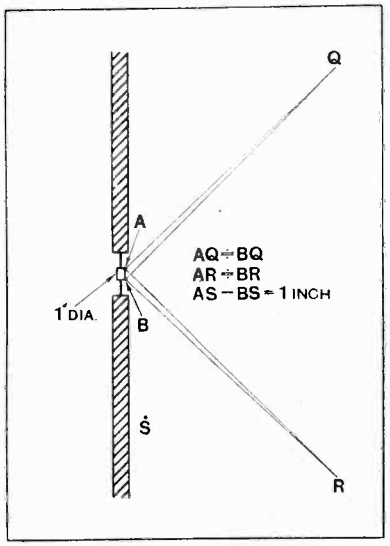

Fig. 11.—Showing reduced interference (focussing) at high frequencies due to a small diaphragm.

Owing to the infinity of radiating elements on the disc and to the different distances, the frequency at which the beam effect begins to get serious cannot be calculated in the simple manner used above by way of illustration. Nevertheless, vigorous analysis corroborates our reasoning.

Before epitomising this investigation it is of interest

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to note that at low frequencies the equivalent mass to be added to the disc due to air inertia becomes important in the case of large diameters. Thus with a 24 inch disc the mass to be added due to air inertia at low frequencies is sufficient to cause an appreciable reduction in radiation (due to reduced motion).

Throughout the article it has been assumed that the alternating force acting on the disc is constant at all frequencies, and that the density of the disc is considerably in excess of that of air In other words, the mechanical efficiency, this being the ratio :—

$$\frac{\text{Acoustic press. on disc}}{\text{Driving force}}$$

is very small (say, 1 per cent. driving force, this being a value agreeing with practice). If the density of the disc were comparable with that of air the argument would require modification.

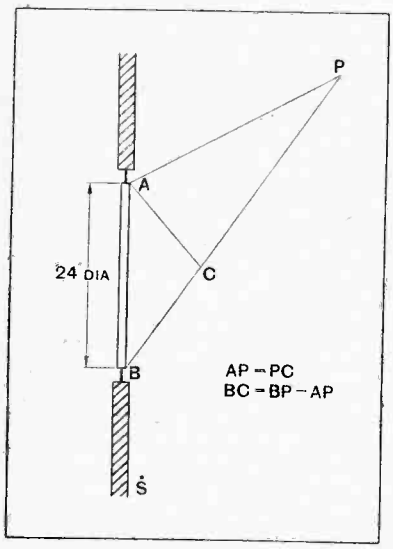


Fig. 12.—Showing that an appreciable difference exists between the distances from a point P in space to diametrically opposite edges of a large disc. When BC = half a wavelength the radiation from opposite sides of the disc will practically cancel out at P.

Summary.

When a perfectly rigid disc is driven in air by an alternating force of constant magnitude, there being no interference between the two sides :

(1) The energy radiated is constant up to a certain frequency, and the waves are propagated hemispherically from the disc.

(2) Up to this frequency the air pressure variations superposed on the normal barometic pressure are constant over any hemispherical surface having the centre of the disc as centre.

(3) Beyond this frequency the waves radiated from different parts of the disc interfere at points in space owing to the difference in distance, and to the comparatively low velocity of sound waves in air. If the velocity of sound in air were 4,800 feet per second the interference would commence at a much higher frequency. (This is really the velocity in hydrogen atmospheric pressure.)

(4) The interference is greatest in the space at the sides of the disc, and the sound is projected in the form of a divergent beam. The angle of the beam decreases as the frequency increases.

(5) Owing to interference the total energy radiated decreases after the transition frequency is reached.

(6) The smaller the disc the higher the transition frequency (the frequency at which the beam or focussing effect begins to tell). Therefore, at any point at the side of the disc the pressure will be equal over a wider range than with a larger disc.

(7) The larger the disc the lower the frequency at which focussing commences.

(8) Owing to (*a*) the additional mass to be added due to air inertia, (*b*) the increased interference, *i.e.*, focussing, the radiation over the acoustic register from a large disc is less than that from a small one.

(9) The air pressure on the axis of a disc is zero at certain points near the disc. These "nodes" depend on the size of the disc, and only occur above a certain frequency. At a point several diameters from a small disc the air pressure is almost constant at all frequencies. But with a large disc the pressure falls off at low frequencies due to the extra mass of the disc in virtue of air inertia. At points on the sides of the disc there are zones where the pressure is a minimum.

The argument clearly points to a small disc as giving not only more uniform radiation in all directions at all frequencies, but an increase in radiation at high and at low frequencies. When we enter the realm of practical loud-speaker design we are confronted with new problems imposed by the driving mechanism which in general tend to curtail the output at both ends of the acoustic register. This, however, is outside our present purview, and must be left for consideration on some future occasion. The main object of the article was to explain the action of a vibrating flat disc, and if the reader assimilates this he will be in a much better position to appreciate the action of a diaphragm loud-speaker than he was previously.

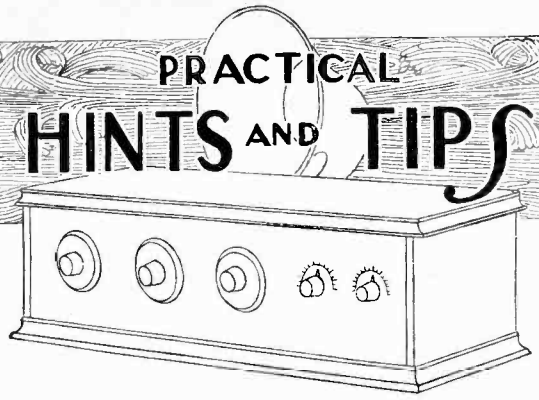
It is well to say that the preceding argument is based entirely upon a steady vibration at each frequency concerned. The problem of transients, *e.g.*, reproduction of drums, pianoforte, gun-firing, paper rustling, and the like where the diaphragm starts and stops suddenly has not been broached.

BALANCING A RECEIVER.

A Test for Neutralised H.F. Circuits.

A FAIRLY good test as to whether an H.F. amplifier stage which appears to be satisfactorily balanced is actually in this condition may be made by rotating the neutralising condenser slightly in both directions. If oscillation is produced on *either* side of the position apparently giving a balance, it may, as a rule, be assumed that everything is in order. In making this test it should be realised that the change in capacity necessary to permit of self-oscillation will depend on the damping present in both plate and grid circuits. With comparatively inefficient coils a large movement of the knob will be possible before this condition is reached, but with modern low-resistance couplings the variation in capacity should be extremely small. If it is not, one should suspect high-resistance joints, leakages, or partial short-circuits, assuming that the H.F. valve and batteries are known to be in order.

PRACTICAL HINTS AND TIPS



Aids to Better Reception.

Theoretical Diagrams Simplified.

BATTERY CONNECTORS.

Porcelain connectors, which are obtainable for a few pence each from many electrical dealers, have already been mentioned in these notes as useful for a number of purposes. It is not generally known that they can be used as a substitute for the terminal strip commonly fitted to the rear edge of the baseboard, thus reducing constructional work. A suitable method of attachment, by means of a narrow strip of metal, is shown

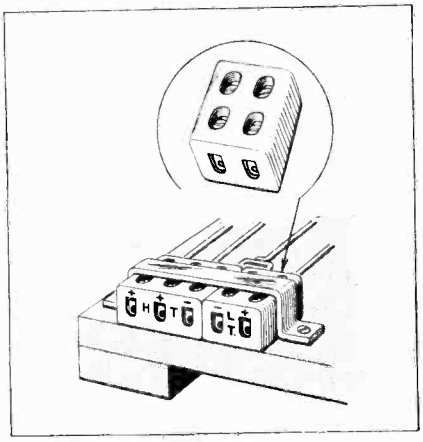


Fig. 1.—The use of porcelain connectors in place of the conventional terminal strip.

in Fig. 1. To prevent any possible movement of the porcelain blocks the surface of the wood may be recessed slightly.

This arrangement reduces to a minimum the risk of leakage which is always present when high H.T. voltages are applied. In the drawing, "two-way" and "three-way" connectors are used, but when a single H.T. voltage only is required one "three-way" block will be sufficient, the centre brass inset being connected to the common negative of both batteries. Another connector will serve for the leads to the grid battery.

For high-frequency work, in cases where incidental capacities must be reduced to a minimum, a "three-way" connector, with the centre inset removed, may be used.

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MEASURING SIGNAL STRENGTHS.

Although an accurate measurement of the strength of received signals is a matter of some difficulty, calling for the use of somewhat elaborate apparatus, the amateur should not imagine that the whole question of obtaining a visual indication of intensity is a subject quite beyond his scope. In point of fact, the contrary is the case, and no more extensive equipment is required than a suitable milliameter. If this is inserted in series with the detector valve anode, as shown in Fig. 2, a deflection of the meter will be obtained when the receiver is tuned to an incoming carrier wave. This deflection varies in accordance with the H.F. voltage applied to the grid, and thus indicates comparatively the strength of incoming signals.

In the circuit as shown, the detector valve is operating as an anode or "bottom-bend" rectifier, with a negative voltage applied to its grid. When no signals are being received, the needle will indicate a steady current flow depending on the characteristics of the valve and its operating conditions. When incoming oscillatory currents are impressed on the grid, however, its mean voltage becomes less negative, so a larger current is passed through the anode circuit from the H.T. battery, with the result that the meter reading is increased. The stronger the signals the greater is the increase in anode current.

The advantages of a visual indication of this sort will be evident, even to the least experienced wireless user. As an aid to quick tuning alone, the use of a meter in this manner may often be considered as worth while, because the eye is a more reliable organ than the ear, and, moreover, there is no need to wait for a sus-

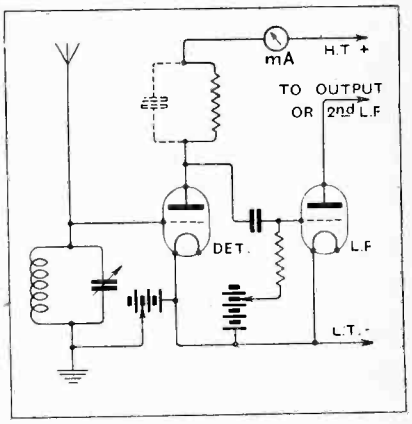

Fig. 2.—A milliammeter connected as an indicator of comparative signal strength.

tained musical passage or for speech to make the final adjustments. The facility for comparative measurement is most likely to appeal, however, to those who like to know the effect of experimental alterations to the aerial and earth systems, to tuning coils and circuits, and, most important of all, to intervalve high-frequency couplings. The circuit shown in the diagram is a simple one, but there is no reason why the measuring device should not be used with a detector preceded by an H.F. amplifier.

When leaky grid condenser detection is used, the milliameter needle will behave quite differently, as H.F. voltages due to an incoming signal will reduce anode current; this reduction will increase with the strength of signals.

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TESTING A CRYSTAL SET.

In the early days of wireless telegraphy, when transmissions were few and far between, there was often a feeling of uncertainty as to whether failure to hear signals was due to a fault in the receiver or merely to the fact that there was nothing to hear. The testing buzzer as commonly used was not infallible, and a better test was obtained by disconnecting the aerial for a few moments and then noticing the effect of re-connecting it to the terminal of the instrument: a click in the telephones, caused by the flow of current due to the accumulation of an atmospheric charge on the aerial indicated with some degree of certainty that everything was in order.

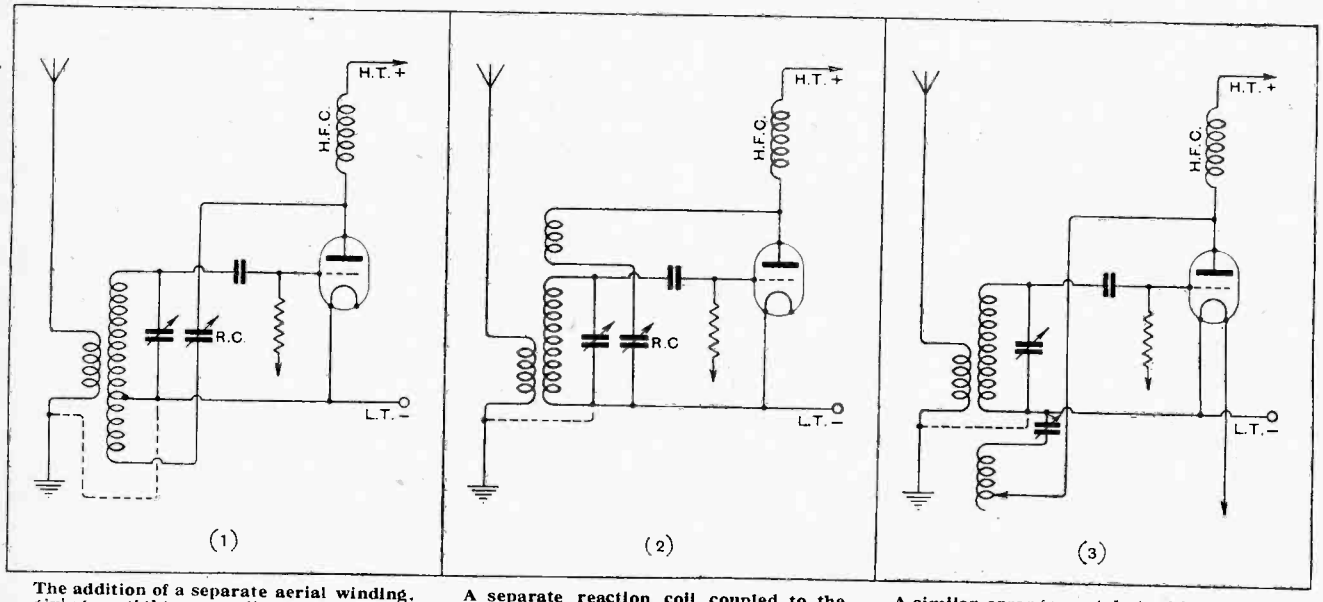
Such a test would be of little value nowadays to the users of valve sets, who can almost always receive signals from a number of stations, but it may be useful to owners of crystal receivers, who normally hear only one transmission.

DISSECTED DIAGRAMS.

Practical Points in Design and Construction.

No. 64.—Modified Reinartz Circuits.

The present series of diagrams is intended to show 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 reading circuit diagrams. Below are shown various modifications of the popular "Reinartz" circuit which was described in last week's issue.



The addition of a separate aerial winding, giving a tighter coupling between the circuits.

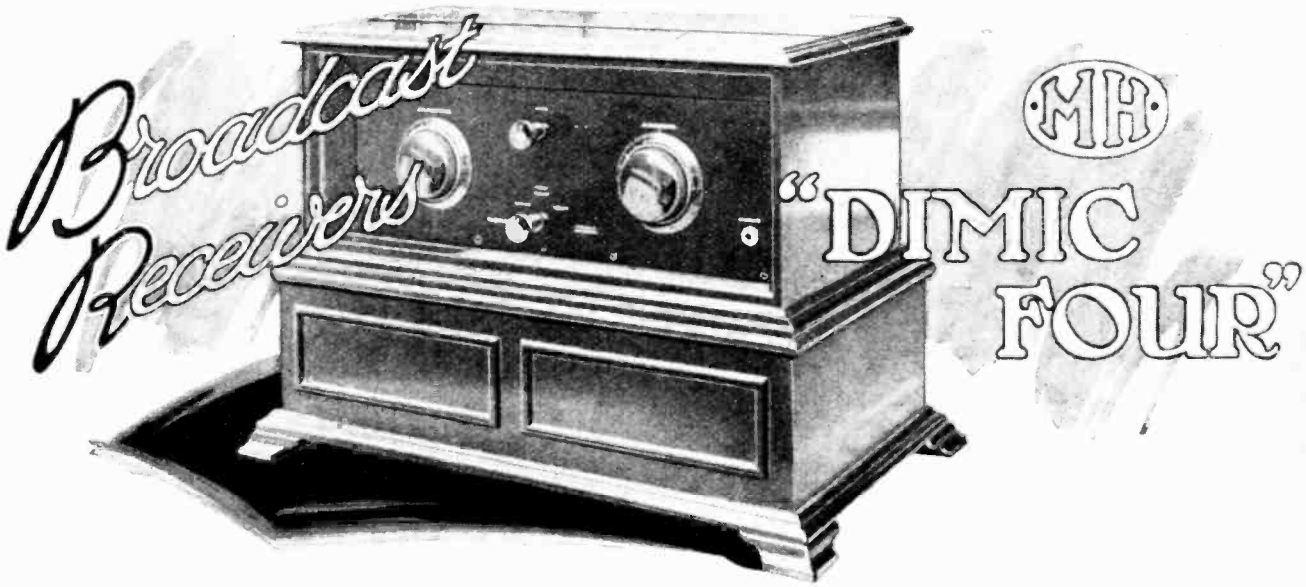
A separate reaction coil coupled to the high-potential end of the grid coil.

A similar arrangement, but with reaction coil coupled to the low-potential end of the grid coil.

THE grid section of the coil used in the first circuit may have 65 turns of No. 22 D.C.C. on a 3in. former as before. The reaction coil, wound as an extension and in the same direction, consists of about 35 turns of finer wire—say, No. 30 D.S.C. Over the low-potential end of the grid coil is wound the aerial winding, with about 12-15 turns of No. 30 D.S.C. carried on ebonite or wooden strips as in the case of the "Everyman Four" coils. The turns of this winding are spaced to occupy a total length of about $\frac{7}{8}$in. This suffers from the same disability as that previously discussed, both sides of the reaction condenser are at high oscillating potential, so an extension handle is desirable to prevent hand-capacity effects.

In the arrangement shown in (2) this trouble is overcome, as one set of vanes are earthed. This is a circuit which can be highly recommended. The aerial and secondary windings of the coils are as specified above, while the reaction winding has about 30 turns of No. 30 or 36 D.S.C. spaced $\frac{1}{4}$in. from the grid end of the secondary. The inductance of the reaction coil should always be a matter for experiment; the number of turns suggested above is about the maximum likely to be necessary.

In (3) the reaction coil, which may be tapped, is coupled to the low potential end of the secondary, but the coils are otherwise unchanged. It should be pointed out that in all these circuits values of components are as specified in last week's issue, while the connections of the anode circuit and grid leak have been omitted.



A General Purpose Broadcast Receiver of High-class Workmanship and Finish.

THE name of McMichael is well established in the minds of wireless amateurs who commenced their activities in pre-broadcasting days, and is now generally associated with broadcast sets and components of high-class workmanship and finish.

The "Dimic Four" receiver is a representative example of the work of this firm, and includes many of their well-known components, such as "Dimic" coils, clip-in mica condensers, and push-pull multiple switches.

The set is intended for general broadcast reception on both long and short waves, and is capable of receiving on the loud-speaker at least three or four stations other than the local station and Daventry. The necessary sensitivity and selectivity to bring in these additional stations is provided by a stage of high-frequency amplification preceding the detector valve. Balanced tuned anode coupling is employed, the balancing condenser being controlled by a knob on the front panel in order to give reaction effects.

High-frequency Circuits.

"Dimic" coils are used both in the aerial circuit and in the anode circuit of the H.F. valve. The aerial is connected through a fixed series condenser to the centre tap on the aerial coil. This method of connection not only gives increased selectivity and wavelength range, but tends to equalise the settings of the two tuning controls.

Separate pairs of coils are used for long and short waves. The coils are inclined to minimise magnetic coupling, and an engraved tablet screwed to the inside of the lid of the cabinet clearly indicates the method of inserting the coils in their holders. The change-over from short to long waves is effected by an ingenious switching arrangement, which is combined with the on-and-off switch. A backward and forward motion of the knob controlling the switching arrangement lights up or extinguishes the valves as required, while a rotary motion of the same knob to left or right changes the wavelength range of the receiver. The interior view of the receiver clearly shows the arrangement of these switches. The on-and-off switch is at right angles to the front panel, while the range switches are parallel to it and are actuated by flexible metal connected rods pivoted to a small crank on the end of the spindle of the on-and-off switch.

Low-frequency Amplification.

The detector valve is followed by two stages of low-frequency amplification, transformer coupling being employed for the first stage and choke capacity coupling for the second. If it is desired to receive on telephones the second L.F. or output valve is switched out of circuit by a telephone jack on the left-hand side of the front panel and the telephones connected in the anode circuit of the first L.F. valve in place of the coupling choke. The loud-speaker jack occupies a corresponding position on the right-hand side of the panel, and includes contacts which complete the filament circuit of the power valve. The valves used in this circuit have 2-volt filaments, and the types recommended by the makers for the various stages are as follow:—

H.F.	Detector.	1st L.F.	2nd L.F. (Power).
DE2 H.F.	DE2 L.F.	DE2 H.F.	DEP215.

High-tension and grid batteries are housed in the base of the cabinet, to which access is obtained by lifting the front edge of the instrument compartment. This is hinged to the lower portion of the cabinet at the back and virtually forms the "lid" of the battery compartment. The leads from the L.T. battery are connected externally to a small ebonite panel at the back of the receiver. The terminals for the aerial and earth leads are also included on this panel. All the wander plug connections to the H.T. and grid bias batteries are clearly engraved, and with the aid of the detailed instruction sheets and a special blue print supplied with the set the connecting up of the batteries should be an extremely simple matter. The makers

Broadcast Receivers. "Dimic Four."—

are to be congratulated on emphasising the necessity for thick leads to the L.T. battery. This is a point which is frequently overlooked, and which is of the greatest importance when 2-volt valves are used.

The set was tested with 120 volts H.T. on the amplifying valves and 60 volts on the H.F. and detector. The total anode current under these conditions with a negative grid bias of 3 volts on the first L.F. and 9 volts on the power valve was 8.5 milliamperes. For this rate of discharge the "large capacity" as distinct from the "Super Radio" type of dry battery will be suitable. The discharge of the "large capacity" cells is rated at 10 mA. and the "Super Radio" at 20 mA. The "Super Radio" has many times the capacity of the "large capacity" type, but it is doubtful if the former could be accommodated in the battery space provided. The filament consumption is 0.51 ampere at 2 volts, so that L.T. maintenance costs should not be very heavy.

The wavelength ranges on an average aerial were found to be as follow:

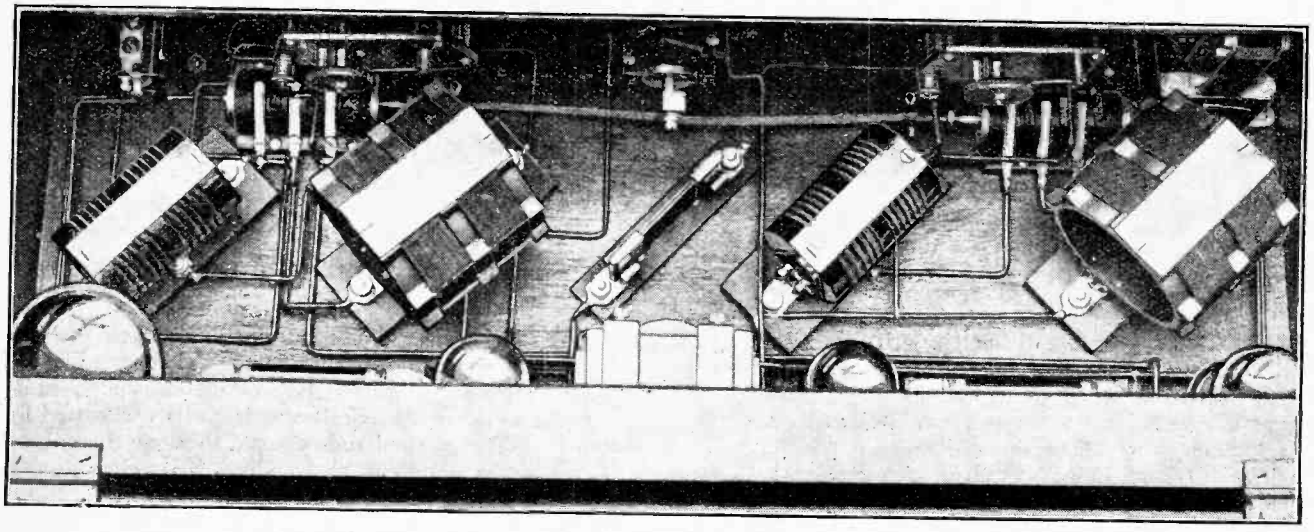
Short-wave Range	230 to 620 metres
Long-wave Range	1,000 to 2,750 metres

The quality of reproduction is very satisfactory and the output from the DEP215 power valve easily satisfies normal domestic purposes. The valves were inclined to be microphonic and there was a tendency to set up howling between the loud-speaker and valves. This trouble was overcome, however, by experimenting with alternative positions for the loud-speaker.

Tuning is made a pleasant operation by the excellent slow-motion dials fitted to the condensers and also by smooth action of the balancing condenser. This is fitted with an indicator similar in design to that employed on micrometer screw gauges. The adjusting knob is provided with a hollow thimble, which fits over a metal sleeve engraved on its upper surface with numbered graduations indicating the number of revolutions made by the knob.

The reader is recommended to set the "reaction" control in the balanced position, as indicated in the instructions, and to make use of reaction by unbalancing only in exceptional circumstances.

On the short-wave range six or eight stations, depending on conditions, could be received at loud-speaker strength, but at a distance of 3½ miles from 2LO interference from that station was experienced over practically the whole of the condenser scale. For instance, while receiving Langenberg (468.8 metres, 25 kW.) the "background" reception from London considerably detracted from the enjoyment of the German programme. On the long-wave range the selectivity appeared to be considerably better and there was not the least difficulty in receiving Radio Paris without a trace of interference from Daventry. Neither of these stations could be received free from interference, however, when 2LO commenced transmission.



Interior of receiver cabinet showing switching system and disposition of tuning coils.

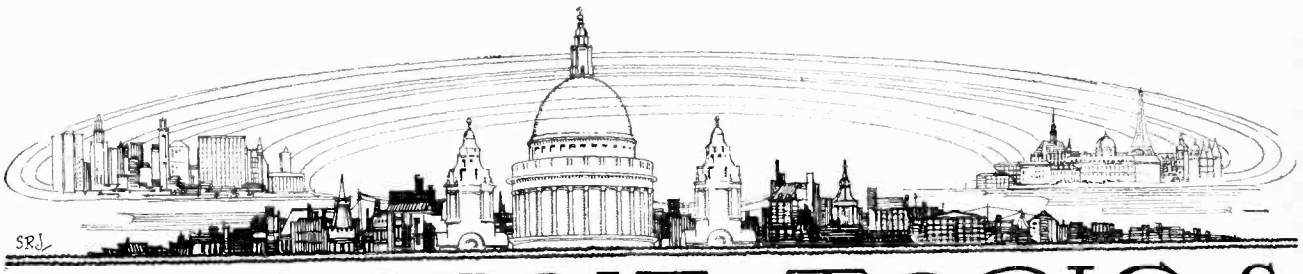
From these tests we are forced to the conclusion that the "Dimic Four" must be regarded as a two-station set within a range of five miles of 2LO. Outside this range it should be possible to enjoy the programme from the other "loud-speaker" stations without undue interference from the local transmitter.

The cost of the receiver, together with four "Dimic" coils and one grid bias battery, is £18 5s., inclusive of Marconi royalties. Necessary accessories would involve an extra expenditure of approximately £11 11s.

The address of the manufacturers is L. McMichael, Ltd., Wexham Road, Slough, Bucks, and their London showrooms are at Hastings House, Norfolk Street, Strand, W.C.2.

RECEIVERS REVIEWED IN PREVIOUS ISSUES.

Dec. 15th, 1926	**– Polar-Three**
Dec. 29th, 1926	**– Burndept Ethophone III.**
Jan. 12th, 1927	**– Gecophone "L. & D." Model**
Jan. 26th, 1927	**– Cosmos 3-valve Set**
Feb. 9th, 1927	**– Gambrell Cabinet Three**
Feb. 23rd, 1927	**– Ediswan R.C. Threesome**
Mar. 9th, 1927	**– General Radio Two-valve Set**



CURRENT TOPICS

Events of the Week in Brief Review.

RECEIVERS FOR THE BLIND.

A fund is being raised in Maidstone with the object of providing wireless receivers for all blind people in the town and district.

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A NEW EXCUSE.

The resourcefulness of wireless "pirates" when charged before a magistrate has more than once been the subject of comment in these columns.

The excuse put forward last week by a Wolverhampton listener charged with operating a set without a licence was that he had had influenza.

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DIPLOMACY BY WIRELESS.

The transatlantic telephony system was enrolled in the service of international diplomacy a few days ago, when Mr. Godfrey Locker-Lampson, the Under-Secretary for Foreign Affairs, spoke by wireless telephony to Mr. Hortis, the Cuban Foreign Minister.

Cuba is the first of the Latin-American countries to be connected with Europe by wireless telephony.

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RIVAL FOR EIFFEL TOWER?

The Eiffel Tower time signals, which have so long enjoyed the respect of mariners, may soon forfeit their supremacy at the hands of Rugby. Arrangements are being made by the Admiralty, in conjunction with the Post Office and the Board of Trade, to institute a British wireless time signal, using Rugby as the transmitter. The range of Rugby is, of course, much greater than that of Eiffel Tower.

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THE "EVERYMAN FOUR" ON VIEW.

As a keen desire has been expressed by very many of our readers to have the opportunity of seeing the "Everyman Four" set before commencing to construct, we have made arrangements to exhibit sets so that they can be inspected in detail.

In London a set is on view, between the hours of 10 a.m. and 5 p.m. (Saturdays between 10 a.m. and 12 noon), at No. 24, Tudor Street, E.C.4.

In Birmingham a set can be seen on application, at the same hours, at our Birmingham offices, Guildhall Buildings, Navigation Street; another instrument is on view at our Manchester offices, 199, Deansgate.

MANCHURIA KEEPS PACE.

Broadcasting has been officially recognised in Manchuria, and regulations for its control are being established. The service will be operated by the North-Eastern Wireless Long-Distance Telephone Service, with headquarters in Mukden.

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DISMANTLING A NEW STATION.

A new broadcasting station at Paraguay has been dismantled for an unusual reason. When the preliminary tests were carried out it was found that the station's range was inadequate, so the apparatus was taken to pieces. A transmitter of higher power has been ordered.

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A GENTLEMAN OF THE ETHER.

To combat the local oscillation nuisance, a Gordon Hill resident has offered, through the medium of his local newspaper, to give his services free in the interests of his long-suffering neighbourhood. He states that he is most willing to visit anyone within a reasonable distance and (1) tell them if their set is causing interference; (2) tell them how to prevent it and at the same time get better reception for themselves.

Let us hope that this labour of love will not go unrewarded.

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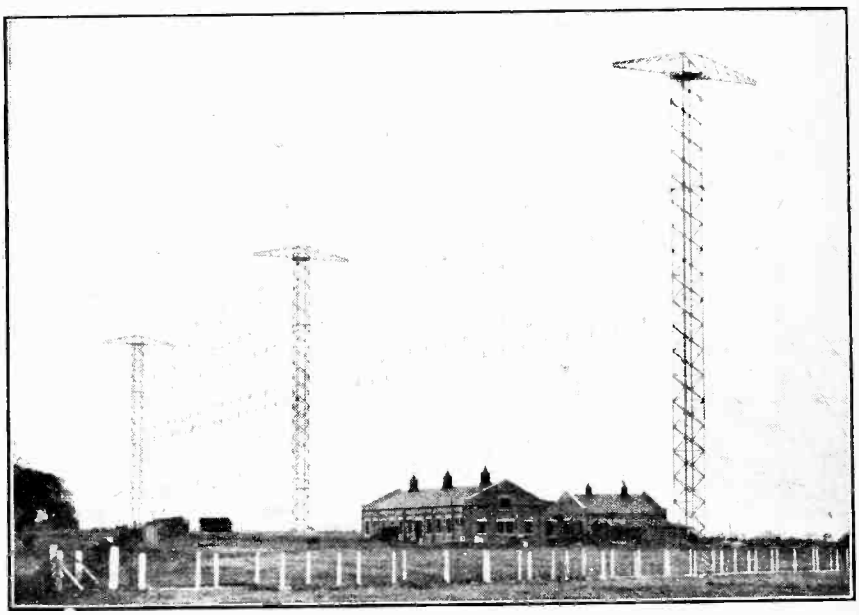
MARCONI CAPITAL SCHEME APPROVED.

After a lively meeting lasting nearly six hours, the shareholders of Marconi's Wireless Telegraph Co., Ltd., accepted, on March 15th, the whole of the directors' proposals, based on the recommendations of Sir Gilbert Garnsey, which include the reduction of the nominal amount of the ordinary shares from £1 to 10s. each.

Five of the directors are resigning, to be replaced by Lord Inverforth, Sir Frederick Sykes, Lord Wester Wemyss, Sir Charles Coupar Barrie, and Mr. F. R. S. Balfour.



AUSTRALIAN BEAM TESTS SUCCESSFUL. Last week the Post Office concluded the second official test of the new Marconi beam stations for communication with Australia, with results that more than fulfilled the conditions of the contract. The photograph gives a general view of the Grimsby transmitting station. The left-hand building is the machinery hall; a covered passage connects it with the transmitting room on the right

AUSTRALIAN BEAM TESTS.

The Marconi beam tests between London and Australia, resumed on March 7th, have more than fulfilled the conditions required by the Post Office contract.

The actual speed of working for the hours during which communication was effected is estimated to be 148 five-letter words per minute. Speeds have not been pressed up to the highest possible point during the tests, but on many occasions traffic was dealt with at speeds of 225 words per minute, while high-speed duplex communication was carried out during the stipulated seven days for an average period of over thirteen hours per day. The transmitting station is situated at Grimsby, the receiver being at Skegness. These work in association with stations near Melbourne.

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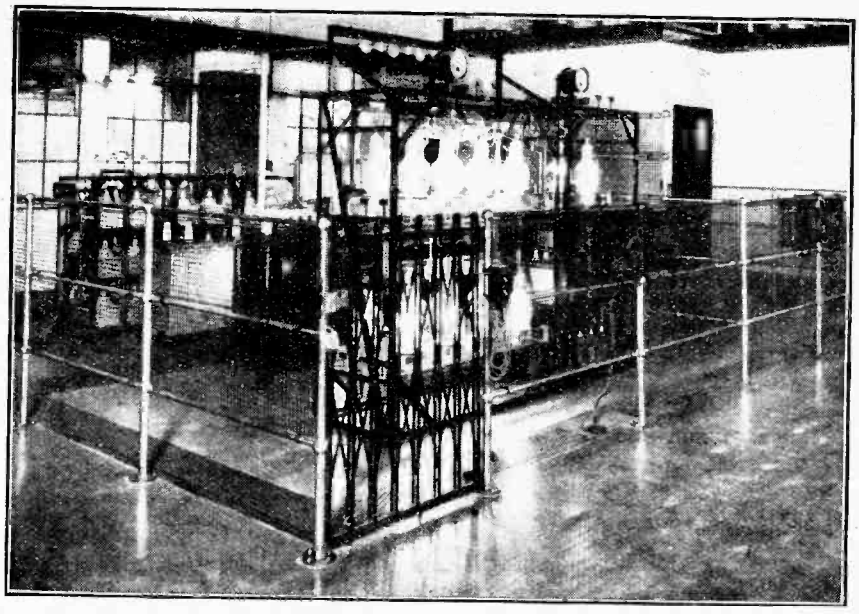
AMERICAN SHORT-WAVE RESEARCH.

Signals on 32.79 metres from 2XAF, Schenectady, inaudible 200 miles from the transmitter, have been heard and copied with perfect accuracy by a listener in Australia, 11,400 miles away.

This fact is alluded to in the report of the engineers of the General Electric Co. of America following a series of transmission tests on wavelengths of 32.79, 65.16, 109 and 140 metres. During the tests power outputs of 150, 500 and 2,000 watts were used successively to obtain a direct comparison between the readability of the received signal and the power of the transmitter.

The conclusions reached after careful experimentation were as follow :—

Wavelength bands shorter than the 66.3 to 75 metre waveband will not give economical service at points within 100 miles of the transmitter, whereas the 66.3 to 75 metre band, the 85.7 to 105 metre band, and the 133 to 150 metre band are capable of rendering economical service at points within that distance.



AT THE GRIMSBY BEAM STATION. This photograph shows the rectifier plant. The left-hand panel supports the main rectifier, while the drive rectifier panel is on the right. In the background are the smoothing condensers, smoothing chokes and the main step-up transformers.

For daylight communication at distances not greater than 90 miles from the transmitter, the 133 to 150 metre band will give better service than the 85.7 to 105 metre band. Similarly, the 85.7 metre band will give results superior to those which can be obtained under the same conditions using the 66.3 to 75 metre band.

The above conditions are reversed when distances between 90 and 200 miles are considered. In this case the 66.3 to 75 metre band will give better service during daylight than the 85.7 to 105 or 133 to 150 metre wavebands.

Further experiments are in progress.

WIRELESS AT WESTMINSTER.

BY OUR PARLIAMENTARY CORRESPONDENT.

Licence Prosecutions.

Sir W. Mitchell-Thomson stated in the House of Commons last week that the number of persons prosecuted for the use of unlicensed wireless apparatus during the twelve months ended on February 28th, 1927, was 600. In 597 cases convictions were obtained, and the remaining three cases were dismissed.

Cost of Rugby.

Viscount Wolmer informed Sir F. Wise that the cost of the Rugby wireless station, including the site, buildings, and plant, was about £480,000.

SHORT-WAVE TRANSMISSION ROUND THE EARTH.

THERE has been little difficulty in spanning half the earth's sphere since amateurs first succeeded in getting across this distance with relatively small powers. It would at first appear that this is the longest range the earth can offer. It is now evident, however, that short electric waves travel right round the whole sphere.

With the traffic between New York and Geltow, near Berlin, it is found at certain times that the characters sent out from the transmitter in New York on the wavelength of 16.2 metres, appear doubled in the recording receiver, and, moreover, that the second mark arrives about $\frac{1}{10}$th of a second after the first. From this displacement and the velocity with which the waves are propagated (300,000 km. per sec.), a difference of 28,700 km. is indicated between the two paths taken by the signals. Obviously, the first mark comes by the shorter path from New York to Geltow, and the second by the longer path, for the difference between these two paths is reasonably accurately equal to the distance mentioned.

Of greater interest, however, is the observation which was made at Geltow upon the 15-metre wave of the Nauen transmitter. The characters from this transmitter also appear doubled at certain times, with an accurately measured separation of 0.1406 second, giving a path-difference of 42,200 km. The distance between Geltow and Nauen is, however, only 40 km., and so does not enter into the question in comparison with terrestrial distances in general. The path of 42,200 km. must thus be traversed by the second wave received. Since, however, the distance round the earth is only 40,000 km., it is easily calculated that the second wave received must have travelled round at a height of about 350 km. Since extremely accurate time measurements can be carried out with the aid of recorder reception, this determination of height is correspondingly accurate, and we thus have for the first time a method free from practical drawbacks for ascertaining the effective height at which short wireless telegraphic waves travel.

H. K.

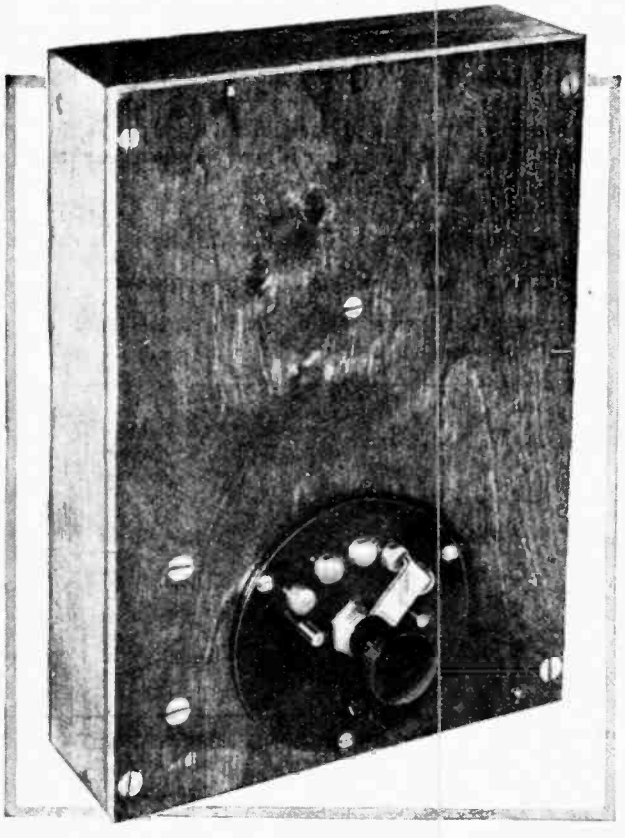
A MULTI-RANGE ABSORPTION CIRCUIT.

A Simple Method of Checking Wavemeter Calibration.

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

IT is often very desirable to have some simple means whereby the accuracy of the calibration of a wavemeter may be checked from time to time, without having to send the instrument back to the standardising laboratory where it was first calibrated. With heterodyne wavemeters especially, if the valve happens to go "dud" during a series of experiments and another of the same type is used in its place, it is very desirable to be able to know at once what percentage change in the calibration has been made.

In this article it is proposed to describe the construction and use of a simple little instrument which will enable the above-mentioned checking to be carried out at any time in the course of a few minutes. The essential parts of the instrument are a coil in parallel with a condenser, the whole being rigidly mounted so that the inductance and capacity of the circuit shall keep constant. Such an arrangement is shown diagrammatically in Fig. 1, and is termed an "absorption circuit" for reasons which will become apparent later.



The multi-range absorption unit.

Let us now consider the principle underlying the absorption wavemeter.

Operation of the Circuit.

When an electromotive force (e.m.f.) is induced in the coil part of the circuit from some outside source, there will be a current flowing in the circuit, and the value of this current, for a given induced e.m.f. in the

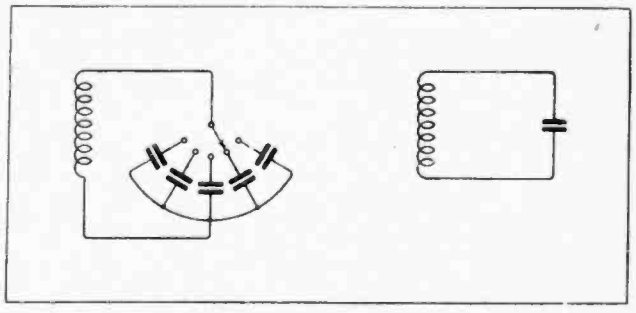


Fig. 1.—Connections for a simple absorption circuit and for a multi-range absorption circuit.

circuit, depends essentially on two things. These two things are the *frequency* of the induced e.m.f. and the *resistance* of the circuit at this frequency. For a given circuit, therefore, the current varies with the inducing (or induced, as this is the same) frequency, also for almost all frequencies this current will be extremely small, and will only become appreciable at all for a very small range of frequencies.

The way in which the circuit current varies with frequency over this range is sketched in Fig. 2, which shows that the current has a maximum value PQ at a definite frequency, which is denoted by f_o in the diagram. The curve shown in Fig. 2 is usually called a resonance curve —a current resonance curve in this particular case—for the circuit, and both the actual maximum height PQ and the width *ab* at, say, half the maximum height depend on the resistance of the circuit; the lower the resistance, the greater is PQ and the less, proportionally, is *ab* for a given induced e.m.f.

The *power* absorbed by the circuit, therefore, being proportional to the square of the current, also varies with the frequency, and is a maximum for the frequency f_o corresponding to the maximum current in the circuit. In short, the absorption circuit may be regarded as a piece of apparatus which has the property of absorbing appreciable power only over a very small band of frequencies —or, what really comes to the same thing, as a piece of apparatus which has the property of setting up appreciable opposing electromagnetic fields only over a very small frequency range. Also by reducing the resistance of the circuit this frequency range is reduced, so that for

A Multi-range Absorption Circuit.—
a very low resistance circuit to all intents and purposes power is only absorbed at the one frequency, f_o.

For practical use of an absorption circuit with a heterodyne wavemeter the method adopted is as follows :—The coil of the circuit is coupled to the oscillatory circuit of the wavemeter at a distance we will call d. In the plate circuit of the wavemeter valve is included a milliammeter, which, if not already incorporated in the wavemeter itself, may be connected in one of the H.T. leads as shown in Fig. 3.

As the frequency at which the wavemeter valve is oscillating is varied so as to pass through the natural frequency f_o of the absorption circuit, the milliammeter pointer will be found to give a curious but quite decided "kick," and if the wavemeter frequency is varied very slowly in the neighbourhood of the "kick," and the milliammeter reading plotted against wavemeter condenser reading a curve similar to the thick-line curve a in Fig. 4 will result. If now the absorption circuit is removed the milliammeter reading over this range should be found to give a smooth curve as shown by the thin

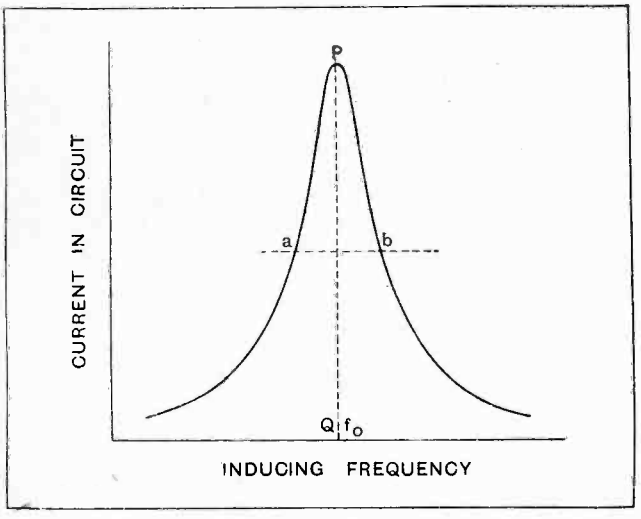


Fig. 2.—Showing how the current flowing in a simple circuit (as shown in Fig. 1) varies with the *frequency* of the inducing voltage, although the *amplitude* of the latter remains constant.

line curve b in Fig. 4. It is obvious, therefore, that this change in the milliammeter readings, as indicated by the difference between the two curves a and b, is due to the presence of the absorption circuit.

If the distance d between the wavemeter and the absorption circuit is decreased sufficiently, the deviation of curve a from the normal curve b will stretch over a larger frequency range (*i.e.*, over more degrees on the condenser scale), while if the distance d is increased the deviation will occur over a smaller frequency range. Another effect that will be noticed with alteration of the distance d is that the amplitude of the two peaks on curve a will increase rapidly with decrease of d, until one, or both, peaks become flat, showing that cessation of oscillation may take place over a short frequency range.

If we wish to disturb the constants of *both* wavemeter and absorption circuit as little as possible, they should be coupled as loosely as is consistent with a readable "kick" on the milliammeter, *i.e.*, the distance d (see Fig. 3) should be as large as possible. For this reason it is distinctly advisable to make the absorption circuit of as low resistance as is possible, consistent with compactness and reasonable cost.

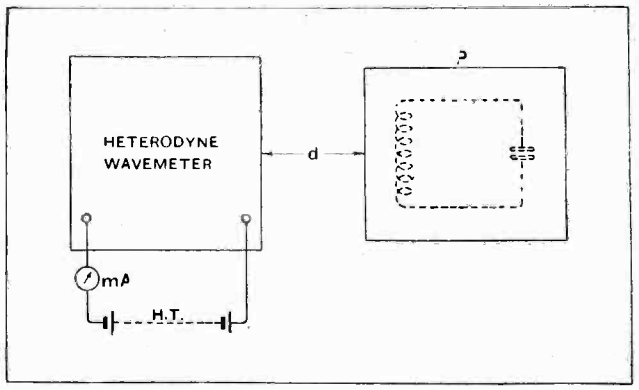


Fig. 3.—Arrangement of apparatus for checking the calibration of a heterodyne wavemeter.

So far, it has only been shown that the absorption circuit—*even of low resistance*—affects the plate current of the valve in a heterodyne wavemeter over a certain frequency range, so that the question now arises as to what point on the double-peaked curve a (Fig. 4) corresponds to the natural frequency f_o of the absorption circuit. It can be shown mathematically—and has been shown notably by Dr. E. Mallett in *Experimental Wireless* and in the *Journal of the Institute of Electrical Engineers*—that this point is that where curves a and b intersect, as shown by the dotted vertical line, and, therefore, that the wavemeter condenser reading corresponding to the frequency f_o is given by C_o in Fig. 4.

If the natural frequency f_o of the absorption circuit is known, the wavelength λ_o corresponding to this may readily be calculated from the expression $\lambda_o = \frac{v}{f_o}$, where v is the characteristic velocity of the ether (or speed of light), which is usually taken as 3×10^8 metres per

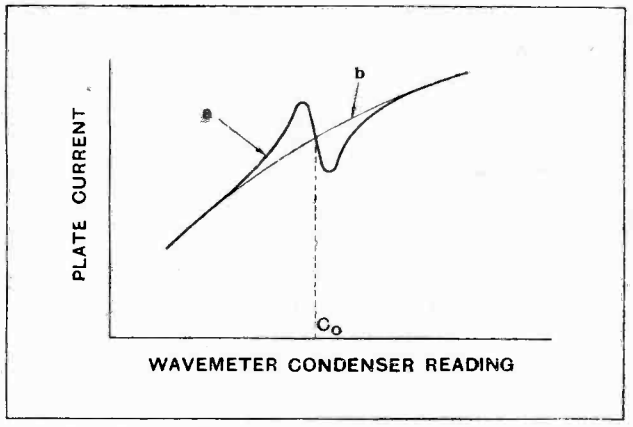


Fig. 4.—Effect on the milliammeter in the plate circuit of the heterodyne wavemeter as the tuning of the latter is altered—curve (a) with the absorption circuit coupled and curve (b) without the absorption circuit.

A Multi-range Absorption Circuit.—

second, and thus the condenser setting C_o on the wavemeter corresponding to the known wavelength λ_o may be found as described above. Various points on the condenser scale can obviously be checked by the use of several absorption circuits, but it would be very convenient to have sufficient circuits in one instrument to be able to check at least one wavemeter range, and it is just such an instrument that is described in this article.

Practical Construction.

One way in which several circuits can be combined into one piece of apparatus is shown diagrammatically in Fig. 1, where any one of several fixed condensers may be put in parallel with a coil by means of a selector switch. Quite a useful condenser for this purpose is the C.A.V. multicondenser, which gives five different capacity values according to which of the connections are utilised, and the size of the multicondenser is not very much more than the size of one of the usual type of fixed condensers, so that it is quite a compact little article.

The coil used may be home-made, or it may be one of the commercial plug-in type, with the actual coil plug removed, but it cannot be too strongly emphasised that

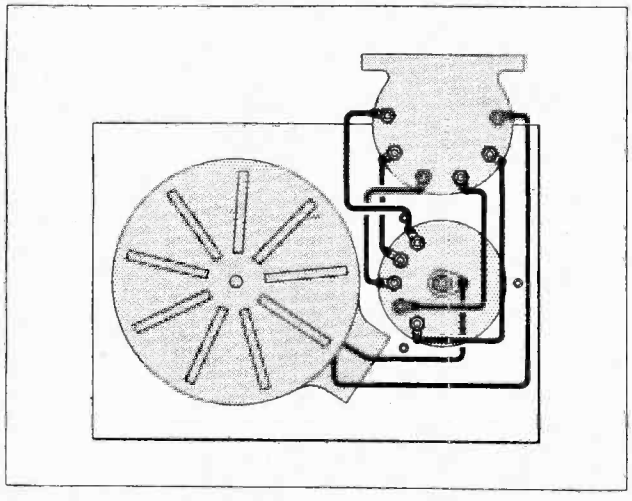


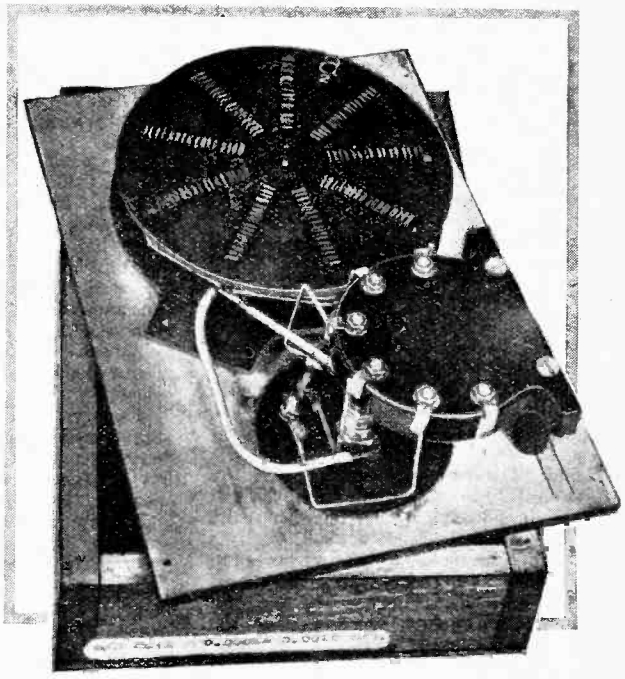
Fig. 5.—Wiring diagram of the multi-range absorption circuit.

the windings *must* be rigid so that the inductance will not change with handling the circuit. For this reason, if a multilayer coil is used, it is advisable to fix the last few turns at each end in position with paraffin wax, but to use such a construction of coil that it is not necessary to set the whole solid in wax, owing partly to the circuit resistance probably being increased by this process and partly to the difficulty of making sure there are no air bubbles left to break down if large inducing voltages happened to be used. This latter point is important if the absorption circuits are used at any time for direct calibration of even a low-power transmitter.

The practical wiring diagram of the multi-range absorption circuit is given in Fig. 5, and all necessary constructional details may be obtained from this drawing, while the general view of the instrument is given in the photographs. One practical point about the switch is that it shall make very definite and good contact with the studs.

Practical Use of the Instrument.

From what has previously been said, if the natural frequency or the natural wavelength corresponding to each



Method of mounting the various parts inside the box.

stud on the multi-range circuit is known, it is possible to check the calibration of a heterodyne wavemeter over this range of wavelengths, so that it would seem to be necessary to have an independent calibration of the absorption circuits. If the reader's wavemeter has not had its calibration checked for some time, it is strongly advised that at least the absorption circuits be sent for calibration; but if the wavemeter can be relied on, then it may be used, as previously described, to *calibrate the absorption circuits*, which latter will then form an extremely useful check on the constancy of calibration of the wavemeter as time goes on. This latter function is one which in itself makes the construction and use of absorption circuits a thing well worth while.

Checking a Buzzer Wavemeter.

A buzzer wavemeter may have its calibration checked by means of the absorption circuits with the aid of what is virtually an uncalibrated heterodyne wavemeter in the shape of a valve receiver which is made to oscillate. The valve receiver should, of course, be used without aerial or earth so as not to cause interference, and should have a milliammeter connected in its plate circuit exactly as described for the heterodyne wavemeter, and its tuning condenser adjusted so that its wavelength corresponds to the natural wavelength of the appropriate absorption cir-

A Multi-range Absorption Circuit.—

cuit. During this latter operation the buzzer wavemeter should be switched off and removed right away from the receiver and the absorption circuit.

When the receiver has been satisfactorily adjusted, the absorption circuit should be removed and the buzzer wavemeter put quite near the receiver and the buzzer started. On rotating the dial of the buzzer wavemeter the milliammeter pointer should be observed to give the familiar kick round about one position of the dial. The buzzer wavemeter should now be moved away from the receiver until only a small kick of the milliammeter pointer is produced on rotating the dial, and the position of the latter corresponding to the "centre" of the double kick (see Fig. 4) found in the usual way. This position of the dial, therefore, corresponds to the natural wavelength of the absorption circuit, since the receiver was adjusted to oscillate at this wavelength. It is important to remember that during this second operation *the receiver must not be touched at all.*

As a matter of practical interest in carrying out this experiment, it is extremely probable that the buzzer wavemeter will have to be put nearer to the receiver in carrying out the final adjustment than the absorption circuit was in the first case, owing to its higher circuit resistance, due mostly to the buzzer; and, of course, it is necessary to have the latter in operation, as its use certainly affects the calibration of the wavemeter.

Book Review.

"The Elements of Radio Communication," by O. F. Brown, with a Foreword by Admiral of the Fleet Sir Henry Jackson. Pp. viii+216, with Frontispiece and 146 Diagrams. Oxford University Press. 10s. 6d. net.

Amidst the vast quantity of literature which has been published since the advent of broadcasting on a popular scale, it is refreshing to meet a book, such as that under review, which purports to give a clear and concise description of the fundamental principles of wireless communication without entering into the constructional details of the apparatus.

The historical side of the subject is described with suitable brevity in the first and introductory chapter. This is followed by a treatment of the mode of production of high-frequency electrical oscillations and of the manner in which these are applied to the production of electromagnetic waves for the purposes of carrying out wireless communication. These are probably the most difficult portions of the book to present with an almost complete absence of mathematics; but the author has succeeded in doing this in an admirable manner. Later chapters of the book deal with the reception of wireless waves, and with the means now commonly employed for the detection of the signals due to these waves and for the amplification of these signals in the receiving apparatus itself. The application of receivers for both telegraphic and telephonic purposes is described, and a chapter is devoted to the subject of "Faithful Reproduction in Radio Telephony." The book is rendered unusually complete by chapters on directional reception, short-wave transmission and reception, the propagation of waves and atmospherics. In these the results of modern research are described in a manner suitable for presentation to the reader who is not a scientific expert on these matters.

Altogether the author has produced a very readable book, which is suitable for the elementary student and also for the general reader who desires to obtain an accurate knowledge of the principles underlying modern wireless communication, both telegraphic and telephonic, and of the various phenomena associated therewith. The book is remarkably free from mistakes of any description, although in one or two cases the statements require some slight revision in the light of knowledge obtained from more recent research. The production of the book is above criticism in all save one detail, viz., the diagrams. These are quite adequate in number and are well distributed, but a little more care might have been spent on their preparation with advantage. On the whole the line drawings are too thin and the accompanying lettering is too small, while some of the "sine" curves are of a rather curious shape. The price of publication is not too high for a volume of such scope and the book deserves a widespread popularity.

R. L. Smith-Rose.

TRADE NOTES.

G.E.C. Pocket Catalogue.

A handy 32-page booklet has just been received from the General Electric Co., Ltd., of Magnet House, Kingsway, W.C.2, giving very complete details of the "Gecophone" range of wireless components and accessories. Constructors and others who seek to keep abreast of progress in wireless production should secure this booklet from their local dealer.

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"Radio for the Million."

The Mullard Wireless Service Co., Ltd., of Mullard House, Denmark St., London, W.C.2, announce that limited supplies of the booklet "Radio for the Million," complete with four blue prints, are now available for free distribution. As the demand is rather heavy immediate application is advised.

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New Address.

Messrs. AFA Accumulators, Ltd., have taken new offices at 120, Tottenham Court Road, London, W.1. The company's works and trade department remain at the old address, 9a, Diana Place, Euston Road, London, N.W.1.

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Loud-speakers at Olympia.

Visitors to the Ideal Home Exhibition at Olympia who have been impressed by the quality of reproduction by the gigantic loud-speakers distributed throughout the building will be interested to know that these are of the standard A3 Celestion type, manufactured by The Celestion Radio Co., 29, High Street, Hampton Wick, Kingston-on-Thames.

During the preliminary tests to decide upon the make of loud-speaker qualified to fill Olympia with music, it was found that two ordinary A3 Celestions connected in parallel gave sufficient volume to fill the Large Hall.

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International Prefix Card.

The stir created in the amateur transmitting world by the excessive zeal of the American IARU in allotting amateur call sign intermediates to countries which had not asked for them lends special interest to a little card issued by Mr. A. Hinderlich, of 1, Lechmere Road, London, N.W.2. The card bears the intermediate call letters for all countries, and includes the original intermediates together with those allotted by the American IARU. It is eminently suitable for adorning the walls of a transmitter's "den."

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Another Amplion Company.

The growth in the business of the House of Graham is shown by the news that yet another company has been added to the chain of Amplion Associated Companies. The newcomer is the "Deutsche Amplion Gesellschaft," m.b.h. Friedrichstrasse 218, Berlin. The company has been formed to handle the increasing demands for Amplion products in Germany.

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A Correction.

On page 270 of our issue of March 2nd reference was made, erroneously, to the "Radiovox" Amplion loud-speakers. This was, of course, a misnomer, the term intended being "Radiolux."

VALVES WE HAVE TESTED

The Cossor Two=volt Series.

THOSE of our readers who normally use valves of the 2-volt class will find the new Cossor series of the greatest interest. Four types are provided; one of these, the 210R.C., a valve with an amplification factor of 35-40 and an anode A.C. resistance of 70,000 ohms, has already been described. Static characteristic curves of the other three valves are given here.

A Good H.F. Valve.

First is the Cossor 210H (Red Band). This valve has a filament rated at 1.8 volts, 0.1 ampere, with a maximum anode voltage of 120. The curves are taken at 60, 80, 100, and 120 anode volts, and the amplification factor was measured with an anode voltage of 120 and a grid bias of negative 1.5. It was found to be 25 with an A.C. resistance of 37,000 ohms. At 120 and negative 3 volts respectively the amplification factor was 25 for an A.C. resistance of 41,000 ohms. A grid bias of negative 3 is too large for normal work, however; negative 1.5 is ample for a valve of this type.

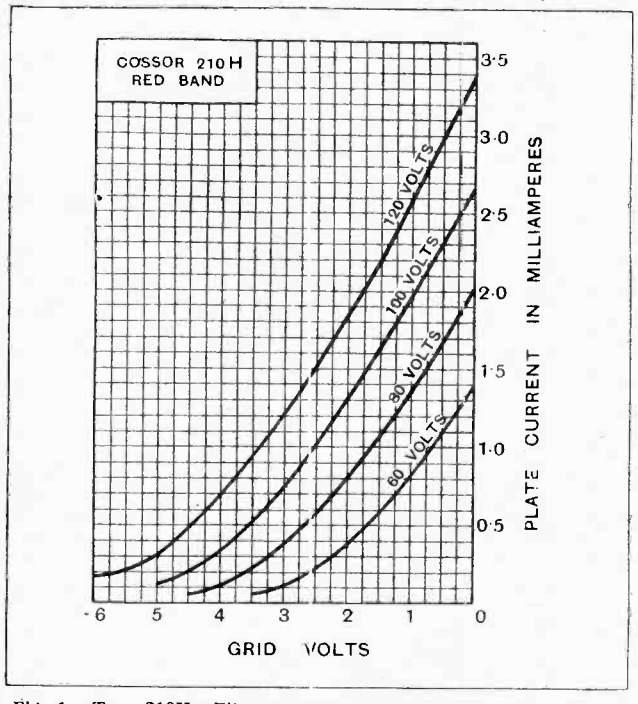

Fig. 1.—Type 210H. Filament voltage, 1·8; filament current, 0·1 ampere; maximum anode voltage, 120. The amplification factor and anode A.C. resistance were found to be 25 and 37,000 ohms respectively for an anode voltage of 120 and a grid bias of −1·5.

Such characteristics as these are remarkable for a valve with a filament taking so little power, and it is strongly recommended for high-frequency amplifiers using tuned transformers or anode couplings.

It is equally suitable for a resistance- or choke-coupled low-frequency amplifier when strong signals are being dealt with. The valve's A.C. resistance is rather too high for it to be employed with L.F. transformers, and it is not intended for this work. Incidentally, this valve

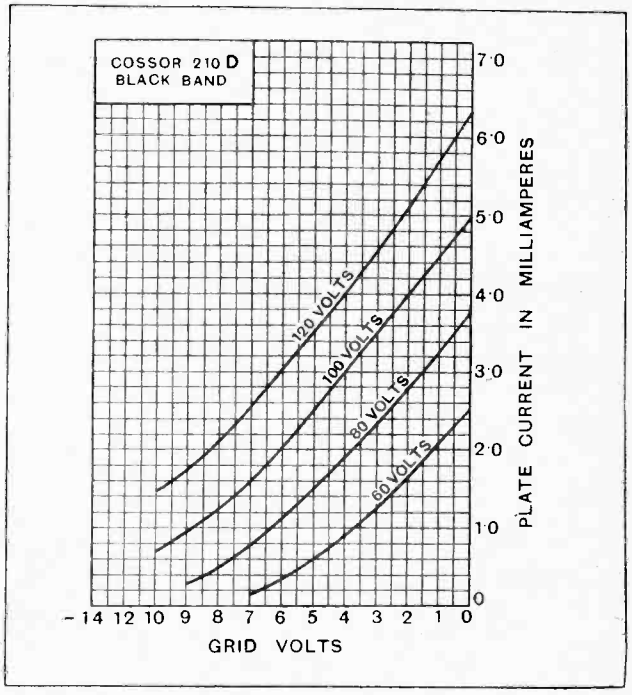

Fig. 2.—Type 210D. Filament voltage, 1·8; filament current, 0.1 ampere; maximum anode voltage, 120. The amplification factor and anode A.C. resistance were found to be 9·1 and 17,000 ohms respectively for an anode voltage of 120 and a grid bias of −4·5.

is very suitable for the H.F. stage in the "Everyman Four" receiver and for the H.F. and detector positions in the "Everyman Three" receiver.

The second valve tested was a 210D (Black Band), curves for which are given for 60, 80, 100, and 120 volts. This has an amplification factor of 9.1 for an A.C. resistance of 17,000 ohms at 120 anode volts and negative 4.5 grid volts. Cossor 210D is therefore a good detector when transformer coupling is used. It may also be used in the first L.F. stage of a receiver with a trans-

Valves We have Tested.—

former having a primary inductance of about 40 henries or more; such a transformer will usually have a ratio of 3 or 4 : 1. This valve will also be satisfactory in the output stage for operating a small loud-speaker, provided a grid bias of − 4.5 or 6 is used with an anode voltage of at least 120. Of course, there is no reason why a valve of this type should not be used for choke-coupled circuits when exceptionally strong signals are being dealt with, but normally a valve in this series with a high amplification factor should be chosen for the work. This valve could be used in the H.F. position in the "Everyman Four" receiver, but the receiver would not give as great selectivity as when type 210H is used, while the amplification would be about equal in the two cases.

A Power Valve.

The third valve to be tested was the Stentor Two (215P, Green Band). Taking 1.8 volts at 0.15 ampere, the valve can be used with an anode voltage as high as 160, and the curves are for voltages of 100, 120, 140, and 160. Tested with an anode voltage of 140 and a grid bias of − 12 volts, the amplification factor was found to be 4.4 for an A.C. resistance of 4,400 ohms. At 100 and − 7.5 volts respectively the amplification factor was 4 for an A.C. resistance of 4,900 ohms. This valve should really be in the "Super Power" class, for, considering the small power taken in heating the filament, it has a very low A.C. resistance, and will therefore supply without distortion sufficient power to operate a large loud-speaker. This valve is comparable with many in the 6-volt class.

The external appearance of Cossor valves is well known, the bulb being of the pipless type and having the silvery appearance usual in modern valves. The base of the valve is of interest, a large air space being left between the valve pins, which results in a low dielectric loss. These are of the latest spring type, making a good fit in ordinary valve holders. The peculiar shape of the electrodes and the method of supporting them account for the fact that valves of a type are remarkably uniform, while they are entirely non-microphonic.

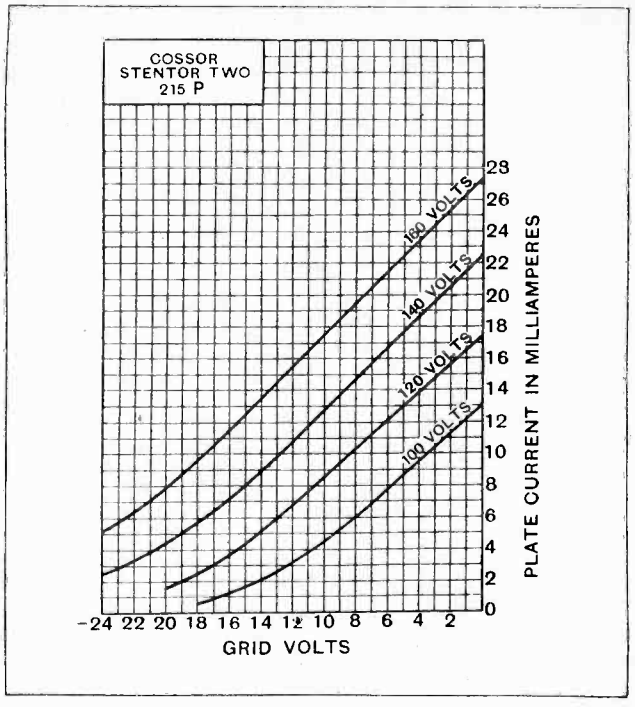

Fig. 3.—Type Stentor Two. Filament voltage, 1·8; filament current, 0·15 ampere; maximum anode voltage, 160. The amplification factor and anode A.C. resistance were found to be 4·4 and 4,400 ohms respectively for an anode voltage of 140 and a grid bias of −12.

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.

Valves of Yesterday and To-day.

Modern methods of valve manufacture formed the interesting topic of a lantern lecture given by Mr. Pratt, of the Mullard Wireless Service Co., Ltd., before the Southport and District Radio Society on March 7th. With the aid of slides the members were able to see the various machines now employed, and to compare them with the weird apparatus used in the early days. All classes of valve were studied, from the earlier types to the modern high-power transmitting valves with water-cooled anodes.

The hon. secretary, Mr. E. C. Wilson, "Lingmell," Kirklees Road, Birkdale, Lancs., will be pleased to forward particulars of membership to enthusiastic amateurs.

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Television Experiments at Hounslow.

The proposed experiments in television to be conducted by the Hounslow Wireless Society were discussed at an informal meeting on March 8th. Great enthusiasm is being shown in the venture, and it is hoped to begin the experiments shortly.

Hon. secretary: Mr. W. R. Collis, 7, Algar Road, Isleworth.

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Mechanical Analogies.

Mechanical analogies illustrating the properties of resistance, inductance and capacity were dealt with in an interesting lecture given by Mr. A. F. Carter, A.M.I.E.E., at the last meeting of the Sheffield and District Wireless Society. After explaining the use of these essential properties in any electrical circuit, the effect of series and parallel resonance was demonstrated by means of very simple apparatus designed by the lecturer. The corresponding mechanical analogies of friction, inertia and elasticity were then dealt with, and by use of an ingenious model consisting of a vibrating system whose frequency, inertia, elasticity and friction could be separately varied, the phenomena of resonance and damping in electrical circuits were clearly demonstrated.

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

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A Dulwich Society.

The Oglander Radio Fellowship has vacancies for new members, and application forms are obtainable from the hon. secretary, Mr. James Sewell, 25, Wingfield Street, Peckham, S.E.

Several profitable evenings were spent during February, a notable occasion being the debate on the respective merits of H.F. and L.F. valves, the protagonists being Mr. Hally and Mr. J. Sewell, Jnr. The debate was described as "instructive and amusing."

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Behind the Microphone.

Mr. J. H. A. Whitehouse, of the B.B.C., was in irrepressible mood on

Friday, March 11th, when he gave an entertaining discourse before the Southend and District Radio Society entitled "Behind the Microphone." The many abstruse problems, scientific and psychological, with which the B.B.C. daily have to grapple were reviewed in quick succession in such a manner that even the beginner was able to follow every explanation. Not the least instructive was the lecturer's discussion of the newest ideas in studio construction and programme organisation, and this section of the talk alone must have enhanced the subsequent pleasure of listening-in for everyone who heard it.

The hon. secretary is: Mr. F. J. Waller, Eastwood House, Rochford, Essex.

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When Appearance Counts.

That the appearance of a wireless receiver was a far more important point than was generally realised was the opinion expressed by Mr. J. E. Houghton, lecturing before the Bristol and District Radio Society on March 11th. Dealing with commercial sets, he explained the requirements of the manufacturer and the buying public and described the efforts made by the engineer to reconcile these two widely differing points of view.

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

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Transmitters in Conference.

An earnest discussion on the new amateur international prefixes took place at the last meeting of the QRP Transmitters Society. The members were of the opinion that revision is necessary, but they deplored the action of the American section of the I.A.R.U. in attempting to impose drastic, and in some cases, unwarranted revision of the amateur prefixes throughout the world, without affording each country the opportunity of considering and voting for or against the proposals.

The Society showed confidence in the suggestion that, were the matter conducted in a proper manner, the British P.M.G. would give full attention to the matter with the idea of giving satisfaction to all concerned. The members expressed their whole-hearted appreciation of the present action of the P.M.G. in asserting his authority in the face of an attempt to usurp it.

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When the "R." Code Fails.

A curious test was carried out at the last meeting of the QRP Transmitters Society when a number of American short-wave transmissions were tuned in on a 2-valve set. The members donned the 'phones in turn and each registered a vote as to the "R" strength of the signals received. It was noteworthy that a signal voted R3 by some members was considered to be R4 and even R5 by others. The test goes to show the fallibility of the "R" designation of signal strength.

The hon. secretary of the QRP Transmitters Society is Mr. L. F. Fuller, 13, Seagry Road, Wanstead, Essex.

Wireless for the Blind.

The Preston Radio Society has organised a "Wireless for the Blind" fund for the purpose of supplying suitable wireless receivers to the deserving blind in the Preston district. Appeals for help are being distributed throughout the Preston area, and the Committee of the Society feel confident that such a worthy cause will receive whole-hearted support. The treasurer of the scheme is Dr. T. H. C. Derham, Albert Terrace, Garstang Road, Preston, and donations are acknowledged through the "Lancashire Daily Post" and "The Preston Herald."

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 23rd.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown. Wireless demonstration by Mr. W. T. Norton.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. Lecture: "High Frequency Voltages, Part II.," by Mr. W. Anderson.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. Lecture: "Sound," by Mr. G. W. Milner, B.Sc.

Institute of Wireless Technology.—At 7 p.m. At the Engineers' Club, Coventry Street, W. Lecture: "Methods of Approximating the Reception Factor," by Mr. S. H. Turle, M.I.R.E., A.M.I.E.E.

THURSDAY, MARCH 24th.

Stretford and District Radio Society.—At "The Cottage," Derbyshire Lane. Lecture by Mr. H. Saville (6HS).

FRIDAY, MARCH 25th.

Leeds Radio Society.—At 8 p.m. At Collinson's Café, Wellington Street. Lecture by Mr. D. E. Pettigrew.

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

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

MONDAY, MARCH 28th.

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

Southport and District Radio Society.—At 8 p.m. At St. John's Hall, Scarisbrick Street. Lecture: "Electro Magnetic Waves," by Mr. W. H. L. Jarvis.

Northampton and District Amateur Radio Society.—At 8 p.m. At Cosmo Café, The Drapery. Lecture: "Ancient and Modern Ideas of the Constitution of Matter," by Prof. Beeby Thompson, F.G.S.

R.C. Coupling—Old and New.

The difficulties confronting the amateur in designing a resistance-coupled amplifier were explained in lucid style by Mr. J. H. Jeffery, of Metro-Vick Supplies, Ltd., at the Southport and District Radio Society's meeting on February 28th. In an unusually interesting demonstration, the lecturer operated a resistance capacity coupled amplifier which was fitted with a switch so that the amplification given by modern units could be compared with that delivered by the old-fashioned type employing low value anode resistances and general purpose bright emitter valves. The amplification obtained on the modern amplifier using S.P.55B valves, with a power valve in the output stage, was several times as great as that given by amplifiers designed on the old principles.

Hon. Secretary: Mr. E. C. Wilson, "Lingmell," Kirklees Road, Birkdale, Lancs.

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Lectures for Beginners.

The Swansea Radio Society has arranged a course of five lectures on "How a Wireless Receiver Functions." Intended for beginners, the lectures are arranged in as simple a form as possible and cover such branches of the subject as aerial tuning, crystal rectification, and the various functions of the thermionic.

Mr. J. C. Kirkman, B.Sc., recently gave an interesting lecture at the Swansea Technical College on "Neutrodyne Circuits," demonstrating the principles involved by means of apparatus and diagrams.

Hon. Secretary: Mr. E. H. White, 100, Bryn Road, Swansea.

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Looking Backwards.

Interesting alike to the oldest and newest members of the Tottenham Wireless Society was the lantern lecture given on March 9th by Mr. F. E. R. Neale entitled "Reminiscences of the Society." A large number of photographs taken on field days during visits to places of radio interest and during the Society's exhibitions and meetings were projected on the screen. Very entertaining were the photographs of the Club's apparatus at different times showing the trend of amateur radio design. At the first field day held by the Society crystal sets predominated. Last year several highly-efficient short-wave receivers were in use. Six transmitting stations were worked, and communication was established with a moving car. Last year, also, two public exhibitions were held, both resulting in a large increase of membership. The lecturer expressed the hope that the progress made in past years would be continued and that next summer's field days would outrival those held in the past.

Hon. Secretary: Mr. A. G. Tucker, 42, Drayton Rd., Tottenham, N.17

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About L.F. Transformers.

"The Amplification of Music and Speech Sounds" was the title of an absorbing lecture given before the Swansea Radio Society on March 10th by Mr. R. Garside, of Messrs. Ferranti, Ltd. Mr. Garside gave a brief explanation of the nature of sound waves and other effects on the transmitter. He then traced the resultant electrical vibrations through all the stages of amplification and the final reproduction in the form of a sound wave on the loud-speaker. The lecturer employed a blackboard to show that amplification by means of properly designed transformers was nearly perfect; in his view it was much superior to that obtained by the resistance capacity and choke capacity coupling.

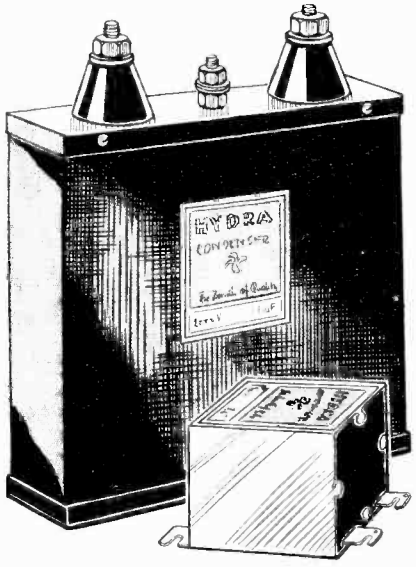
Hon. Secretary: Mr. E. H. White, 100, Bryn Rd., Swansea.

NEW APPARATUS

A Review of the Latest Products of the Manufacturers.

LARGE-CAPACITY CONDENSERS.

There is a considerable demand at the present time for condensers of large capacity for use in the construction of battery eliminators. Much higher potentials are available when supply mains are employed as a source of H.T. in place of a high-tension battery, and it is essential that the condensers employed in making up an eliminator shall be capable of withstanding high voltages. In the case of A.C. supply,



Owing to their compactness the "Hydra" large capacity condensers are suitable for use in the construction of battery eliminators. The larger condenser is for use in the smoothing circuit of a transmitting set.

particularly where the condensers are used for smoothing purposes, it must be borne in mind that the maximum potential passed to the smoothing condensers is appreciably higher than the mean A.C. potential delivered at the output terminals. Smoothing condensers are therefore required to be of large capacity and capable of being used without danger of breakdown with potentials very much higher than the normal H.T. potentials applied to the receiving set.

A new series of condensers especially suitable for this purpose are obtainable from Louis Holzman, 109, Kingsway, London, W.C.2. For battery eliminator construction these condensers are supplied in two grades suitable for use with A.C. or D.C. potentials up to 500 volts. As the overall dimensions of a condenser depend upon the thickness of the dielectric used in its construction, one may be led to think from their compactness that these condensers possess a very small margin of safety as regards their breakdown voltage. The 500-volt A.C. condenser of 2 mfds. capacity is roughly a cube with 1¾in. sides and is rated to withstand the peak voltage. To determine the breakdown voltage the condenser was tapped across a number of series-connected high-tension batteries. The voltage was steadily increased up to 1,500, and there was no indication of breaking down, which indicates that these condensers can be relied upon as suitable for use in the smoothing circuits of battery eliminators. The stated capacities of the several condensers tested were accurate to within 5 per cent., whilst the insulation resistance considerably exceeded the standard of 200 megohms per 1 mfd. specified by the manufacturers. It is understood that the plates are of aluminium foil. A higher voltage series is also available rated as suitable for D.C. potentials up to 1,000 volts. These are similar in external appearance to the 500-volt grade. Marketed, under the trade name of "Hydra," these condensers are offered at a low price.

Transmitting amateurs will be interested in the large-capacity high-voltage condensers obtainable in the same series. The illustration shows a 1 mfd. 2,000 volt condenser, the metal case of which measures about 5 × 5 × 1¾in. On test the voltage across the terminals was taken up to 3,000 without breakdown. A useful feature is the provision of an earthing terminal secured to the metal case.

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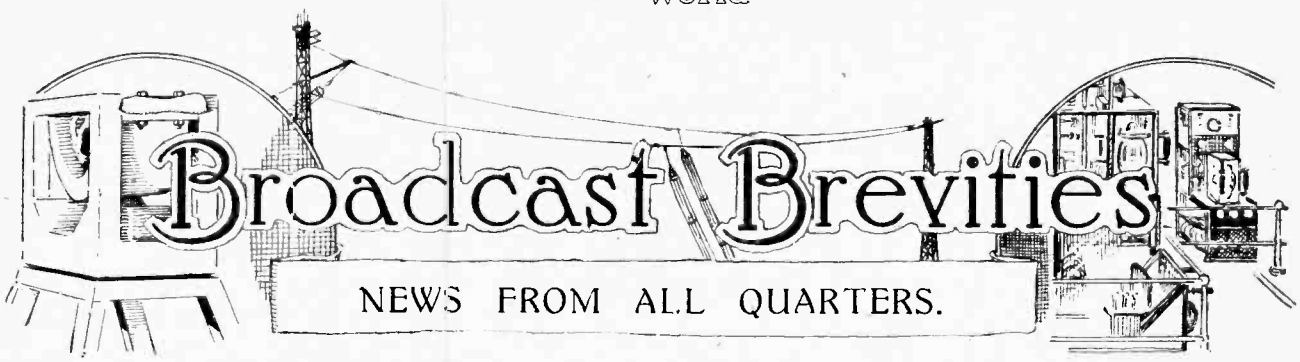
NEW LOUD-SPEAKER HORN.

Much controversy exists as to the type of loud-speaker which should be employed in an endeavour to obtain good quality of reproduction. The reed-driven cone liked by many listeners is considered by others to be surpassed by the coil-driven diaphragm type. The latter is an expensive instrument, and, in view of the large input required, is costly to run. Considered from the point of view of cost, therefore, the amateur can probably do little better than to devote his attention to the horn type, taking care that the type of horn employed has been carefully designed both as to shape, overall dimensions, and the material used in its construction.

The employment of a large horn is one of the best methods of obtaining good quality.

A well-designed horn is now manufactured by Scientific Supply Stores, 80, Newington Causeway, London, S.E.1. It measures 5ft. in length, and at the flare is 2ft. in diameter. The design has not been adopted at random, but has been produced with a full knowledge of the facts governing the acoustic properties of horns of this type. It is constructed from a non-resonant material, which in use does not vibrate at a period of its own, and, judging by the thickness and weight is, no doubt, papier-maché.

A Brown movement was used for testing, operated from a set comprising an anode bend detector, followed by a two-stage power amplifier. Particularly pleasing results were obtained, the base notes appearing to be present in their correct relative strength, though not tending to drown those in the upper register.



By our Special Correspondent.

Daventry Regional Tests.—Night Operations at 2LO.—The Beethoven Centenary.—News from Cork.—Spain and Russia.—

"Daventry Junior."

In about three or four weeks' time those to whom the nocturnal ether appeals more strongly than the seductive pillow may reap a reward. The tumult and the shouting over "Daventry Junior" have died down of late, but work there is still going forward, and I should not be surprised if the lower broadcast band receives a severe shaking before April is out. No telephony with a power approaching 25 kilowatts has yet been heard on the British waveband between 300 and 400 metres, so the results may be rather startling. The range of 5XX may be eclipsed quite easily.

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The First Tests.

All the gear has now arrived at "Daventry Junior," but the task of assembly is not completed. The first tests will be conducted after the ordinary broadcasting, and may go on into the wee sma' hours.

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Those Busy Engineers.

By the way, in the matter of early morning experiments the B.B.C. engineers have recently been upholding the worthiest traditions of the wireless fraternity. Tests have been going on after midnight.

The most mystifying to many listeners has been the transmission of the tuning note from 2LO at times when the idea of sitting down to enjoy a broadcast programme would be the last thing to occur to a sane person. The explanation is that adjustments are best made when the station is working, and in the early hours the tuning note is the most convenient "turn" to put on the air.

One of the most pathetic things I know is the sound of a tired engineer trying to get his tongue round a reading from Shakespeare. The tuning note is far more bracing.

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"S.B." Testing.

Another transmission which can generally be heard late on Mondays, Wednesdays, and Fridays is the "S.B." line test. The provincial stations take turns on the line, and anyone who is sufficiently interested can sit up to hear 2LO relaying "English as she is spoke," from Land's End to John o' Groats.

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A Human Explanation.

The question which arises is why 2LO should deem it necessary to *rebroadcast* all this patter. Surely the behaviour of the land lines could be noted in the Savoy Hill control room?

The explanation is a very human one. Even the most rabid engineer likes an occasional slumber under his own roof, so the line tests are rebroadcast for the benefit of the engineers who have gone home. It matters not to the B.B.C. that a million listeners can overhear; they ought to be in bed!

FUTURE FEATURES.

Sunday, March 27th.

LONDON.—Military Band Programme.
BOURNEMOUTH.—Operatic Concert.
CARDIFF.—Evensong relayed from Llandaff Cathedral.
GLASGOW.—Orchestral Concert, with Frederic Lamond (pianoforte).

Monday, March 28th.

LONDON.—"Kismet," in three acts, by Edward Knoblock.
BELFAST.—French and Belgian Music.

Tuesday, March 29th.

LONDON.—Songs of the Norseland.
NEWCASTLE.—A Recital of Old English Music.

Wednesday, March 30th.

LONDON.—"Going Up," a musical comedy in three acts.
DAVENTRY.—The Compositions of Mendelssohn.
BIRMINGHAM.—Scottish Programme.
MANCHESTER.—"Eric's Winning Way" Farce in one act by Reece Evans.
ABERDEEN.—Community Singing Concert.

Thursday, March 31st.

LONDON.—B.B.C. National Concert relayed from Albert Hall.

Friday, April 1st.

LONDON.—"April Fooling."
BOURNEMOUTH.—Sussex Musical Festival relayed from Bognor.

Saturday, April 2nd.

LONDON.—Concert relayed from Kingsway Hall, directed by Gatty Sellars.

Transatlantic Relays.

The novel feature of Keston's relay from Schenectady last week was the news bulletin, read in clearest of tones by the WGY announcer. The thrill came when he held out a threat to American listeners who had not paid their income-tax!

The suggestion is being made that a New York time signal should be picked up. A clock chiming the hour of seven would remind many midnight listeners in this country of the time lag across the Atlantic, and incidentally remove the doubts of the sceptics who still think that the American transmissions are faked at Savoy Hill!

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A Welsh Rare Bit.

I see that a Welsh writer is castigating the B.B.C. for calling a town "Nym Yw'r Meilsion Cerddgar." After this we may expect them to stoop to anything!

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The Beethoven Centenary.

Saturday next, March 26th, the centenary of Beethoven's death, will be marked by special broadcasts from all stations of the B.B.C.

A special Beethoven centenary concert will be relayed to all stations from the Bishopsgate Institute on that day, when the Wireless Symphony Orchestra is to be conducted by Alexander von Zemlinsky, and the solo pianist is Solomon. The items to be performed are: Overture "Egmont," Ballet Music from "Prometheus," Symphony No. 8 in F, Crosse Fugue for String Orchestra, Concerto No. 4 for Pianoforte and Orchestra in G major, and Overture "Leonore" No. 3.

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Broadcasting from Cork

The southern portion of the Irish Free State has been badly neglected so far as broadcasting is concerned. Last autumn, when I travelled by train through the

counties of Wexford, Waterford, Cork, and Kerry, receiving aerials were spaced at distances of about fifty miles, and there was no risk of interference by local oscillation!

In a few days' time, probably, the Cork station will broadcast its opening programme. At first it will act principally as a relay station for the Dublin programmes, but a studio is being erected at Sundays Well, and no doubt Cork will be showing a spirit of independence before many months are past. Much will depend upon the qualifications shown by local talent.

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Music from Romsey Abbey.

The first Romsey Abbey Musical Festival is being held in the Abbey at the end of the month. A part of the festival, in which the Wessex String Quartet is to participate, will be broadcast from Bournemouth on March 30th. The Abbey dates back to the year 907.

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"Four Hundred Years Hence."

What will the world think of twentieth-century music? This is the keynote of a broadcast entitled "Four Hundred Years Hence," to be given from Daventry to-morrow (Thursday). A professor of ancient music will lecture to his students on "The Songs and Dances of Civilised Savages, 1850-1950," a subject which should prove very diverting.

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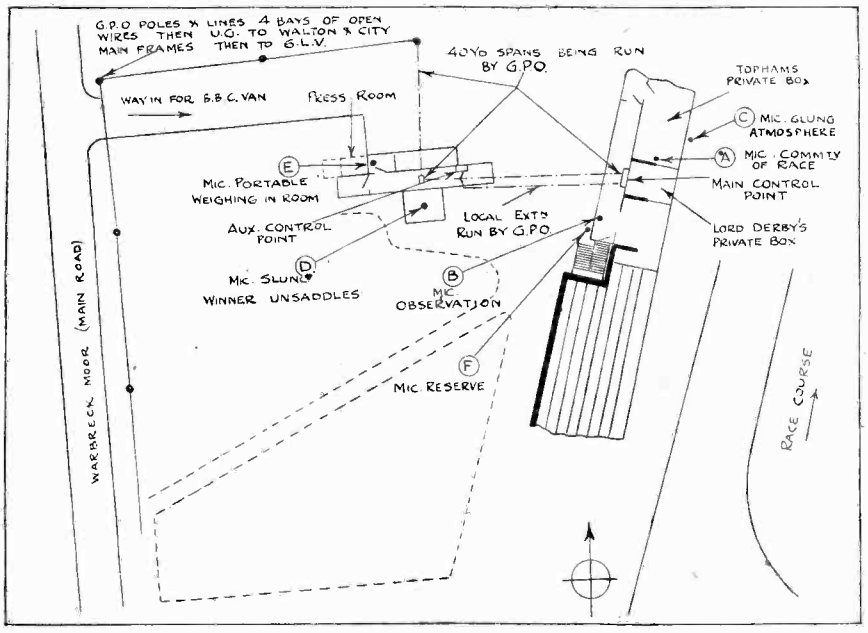
A Spanish Octopus.

Do many people realise that the "Union Radio" Company in Spain is now one of the most powerful organisations of its kind in Europe? During the past few months, when most broadcasting concerns have found enough to occupy themselves in endeavouring to comply with the Geneva scheme without quarrelling with their neighbours, "Union Radio" has been calmly ignoring the rest of Europe and concentrating its energies on the gradual absorption of all stations within reach of its tentacles. The latest additions to the group are the stations at San Sebastian and Salamanca, their call-signs being EAJ8 and EAJ22 respectively.

Before sighing for fresh worlds to conquer, "Union Radio" would be well advised to set its house in order by making an attempt to fall in with the Geneva scheme. Happily, there are indications that something of the sort is at last being attempted.



BROADCASTING THE GRAND NATIONAL. A diagram showing the arrangement of microphones at Aintree on Friday next, March 25th, when the B.B.C. will attempt their most ambitious "running commentary." The race will be described by the well-known sportsman, Mr. Meyrick Good. The winning jockey will probably relate his experiences.

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With a Crystal Set in Russia.

Given a crystal set, it appears that you have only to live in Russia to pick up nearly everything that's worth hearing, according to a letter I have received from a correspondent at Orel, some two hundred miles south of Moscow. With his humble crystal set he hears Moscow, Komintern (12kW), and Moscow, Popoff (6kW), Leningrad (10kW), and Kharkov (4kW).

"Besides these Russian stations," he writes, "I often hear many foreign stations, chiefly German, on the lower wavelengths. Four days ago I heard Radio-Wien very well until 2 a.m.; only occasionally was there any fading. Recently I heard Königswusterhausen at good strength (R4) until 1.30 a.m.

"My aerial is L-shaped, and its length is 30 metres. The middle height is 15-17 metres, and the earth is composed of an iron rod 3 metres long, buried in the ground near my window."

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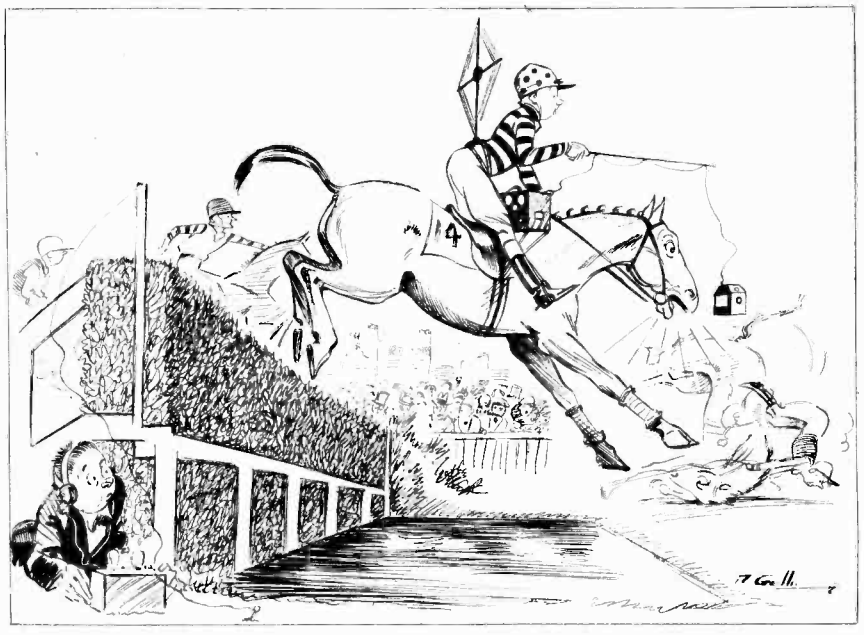
High Power in Moscow.

Test transmissions are now being conducted from the new Moscow station. "Great Komintern," on a wavelength of 1,250 metres with a power between 15 and 20 kilowatts.

STRAIGHT FROM THE HORSE'S MOUTH.



The B.B.C. have still two days in which to revise the Aintree arrangements to conform with our artist's idea of a real "running commentary"!

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

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

THE SILENT PERIOD.

Sir,—The question of closing down our stations occasionally for brief periods to allow of distant reception is closely related to a serious problem with which British listeners will be faced before long. I rather think that many overlook the real importance of wireless progress. The man who is content to listen to his local station might easily be accommodated by a receiver connected through telephone, such as an existing apparatus permitting a subscriber to choose his London theatre programme as he pleases. Wireless is the conqueror of distance; the link that connects countries leagues apart. If a country is to feed its music, its drama, its speech forcibly into the ears of its listeners, surely the international aspect of this wonderful science is entirely lost?

Does any intelligent individual really think that the enormous power behind some foreign transmissions is merely to provide crystal reception for one particular country? No, sir. Not only is it a question of propaganda, but of teaching and learning. When the foreigner is not teaching he closes down and listens—and learns by the simple method of comparison.

Before long we are threatened with high-powered stations, with their accompanying "wipe out" possibilities, to provide crystal set owners with alternative programmes. Very nice too! But what good to the trade of England is a man who might possibly support the gramophone industry and yet reclines snugly in his chair wearing a pair of cheap foreign phones attached to a cheap "catswhisker arrangement"? If the B.B.C. is to encourage only the "penny farthing" listener, exactly where shall we stand ten years hence?

Surely the unfortunate listener with a shallow pocket is not harshly treated in having but one programme and roughly sixty hours' pleasure for about twopence per week. Every form of enjoyment is increased by the participator's pocket—why not wireless? I do think that the valve user should be compensated for his greater outlay and costs of upkeep with greater scope.

At present I am using a very efficient four-valve neutrodyne set on which some seventy stations have been received, ten of which suffer from interference when 2LO is working. An alternative high-power station would, if working on the broadcast band, probably rob me of a further ten stations, and so on until my receiver would be nothing more or less than a very expensive "musical box" of British talent. However patriotic one might be, is there not something very refreshing in change and comparison? I myself appreciate the local programme trebly after an hour's opera from Barcelona or Frankfurt.

At present the average British station transmits incessantly from 3 p.m. until 11 p.m. or midnight, at least an eight-hour day each day of the week, excepting for a short period on Sunday evening. During that time it endeavours to cater for every type of listener, and it should try to encourage the "wanderers" also.

Surely the logical solution, instead of rushing into the heavy expense of high-power stations, is to split up the total periods of transmission, not into fragments of food, but into substantial meals for each class of listener, and to close down stations for brief periods to allow of foreign reception. This would seemingly satisfy not only the man whose outlook on broadcasting is wider, but also the local programme critic who has only to operate judiciously his "on and off" switch.

In case I should be attacked vigorously by those crystal "gazers"—I should say listeners—I am going to take cover under a fact too often forgotten by the simple set owner. If it were not for the enormous trade in the more expensive wireless components, the "baby of wireless reception" would cost to buy what it used to, a matter of pounds—not a few shillings.

Croydon. F. CADDICK.
March 10th, 1927.

Sir,—Referring to your Editorial in the issue for March 9th, in which you suggest British stations should close down for a period once a week to enable users of valve sets to "reach out," I venture to say the number of listeners using crystal sets is still in the majority, and that there is actually a silent period now from about 6 to 8 o'clock on Sunday evenings, which I consider to be sufficient.

As to the swamping-out effect from a near-by station, I have experienced almost as much trouble during the silent period on Sundays, when DX enthusiasts are using the carrier-wave method of tuning in a distant station.

Again, with the coming of the light evenings it will not be worth searching before about 10 o'clock, when enthusiasts could afford to wait an hour until the station closes down for the night. F. NICHOLS.

London, S.W.6.
March 11th, 1927.

Sir,—I have read with interest your Editorial entitled "The Silent Period," and as I know you are always anxious to hear "the other fellow's" viewpoint, I should like to put before you my own opinion on this question, which I have discussed with many listeners, and concerning which I have usually found them in complete agreement.

Wireless reception in my own circle is being looked upon more and more as a means of obtaining entertainment rather than as a scientific hobby. The reception of programmes from distant stations can rarely be looked upon as a method of entertainment, excepting from the point of view of the peculiar interest attached to receiving, without apparent connection, music which may be transmitted from a distance of possibly 1,000 miles or so. Reception from the home stations other than the local station and Daventry is usually only of particular interest, if there is some item in the programme of one of these stations which one particularly desires to hear. This might well come under the heading of entertainment, although it is usually subject to considerable interference.

It would be more than a curious coincidence if the silent period suggested happened to coincide with the time of the item which one desired to hear from a distant station. It may therefore be taken that the silent period is only in use and interest to the experimenter who desires to carry out long range tests, or to the new-comer to radio to whom there is still a fascination in hearing imperfect and interrupted reception from a considerable distance.

With regard to the former, an experimenter who is seriously interested in long range reception and carrying out any really valuable research work in connection with this should be quite capable of constructing and using a selective receiver. In connection with the latter class I am seriously led to believe, after discussion with considerable numbers of listeners, that they are very much in the minority

In my case there is only one thing to be said in favour of your suggestion, and that is, that if the period were confined to half an hour a week, and the suggestion did not apply to the Daventry station, the ordinary listener would be called upon to make little sacrifice in order to give pleasure to the minority. There is, however, one very important point connected with the suggestion which may have escaped your notice. I believe it is the endeavour of all progressive manufacturers to make their receivers so simple that the reception of broadcasts can be obtained by the mere movement of a single switch. Such forward statements of the B.B.C. as we have seen published appear to be working in this direction, and it seems to me that it would be a great pity if the position in regard to this were complicated by the necessity of manufacturers turning their attention to multi-station long-distance receivers. In the early days of radio this craze for long-distance reception was so marked that the type of receiver offered to the public had to be capable of such reception in order to find a market. The added complications to the receiver so frightened many would-be listeners, whose desire was to be entertained by radio, that they "held off" installing a receiver, considering it to be too complicated an apparatus for them to handle. Recently we have seen a distinct tendency for the public to lose interest in this long-distance reception, and to demand simple receivers for entertainment purposes, and the manufacturers appear to be more and more devoting their energies in this direction.

It is my opinion that any encouragement for a diversion of interests, such as would be given by the silent period, would be far from beneficial to the industry and to the listening public, for, after all, these long-distance receivers, with their added complications, do raise the price of apparatus, and it is not difficult to produce figures which tend to show that the listener might be called upon to pay from £5 to £10 extra for the sake of hearing imperfect reception from a distant station half an hour or so a week. COLIN H. GARDNER.

Stourbridge,
March 10th, 1927.

Sir,—The arguments put forward in the Editorial in the issue dated March 9th, in favour of a silent period for B.B.C. stations are incontrovertible, but there is a point against the proposal which, I fear, is of overwhelming importance, and is the one consideration which makes me hesitate to give your proposal my wholehearted support. I refer to the re-radiating receivers which make reception of Continental stations at times when the B.B.C. stations are closed down merely an exasperation.

There appears to be no means either of persuading or compelling a certain type of listener from "searching" with his set in violent oscillation, trying to tune in each carrier wave in turn by "running down the howl" and then, for a minute or two only, oscillating steadily on the "silent point" before resuming searching operations. Of course, the receiving set is often quite as much to blame as the operator, because so many are incapable of making a distant transmission audible at all by any other means, but that is beside the point.

Speaking from a certain amount of experience, I can add that this oscillation trouble does not appear to be confined to the big cities. Even in the smaller country towns and villages, wherever a few aerials are gathered together within a radius of a mile or so, there are the oscillators in the midst of them.

Perhaps in the course of time this curse of wireless reception may die out, but there are no signs of that happy day arriving in the near future. Rather the reverse, unfortunately.

London, S.W.5, J. H. S. FILDES.
March 12th, 1927.

Sir,—The suggestion that B.B.C. stations should close down for silent periods is an excellent one—in theory.

Practically, the position would approximate to that which obtained when the B.B.C. used to transmit experimental programmes from each station in turn at a late hour of the night. As a rule, all that could be heard was the "cat-calls" of the local "experimenters," whose zeal was only equalled by their disregard of the oscillation clause in their reception licence conditions. In all probability, the position to-day would be much worse if the B.B.C. conceded the silent period.

Listeners—and experimenters too—have the remedy in their own hands if they wish to listen to foreign broadcasts, and they should have no difficulty in doing so unless they are so near to a transmitting station that none but the most selective sets will cut it out. Any properly constructed three- or four-valve set capable of receiving foreign programmes should easily cut outy the local station within, say, 20,000 to 30,000 cycles, and the pest who desires to tune in America on half a valve and no aerial should not be pandered to.

Dundee. A. G. N.
March 9th, 1927.

Sir,—Although a valve set user myself, I see no point whatever in the suggested silent period referred to in the March 9th issue of your paper.

First, people with really powerful sets are already able to get all the foreign stations they may require, and the question, therefore, seems to be one for persons using up to, say, three valves. What is the position regarding the latter? They set up a considerable amount of squealing and oscillating on Sunday between B.B.C. afternoon and evening programmes, making it far from a pleasant job to endeavour to tune in other transmissions. Is it not reasonable to suppose that during a silent period on a week-night matters would be very considerably worse?

Why should London's tremendous population be without a programme, even for part of an evening, for the satisfaction of a very small proportion of its listeners?

In any case, the question is surely one only for winter evenings, as it would be of no use during the summer, when the evenings remain light until after ten o'clock.

I feel confident that the silent-period advocates will not be successful—in London, at any rate—although a low-brow friend tells me he might be inclined to weaken in their favour if such a silent period took place during the time scheduled for such items in the programmes as chamber music, etc.!

London, E.8, ROBERT CAMPLING.
March 12th, 1927.

B.B.C. TRANSMISSION OF PIANOFORTE MUSIC.

Sir,—The suggestion of one of your correspondents that Mr. E. C. Richardson should remember his grid bias and other elementary matters has caused me some amusement. He evidently does not know Mr. Richardson.

Surely many people must remember one day last December when Sir H. Walford Davies changed his piano in the course of a lecture—one piano was good, the other perfectly awful.

I have no doubt but that the B.B.C. are doing their best, although I sometimes wonder if their apparatus is up to that used by some other countries. Those of us who remember "Writtle" look upon their chief engineer as an old friend, but I do think there are some good outside men whose advice would be extremely useful to the B.B.C.

As an example, I wonder whether any of your readers heard some time ago an amateur retransmitting America excellently shortly after the B.B.C. had not been very successful, and actually demonstrating that what the B.B.C. called interference was instrumental.

There is just a little too great a tendency for the B.B.C. to put every fault down to the receiving end: just a little too much of the attitude:—

"We are by God appointed,
And damned be all who do resist or touch the Lord's anointed."

A demonstration of what can be done is being given by the B.B.C. at the Ideal Home Exhibition. I hear one loud-speaker is very good, but I understand it is one costing, with contained amplifier, about £40; and Olympia is about two miles from 2LO! ALFRED W. SIKES.

Langley, Bucks.
March 11th, 1927.

Sir,—Being one who often suffers from the poor transmission from 2LO, and having a little knowledge of radio engineering and a large experience of broadcasting in this country and on the Continent, may I suggest an explanation of the reason for the complaints?

With a well designed and operated receiving set and a "Kone" loud-speaker the owner suffers for the perfection of his apparatus. It shows up the defects of the transmission; whereas if he substituted a good horn loud-speaker, the quality of the reception would be lowered, but the defects in the transmission would be masked.

The B.B.C. microphones, amplifiers, etc., are of first-class quality, designed and made by firms who understand their business. It is in the operation of this apparatus and in the arrangement of the performers in the studios that the trouble lies. In the control room the least inattention on the part of the "engineer" is likely to result in bad transmission. Further, the "engineer" wears headphones, and thus he has no means of verifying his control of musical items.

The transmission from the German broadcasting stations is invariably of better quality than that from the British stations, not because their apparatus is better, but solely on account of a better educated and more painstaking *personnel*.

It is always possible to tell when a control engineer is relieved at 2LO by the change in the quality of the transmission. Except when one man is on duty the control at 2LO is probably worse than at any of the other stations. My experience leads me to suppose that women in charge of the control apparatus would prove far more satisfactory than the young men at present engaged in this work.

I have for the reception of broadcasting five sets; one of them—and by no means the best—is a replica of the set made by the B.B.C. for exhibition at the Science Museum.

London, S.E.22. S. MEREDITH.
March 10th, 1927.

Sir,—As a music—and wireless—lover I strongly protest against the suggestion contained in Mr. Ballard's letter in the March 9th issue of *The Wireless World* that transmissions known to be imperfect should be tolerated when the "imperfections are not apparent to the average music-loving public." If there is one thing more than another which is necessary for the future welfare of both music and wireless it is that the general public should be stimulated to demand of the B.B.C. and also of the wireless industry that the received reproductions of music should be faithful copies of the original performances. I imagine that the B.B.C. will not thank Mr. Ballard for the particular form of defence which he has chosen.

I was very glad to see the question of the quality of pianoforte transmissions from Daventry raised by Mr. Richardson. For months past I have been seeking in my own set a cause of the distortion which he and your other correspondents describe. My experience may be summed up as follows: Most studio transmissions are defective; most "outside" transmissions are more or less satisfactory. The defective studio transmissions seem to come from small studios or occur when the piano appears to be too near the microphone. For example, the reception of the pianoforte illustrations to the talks by Sir Henry Walford Davies has been consistently bad. (Is Sir Henry aware of some trouble of the kind? He often shows anxiety as to how his illustrations are being received.)

As a specific instance of satisfactory and defective transmissions within half an hour of each other I would mention the pianoforte solo in the recital of Gershwin's music given one evening last week and the "stop-gap" piano item which immediately followed the recital.

In view of the nature and quantity of the evidence which is accumulating in your columns on this subject I hope that the B.B.C. may be moved to take effective action in the matter, and, in my opinion, the "frank avowal" for which Mr. Richardson asked would be only an act of bare justice to those trade and amateur experimenters who are being misled as to the performance of their receiving sets, not to mention the listening public, whose musical taste is in danger of being vitiated. P. C. MARKS.

Brighton.
March 10th, 1927.

Sir,—I have been following with interest the correspondence on the subject of piano transmissions, and I cannot help thinking that the B.B.C. engineers will be very grateful to your two correspondents, Messrs. Harold C. Huxter and Robert N. Ballard, whose letters are published in the March 9th issue of *The Wireless World*, for the "fairy godmother" attitude which they adopt.

Surely the policy of the B.B.C. has always been to welcome any constructive criticism, and, from my own experience, and that of several of my friends, who have sets quite capable of giving really good results, I certainly think there is bad distortion at times in the transmissions of pianoforte music, and I have noticed that it usually occurs on the London transmission during the time when Daventry is giving the Shipping Forecast. I would venture to give a concrete instance, *viz.*, Thursday night, March 3rd, when Miss Cecil Dixon played after the news in the interval between the two halves of the National Concert. No fewer than three of my friends noted this case, and remarked about it.

As regards my equipment, I use a Standard-Western Electric "Kone" loud-speaker, working from a crystal detector and a properly designed power amplifier, which gives excellent results.

In all fairness I must say that I find the transmissions from London usually very fine, and with the above equipment a real musical treat, but those interval transmissions of piano music are often very rough and distorted—a small fault, no doubt, but one which could, I imagine, be fairly easily rectified.

London, N.19. J. E. UNDERHAY.
March 9th, 1927.

Sir,—With reference to correspondence on pianoforte music, I am inclined to think that Mr. Pilpel has put his finger on the weak spot and that one particular studio, or perhaps the piano or microphone there, is at fault. To say there is not and can be nothing wrong is misleading both to the B.B.C. and listeners.

In Glasgow our experience of piano music from London is, of course, S.B., and there might be distortion in the land lines, but the difference between piano tone from the local studio and from London on the same evening and often within a few minutes' interval is extraordinary, proving it is not always the set's fault. Nearly all Sir Henry Walford Davies' delightful lectures this winter have been spoiled by rattling and broken notes, and I noted on one occasion that on going over immediately after to the Chenil Galleries the piano there came over perfectly.

Crystal and valve both showed the same defect. On one occasion I changed over to London direct and heard the same poor quality, and on picking up a German station heard piano music as clear as one could wish. One can often only place the blame by a process of elimination, and in this case I do not think it can possibly be the sets which cause the distortion of which there have been complaints. W. SMITH.

Glasgow.
March 9th, 1927.

WIRELESS AT THE IDEAL HOME EXHIBITION.

Sir,—I wonder if any one of your readers who has visited the Ideal Home Exhibition has had the same experience as myself. Strolling down between the various "shows," I espied a stall exhibiting an unusual form of loud-speaker, and heard, at the same time, a remarkable series of runs and trills on a pianoforte, the very low and very high notes coming out beautifully.

Hastening to the spot to ascertain the make and type of this loud-speaker and wondering whether I had enough money to buy one, I enquired which of the several on view was working, and found that the music emanated from a piano stall backing on to the loud-speaker exhibits.

The subsequent explanation of how the magnet system operated and how resonance was avoided in the diaphragm left me cold, and I walked away with another of life's disappointments.

London, S.E.4. HAROLD C. HUXTER.
March 10th, 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.

Resistance or Choke Coupling.

I have two of the new high-impedance valves which are said to be suitable for resistance or choke-condenser coupled low-frequency circuits, and I am wondering which is the best form of coupling to use. The valves have an amplification factor of about 35.

R. N. D.

The valves to which you refer when used as a detector or in a low-frequency amplifier must have connected to them a circuit of high resistance or high impedance at speech frequencies. For this reason resistance coupling has many advantages, as the effective resistance of the circuit connected to the anode of the valve can be made to remain fairly uniform over the whole range of speech frequencies. At low frequencies stray capacities are negligible, while for the higher audio frequencies the effect of stray capacities becomes of importance. For this reason it is advisable not to use too high a value of anode resistance. A good value is 0.5 to 1 megohm.

Choke coupling, besides being more expensive, is usually not productive of such good quality, as the impedance of the circuit connected to the valve, which includes the anode choke and the associated stray capacities, varies with frequencies rather more than the simple resistance mentioned above. Even so, with choke coupling it is possible to obtain higher amplification, so that, provided well-made chokes of ample inductance and low self-capacity are used, it would seem that on the whole choke coupling is to be preferred, but for simplicity and low first cost the resistance condenser method is undoubtedly superior, in spite of the fact that the amplification by comparison is a little less.

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Anode Bend Rectification.

I notice that anode bend rectification is often recommended instead of the better-known grid circuit method. What are the reasons for the failing popularity of the latter system?

G. N. J.

An essential of grid circuit rectification is grid current. A grid condenser and leak are used, and the normal potential of the grid of the rectifier is set at a value at which grid current flows. The potential of the grid, and therefore the normal working point on the valve's characteristic, can be varied by adjustment of the ohmic resistance of the grid leak and by the voltage with respect to the negative side of the filament to which the return end of the grid leak is connected. Now, the incoming modulated high-frequency currents are applied to the rectifying valve through the grid condenser, with the result that the low-frequency voltage developed across the grid and filament terminals of the valve depends to some extent on the value of this condenser, the resistance of the grid leak, and the grid filament resistance of the valve. Hence frequency distortion is produced, its seriousness depending on the relative value of these three things.

A further effect of this type of rectifier is to load the circuit to which it is connected. When a tuned circuit is used the effect of connecting the rectifier is to reduce the voltage across the tuning condenser, since the circuit has to supply a certain amount of power to the rectifier. Naturally, this also affects the selectivity of the tuned circuit, because the apparent resistance of the circuit is increased by the load of the rectifier. So far as the anode circuit is concerned, a by-pass condenser has to be used in the majority of instances, which has the effect of reducing the strength of the upper frequencies.

An anode bend rectifier, when adjusted, as it normally is, so that grid current does not flow, has only a very slight loading effect. The voltage applied to the grid of the rectifier is therefore practically the same as the voltage across the tuning condenser when the rectifier is not connected. Similarly, the selectivity of the tuned circuit is hardly affected by the rectifier. As regards the output low-frequency voltage, now that valves of really high voltage factor are available the actual low-frequency voltage passed to the L.F. stage can be made practically the same for the anode rectifier as for the grid circuit rectifier for equal quality in the two instances. The anode rectifier will deal with strong signals without distortion, but if the valve is of a type having a very high anode resistance and a shunting condenser is used the high tones will suffer relative to the low ones.

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Tuning Condensers.

I am about to make up an "Everyman's Four" receiver, but I thought of using tuning condensers of the straight line frequency instead of square law type, as I am told that tuning is easier with straight line frequency type condensers. If tuning really is easier, why were condensers of the straight line frequency type not included in the original receiver?

P. K.

Properly made tuning condensers of a type which give straight line frequency tuning, providing as they do an equal separation between stations working on a frequency basis, are very useful, but if one examines a table showing the wavelengths and the power of the various broadcasting stations it will be found that the tendency is for the stations working on the upper half of the broadcast band to be of much higher power than those working on the lower half of the band. For instance, the relay stations have low wavelengths. The result is that in practice the user finds that he does not receive so many stations over the lower half of the tuning range of his circuit as he does over the upper half, simply on account of the latter stations having more power. The result is that the advantages of straight line frequency tuning are mainly theoretical, because the user can afford to crowd the few stations received on the lower wavelengths a little closer together on the condenser dial, while he would like to be able to space the stations working on the longer wavelengths a little farther round the dial. For these reasons many users prefer the square law condenser to the straight line frequency type, and for this reason the former condensers were recommended for the "Everyman's Four" receiver. Anyone having condensers of the straight line frequency type of the correct capacity may, of course, use them in this receiver. It would hardly be worth while discarding them in favour of square law condensers.

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RECEIVER EFFICIENCY.

THE question of the amplification, in proportion to the number of valves employed, which can be obtained from a receiver, is always a debatable point, because, even supposing that all the technical data regarding the set is available from which the amplification can be calculated, the influence of different aerials cannot be accurately allowed for. It is very difficult to make any assumption as to how many stations can be expected at loud-speaker strength on, say, a detector and one L.F. receiver without knowing the locality where the set is to be used, the aerial and earth available, and the extent to which the user is going to make use of reaction or to sacrifice quality. Our own view is that the wisest course is to adopt a conservative estimate. In describing *Wireless World* receivers our policy is always to assume reception conditions somewhat below the average when we state what the reader may expect to obtain. It frequently happens that if we say that ten stations can be heard on the loud-speaker with a particular set, we receive letters from readers who express the view that we are too conservative in our estimate because they have, perhaps, got thirty stations on the set.

Unfortunately, we frequently see exaggerated statements made of the reception possibilities of a receiver, but very little good can result from misleading the prospective user of a receiver in this way, and, incidentally, it does much harm to wireless generally. Is it not better that the builder or purchaser of a receiver should find that it exceeds rather than falls far short of its estimated performance? No doubt the time will come when it will be the accepted policy to guarantee the performance of receivers within definite limits, but at the moment this is scarcely possible on account of the many variable factors which have to be taken into account, largely owing to the absence of standardisation of valves and other components.

CONTENTS.

B.B.C. POLICY.

IN a letter published under "Correspondence" in this issue the Chief Engineer of the B.B.C. replies to our editorial note which appeared in the issue of March 2nd. We are taken to task for having suggested that the crystal user in the vicinity of one of the new stations will be at a disadvantage. It is interesting to have the assurance of Captain Eckersley that the new B.B.C. plan is "quite definitely to place the new high-powered transmitters well away from the large centres of population." But still we feel very sorry for those listeners whose misfortune it will be to have a high-powered station in their neighbourhood.

We are also told that there is no justification for our feeling of anxiety as to the possibility of international strife over the question of station power. We are assured that the International Committee of Broadcasters is fully alive to the situation. We sincerely hope that the Committee has the position well in hand, for only chaos can result if once that authority is disregarded.

Coil-driven Diaphragm LOUD-SPEAKER DESIGN.

Factors Governing the Design of the Diaphragm and the Moving Coil Windings.

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

This article is the outcome of repeated requests from numerous correspondents for further particulars of the loud-speaker demonstrated to the Radio Society of Great Britain in January, 1926, and described in Experimental Wireless *for March, 1926.*

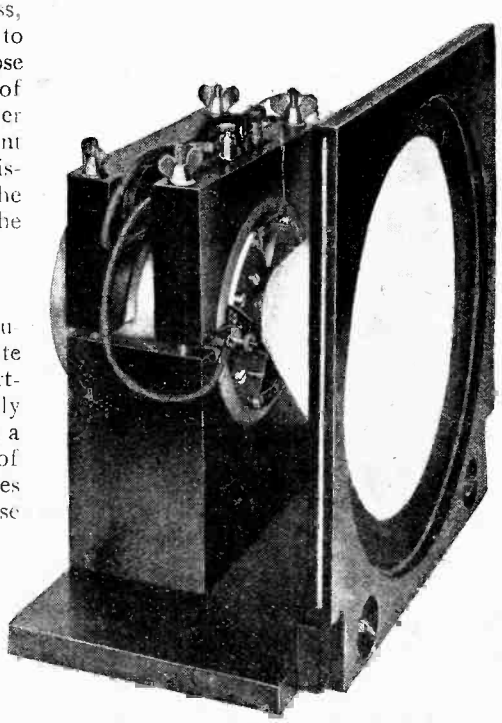
The first part deals with the design of the moving coil and its associated circuits, and will be followed in a later issue by details of the construction of the magnet system and the cone diaphragm.

THE *pièce de résistance* in a coil-driven diaphragm loud-speaker appears to be the diaphragm. It seems almost impossible to avoid a certain amount of acoustic coloration (probably undetectable by many persons, but present nevertheless), due to diaphragm resonances. The material of the diaphragm has a profound effect, and some materials are much better, or worse, than others. The best diaphragm which I have tried seemed to be one of the doped cloth variety, about 9in. in diameter. Owing to its rather large mass the efficiency was impaired appreciably, and the difference in quality between it and a paper diaphragm was hardly worth the loss in efficiency. Pleated diaphragms have not been tried, owing to the effect due to proximity of the magnet. With a cone the convex side bears away from the magnet and allows a fairly clear path for the sound to be radiated, whereas the pot magnet would cast a definite shadow and might interfere with the action of a quasi-flat diaphragm. Nevertheless, it would be interesting for readers to experiment for themselves. Those who are conversant with this type of diaphragm will know that it is rather prone to a pronounced and unpleasant resonance. In any case, it is advisable to keep the diaphragm and the coil as light as the exigencies of the situation will allow.

Theoretical Considerations.

Before giving details of the instrument, it will be advisable to indicate several points of theoretical importance. The theory, as given broadly in "Loud Speakers,"[1] is based on a flat, perfectly rigid disc, in a wall of infinite extent. This, of course, does not always hold in practice, because there are only a few people like Mr. Denman who run to spare doors, etc.![2] However, at frequencies above 100 cycles, by using a baffle 4ft. square, the wall condition is fairly well satisfied, although the distribution of sound from the convex and concave sides of the disc is quite different. The concave side gives a more pronounced focussing of the high frequencies, due, in part, to interference, as described in a recent article,[3] and to the fact that the waves cannot spread until they reach the mouth of the cone. Thus the cone acts as a short horn at high frequencies, and the solid angle into which the apex of the diaphragm discharges is not that of a hemisphere but that of the cone, which is considerably less. Thus the higher frequencies are augmented, compared with those at the convex side, where the solid angle is greater than that of a hemisphere, *i.e.*, the solid angle in the vicinity of the cone is greater. However, despite the disparity of conditions between flat discs and cones, the design of the moving coil can be arrived at quite comfortably on the disc theory.

The acoustic pressure on the diaphragm is so small, compared with the force to overcome the inertia of coil and diaphragm, that it can usually be neglected. At low frequencies, where there is no focussing and the whole hemisphere of fluid (air in our case) is set into vibration, there is a definite increase in the mass of the disc, which we can regard as an accession to inertia by virtue of the mass of air moved. This is not negligible unless the coil and diaphragm are unusually heavy. Thus, due to the inertia component, the mass of the moving parts varies with the frequency. Some data, calculated from the theory of the instrument, bearing on this subject, are given in Table 1. It will be seen that the inertia component is by no means negligible, being 35 per cent. of the mass of the disc up to and somewhat beyond the middle of the pianoforte. Now the air pressure at a point on the axis of the disc, distant, say, 8 diameters (about 5ft.), is *inversely* proportional to the mass



Coil-driven loud-speaker without baffle, showing cone diaphragm and method of mounting magnet system

[1] "Loud Speakers," by N. W. McLachlan. Messrs. Iliffe and Sons Ltd. Price 2s. 6d.

[2] *The Wireless World*, p. 92, January 26th, 1927.

[3] *The Wireless World*, March 23rd, 1927.

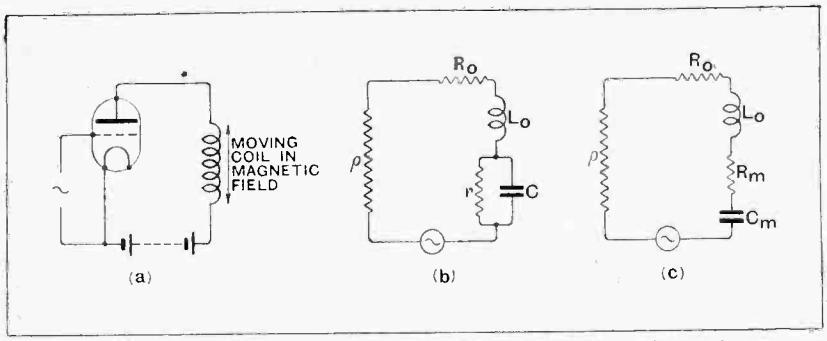


Fig. 1.—Equivalent circuits of moving coil. R_m=acoustic radiation resistance; C_m=motional capacity; ρ=A.C. resistance of valve; R_o=coil resistance; L_o=coil inductance. r and C are equivalent to the series arrangement R_m C_m.

of the diaphragm *provided the current in the coil is constant*. If the latter condition held good for the 10 cm. disc, the pressure would increase above middle C, and at 2,048 cycles would be 35 per cent. greater than at 256 cycles.

TABLE I.—Accession to Inertia of Vibrating Disc, 10 cm. Radius (8 ins. Dia.), at Various Frequencies.

Frequency Cycles per sec.	Mass of Disc (Grams).	Accession to Inertia. M_1 Grams.	Total Mass. (Grams.)
32	10	3.5	13.5
64	10	3.5	13.5
128	10	3.5	13.5
256	10	3.5	13.5
512	10	2.6	12.6
1,024	10	1.2	11.2
2,048	10	0.1	10.1
4,096	10	Negligible	10.0
8,192	10	,,	10.0

This brings us to the next point, namely, the value of the current in the moving coil at various frequencies. Now there are two types of coil construction: (a) without transformer, in which case the coil resistance is what is commonly known as "high"; (b) with transformer, in which case the coil resistance is "low." Leaving alone a discussion of the type to be employed for the moment, suppose we choose a high-resistance coil. Then it can be shown that the circuits of Fig. 1 (a, b) are equivalent *when the coil is in motion*. Fig. 1 (b) can be further simplified when single frequencies are being considered, as shown in Fig. 1 (c). Here we have ρ the internal A.C. valve resistance, in series with L_o, the static A.C. inductance, and R_o, the static A.C. resistance of the coil (coil at rest), a condenser C_m, equivalent to the motion of the coil in the magnetic field, whence a back E.M.F. is induced, and lastly R_m, a resistance equivalent to the energy radiated as sound and also existing in virtue of the back E.M.F. due to motion. The values of C_m and R_m depend upon the mass of moving parts, strength of magnetic field, turns on coil, frequency, and size of diaphragm. They both vary with the frequency. The calculation of C_m is quite simple, but R_m is more complex. Since R_m is never more than about 2 per cent. of the total resistance in circuit, it will

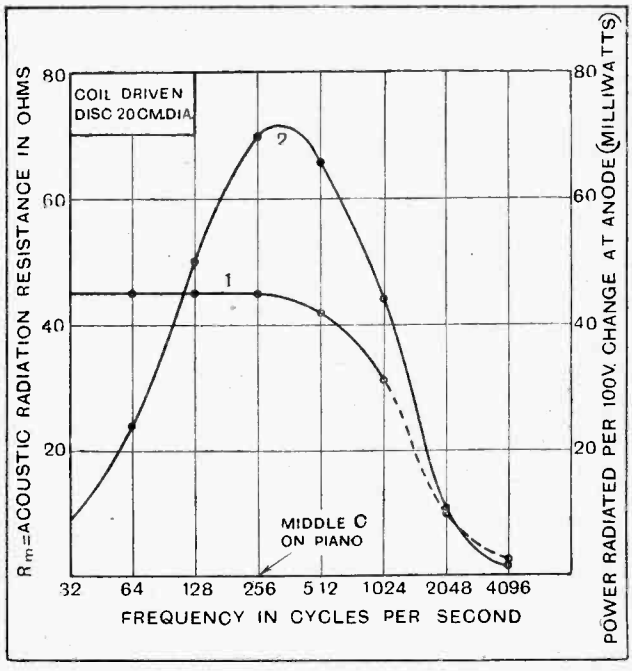


Fig. 4.—Curve (1): Acoustic radiation resistance. Curve (2): Power radiated as sound. If the current were constant at all frequencies the power radiated would follow a curve of the same shape as (1), since Power=$R_m I^2$ and I^2 is constant.

not be treated in detail. C_m, the motional capacity in microfarads, is approximately given by $\frac{m \times 10^{15}}{C^2}$ where $m = M + M_1 +$ mass of coil, and $C = \pi dn H$ where $\pi dn =$ total length of wire in coil and H = strength of magnetic field in lines per square centimetre. For example, suppose we take the following data, based on an actual design: $d = 5$ cm. dia., $n = 1{,}000$ turns, $H = 10{,}000$ lines per square centimetre, mass of coil 5 grams. Taking $m = M + M_1 = 13.5$ grams, from Table I, and adding the mass of coil, we get the total mass $m = 18.5$ grams. $C = \pi \times 5 \times 1{,}000 \times 10{,}000 = 5\pi \times 10^7$. Thus $C^2 = 2.5 \times 10^{16}$ and the motional capacity $C_m = \frac{m \times 10^{15}}{C^2} = \frac{18.5 \times 10^{15}}{2.5 \times 10^{16}} = 0.74$ micro-

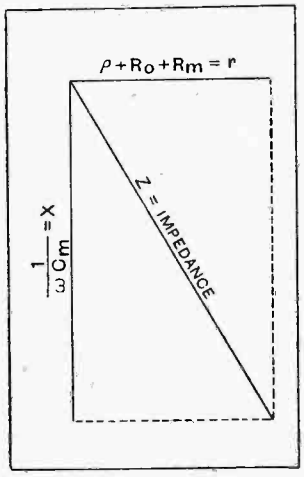


Fig. 2.—Vectorial calculation of coil impedance given C_m. X=4,300 ohms; r=4,500 ohms; and Z=5,000 ohms.

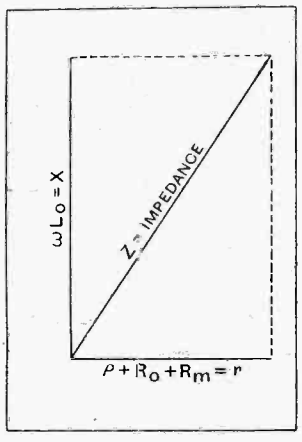


Fig. 3.—Vectorial calculation of coil impedance given L. X=3,800 ohms; r=2,500 ohms; and Z=4,500 ohms.

Coil-driven Diaphragm Loud-speaker Design.—

farad. At 50 cycles the impedance of this condenser is about 4,300 ohms. Neglecting the inductive reactance, which is quite small, at 50 cycles, and assuming the coil and valve to have a total A.C. resistance of 2,500 ohms, we have two components at 90°, as shown in Fig. 2. The impedance Z of the circuit is now 5,000 ohms, which is greater than the ohmic resistance by 2,500 ohms. This is due to the motional capacity arising from the back E.M.F. induced in the coil, due to its motion in the magnetic field. At electromechanical resonance, which occurs when $\omega^2 L_o C_m = 1$, where L_o is the A.C. inductance of the coil, the impedance is 2,500 ohms, this being resistive. In the present case, taking L_o as 0.15 henry, we find that resonance occurs when $f = 500$ cycles. The current at this frequency has its maximum value (apart from a slight effect due to radiation resistance variation, which can be neglected), but the current curve is very flat. At 4,000 cycles

TABLE II.—Current in Moving Coil at Various Frequencies.

f Cycles.	Z Ohms.	R.M.S. Current per 100 V. Milliamps.
50	5,000	20
450	2,500	40
4,000	4,500	22

the capacity reactance can be neglected, but the inductive reactance is now 3,800 ohms. The impedance of the circuit is found as before (see Fig. 3), by combining the resistive and reactive components, which are at right angles. The value of Z is now 4,500 or about 500 ohms less than it is at 50 cycles. Taking the A.C. voltage V on the anode of the valve as 100, the currents at the

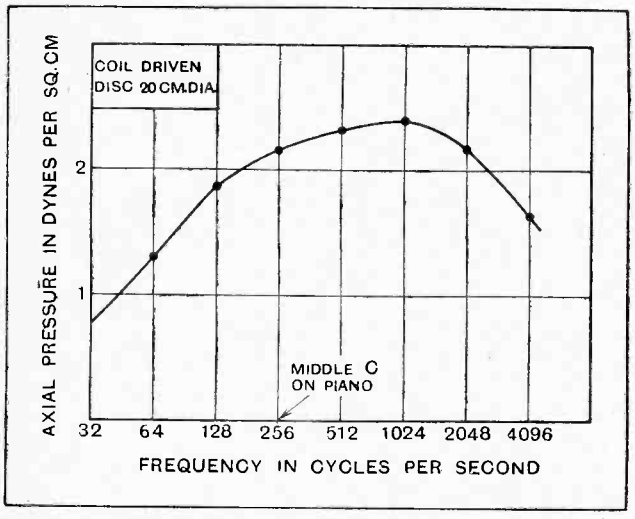


Fig. 5.—Axial air pressure at a distance of 10 metres from disc. The pressure at a point the radius vector of which makes an angle θ with the axis is given by the ordinate of this curve multiplied by a factor depending on f and θ. The curve falls away on the left due to added air inertia and motional capacity and on the right due to inductive reactance.

three frequencies under consideration are given in Table II, the current at any frequency being, of course, $\frac{100}{Z}$. To find the current at, say, V = 30 volts, it is merely necessary to multiply the figures in the third column by 0.3. Now the air pressure depends upon the value of the current. Thus there is a 50 per cent. reduction at each end of the scale, due to the motional and inductive reactance of the coil. If, however, we made the valve resistance 4,000 ohms, the reduction in current would be only 20 per cent., which is of much less account acoustically.

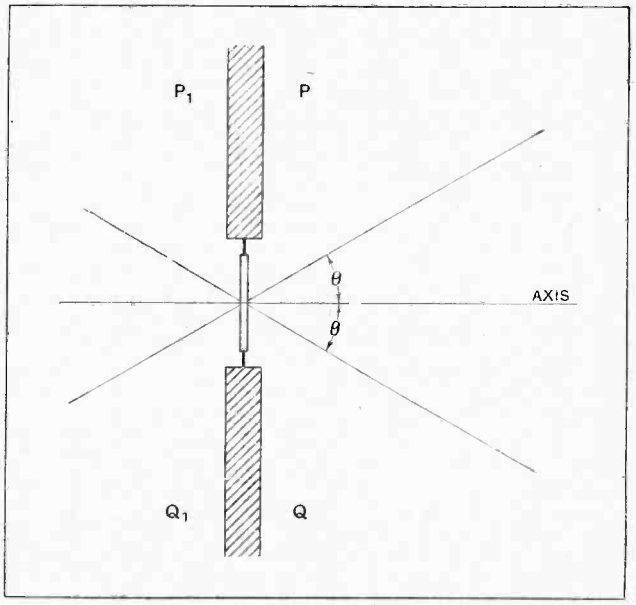


Fig. 6.—Interference effects at high frequencies reduce the air pressure at points PP_1QQ_1, as compared with points along the axis.

In calculating the current in the moving coil at high frequencies we have assumed the A.C. resistance and inductance of the coil to be constant. This does not hold in practice, because the resistance increases whilst the inductance decreases, due to the increased eddy current effect in the pole faces of the magnet. The values will doubtless depend upon the current in the moving coil. Some data taken by a bridge method, using a small current (telephonic measurements) are given in Table II. This applies to a 50-turn coil about $\frac{1}{4}$in. long and 2in. in diameter. The direct current resistance was 8.7 ohms. It will be seen that the variation in resistance and inductance are by no means negligible. It must be borne in mind that these data were taken with much smaller currents than those used in practice.

TABLE III.—Showing Variation in Inductance and Effective Resistance of a Moving Coil situated in Magnet Pot (unless otherwise stated) with Magnetic Field full on.

f.	A.C. Resistance (Ohms).	A.C. Inductance (Micro-henries).	Added Resistance Due to A.C.	Inductance Out of Pot (Micro-henries).	Remarks.
1,000	10.5	625	1.8	315	L_o and R_o decrease with magnetic field off at 1,000 cycles by 50 μH and 0.3 ohm respectively. With field on L_o varies with position of coil, R_o almost constant.
2,000	11.5	550	2.8	—	
3,000	12.2	470	3.5	—	
4,000	13.0	430	4.3	—	

Focussing Effects at High Frequencies.

Our next consideration is that of the acoustic performance of the diaphragm, including that of the air pressure

Coil-driven Diaphragm Loud-speaker Design —

in the space into which the diaphragm discharges. In a recent article the focussing effect at high frequencies was discussed, and it was shown that owing to interference the power radiated decreased after a certain frequency was reached.[1] In Fig. 4 is shown the acoustic radiation resistance R_m plotted against frequency for the 1,000-turn coil and 10 cm. disc; also the power radiated at various frequencies, this being $R_m I^2$, where I is the R.M.S. current in the coil. It is clear that the power falls off at both ends of the acoustic register, but particularly at the upper end. This is due to the focussing effect arising from interference. It is important to observe, however, that although the power radiated decreases owing to the absence of radiation in the regions making a large angle with the axis (Fig. 6), the energy *on the axis of the diaphragm*, several diameters distant, is unaffected. In other words, the focussing does not interfere with the axial air pressure some distance (say 8 diameters) from the diaphragm.

Calculation of Air Pressure.

This is portrayed in Fig. 5, which shows the axial pressure at various frequencies. The pressure some distance from the diaphragm is given by the formula $p = \frac{\rho a^2 b}{2d}$ where ρ = density of air $= 1.3 \times 10^{-3}$ gm. per c.c., a = radius of disc, b = axial acceleration of disc due to coil, d = distance of point from disc. Thus the pressure is directly proportional to the acceleration of the disc and inversely proportional to the distance. At a fixed point, therefore, the pressure depends upon the acceleration of the disc. The latter depends upon the current in the coil and the mass of the moving parts, including the inertia component, at low frequencies. If both current and mass were constant, the axial pressure would also be constant. But increased mass and decreased current at low frequencies, and reduced current at high frequencies, are responsible for the shape of the curve of Fig. 5.

We have tacitly assumed that the sound wave progresses without loss of energy. In air, as in other media, there is a transmission loss resulting in attenuation of the air pressure with distance. This, of course, has been left out of account, because it is not serious in the vicinity of the diaphragm. Furthermore, it is clear that there must be no reflection of the sound from walls, etc., so that the data apply exclusively to a perfectly damped enclosure or to the propagation of sound in the open air free from external interference.

Relation between Focussing and Radiation Resistance.

The frequency at which focussing begins is sensibly that where the radiation resistance begins to fall away. In this case it occurs at about 500 cycles per second. The air pressure at points away from the axis will not be considered now, but it may be stated that the pressure is given by the same formula as before, multiplied by a factor depending upon the angular distance from the axis and upon the frequency. For our 10 cm. radius disc it is of interest to observe that at a frequency of 4,000 cycles the air pressure is zero when $\theta = 30°$ (see Fig. 6). For angles greater than 30° the pressure has a series of zero values, but between these zeros its magnitude never exceeds about 13 per cent. of that on the axis. From the axis to $\theta = 30°$ the pressure gradually decreases. Thus for all practical purposes we can say that at some distance from the diaphragm the sound at 4,000 cycles is confined to a beam having a total angle of 60°. As the frequency rises the beam becomes narrower, and at 10,000 cycles it is only 11.5°—a veritable rival to the narrow beams of transoceanic short-wave wireless.

It should be observed that there is a falling away of power and pressure in the lower or bass register, but it is far less marked than with the average horn type instrument. In any case, unless an adequately large baffle is used it is not worth worrying about frequencies as low as 32 cycles. The size of the diaphragm is an important factor in various ways, and there is an optimum size. The conditions, however, are so complex that it is difficult to define concisely what is meant by "optimum." As judged by ear, energy output depends upon the band of frequencies embraced. For example, a flat diaphragm, 12in. diameter, would radiate much more energy over a range of 50 to 4,000 cycles than a diaphragm 4in. diameter driven with our present coil. But the latter diaphragm would probably appear to be louder (excluding resonances), because it emits more energy at frequencies where the ear is most sensitive. For the present, therefore, we will say that "optimum" implies the maximum output on a piano, an organ, or an orchestra, the scale being well balanced, and the reproduction, although loud, not causing irritation.

High- versus Low-resistance Coils.

We now arrive at an important and polemical issue, namely, whether we should use a high-resistance coil or a low-resistance coil with a transformer. There are two

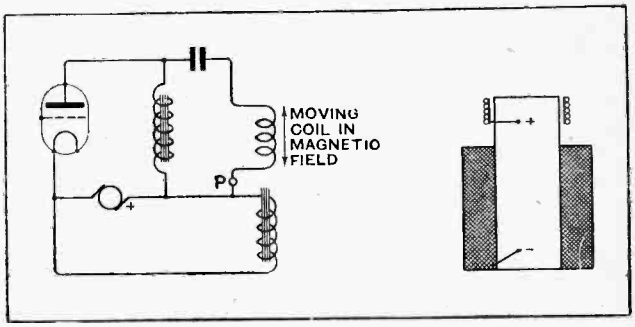


Fig. 7.—Diagrams showing risk of short circuit when using mains to energise field magnet and also for H.T. to power valve.

salient aspects of the subject: (1) commercial, (2) scientific. With a high-resistance coil of reasonable radial thickness, so that the air gap in the magnet is not excessive, the size of wire will not usually exceed No. 46 S.W.G. enamelled. Wire of larger diameter means reduced output owing to the smaller number of turns on the coil. The readers of this journal are doubtless well acquainted with the performance of fine wire in the anode circuit of a valve, whether a D.C. blocking condenser is used or not. The usual result in the long run is a breakdown. Against this, however, we must record the fact that the majority of loud-speakers have high-resistance

[1] *The Wireless World*, March 23rd, 1927

Coil-driven Diaphragm Loud-speaker Design.—

windings of fine wire. Owing, however, to the smaller inductance of the loud-speaker, there is less liability to breakdown due to voltage kicks on switching off than in the case of a transformer. Unless the coil is skilfully wound and properly varnished it may be mechanically weak. When an electromagnet is employed it is usual to energise it from the mains. In general, the D.C. feed to the power valves will also be obtained from the mains. Looking at Fig. 7 we see that if the magnetising winding and the moving coil become "earthed" to the pot, the H.T. mains will be short-circuited. This difficulty can be surmounted in several ways which will be given later. So much for the commercial aspect of high-resistance coils.

With a transformer the wire used for the coil is larger and can be silk covered. This is a much easier winding proposition, which lends itself to greater mechanical rigidity and possibly to a coil of smaller mass. The transformer primary is subject to the anode current (D.C. or A.C., or both, according to connections) of the power valve, but the wire can be made of heavier gauge than the high-resistance moving coil, since mass and space are of less account. If the transformer breaks down, it is more readily repaired than the moving coil. To repair the latter usually means making a new diaphragm also. With a transformer the insulation between the anode circuit and the coil can be made quite safe, so that there is no fear of short-circuiting the H.T. mains when the electromagnet and the receiver are energised therefrom. The transformer enables long leads to be used, if necessary, between the speaker and the primary, so that the H.T. is not wandering all over the place. (Of course, this should not be done unless it is imperative.) Also the capacity of the leads has little effect owing to the low voltage of the coil circuit. Unless the leads are inductive there is little attenuation of the higher frequencies.

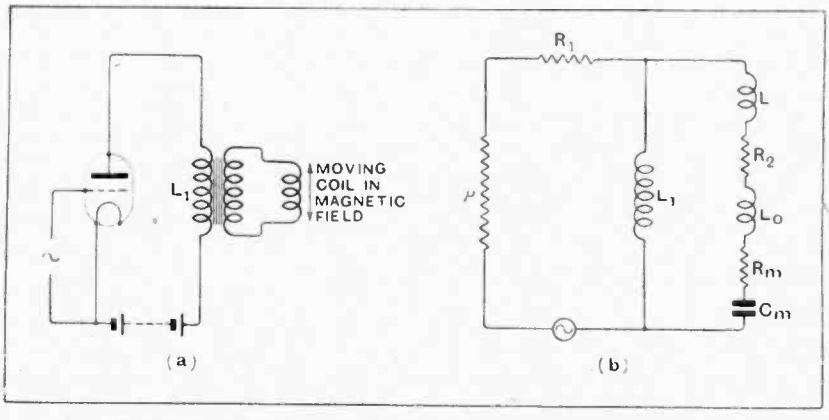


Fig. 8.—Equivalent circuit of moving coil with transformer coupling to the power valve. ρ=A.C. resistance of valve; R_1=A.C. resistance of primary; L_1=inductance of primary; L=equivalent leakage; R_2=equivalent secondary resistance including coil; L_o=equivalent coil inductance; R_m=equivalent radiation resistance; C_m=equivalent motional capacity. The self-capacity of the windings is neglected.

Scientific Aspects of Coil Resistance.

So far it is quite clear that the transformer wins commercially. Now we come to the scientific side to examine the relative acoustic reproducing merits of the two contestants. The boot will tend to be on the other leg. Consider the circuit of Fig. 1(c). If $\rho + R_o$ is constant and relatively high, then the reactance of the motional condenser C_m at low frequencies and that of the inductance at high frequencies will not increase the impedance of the whole circuit to any extent from, say, 50 cycles to 7,000 cycles. To arrive at this condition it is necessary to sacrifice output, and in general it is usual to compromise. But in many cases the top or the bottom end of the register, or both, receive some boost from diaphragm resonance. Moreover, the problem resolves itself into one of balancing the coil and the diaphragm to get a fairly uniform response throughout the register. There is one point which ought to be mentioned. We often hear of matching a loud-speaker to a valve. So long as the impedance of the apparatus does not vary with the frequency, this can be done, but such a condition does not hold for the coil-driven loud-speaker. Thus, the term matching as applied to the speaker is a misnomer, unless it is applied to a certain band of frequencies where the coil impedance is substantially constant.

When the valve resistance is reduced the intensity increases, due to the greater current, but with a really low resistance there is a rounding off at both ends of the acoustic register which is quite noticeable if the coil has too many turns.

The scientific side of the transformer is more difficult. If the transformer were perfect, and had neither leakage, capacity, nor resistance, the issue would be identical with that of the high-resistance coil. This ideal we know cannot be enjoyed. The simplest way to deal with the transformer is to substitute the equivalent circuit shown in Fig. 8 (b), which is on the lines indicated by Fig. 1 (c). Again, the radiation resistance is placed in series with the condenser C_m. We have here two component parts to consider: (1) the internal A.C. valve resistance in series with the effective primary resistance, (2) a parallel combination of the primary inductance in one limb, and the equivalent leakage, equivalent coil inductance, resistance, and motional capacity constituting the other limb. Compared with Fig. 1 (c), this is a complex circuit and one which requires careful analysis. At low frequencies, unless the primary inductance L_1 is large, the major part of the current will flow through L_1, since the impedance of C_m is high. In other words, a low primary inductance means a large magnetising current to get the necessary secondary voltage. Thus the low-frequency coil current is reduced. At high frequencies the reactance of L_1 is large, and the current flows chiefly through the coil circuit. Now, in a transformer there is always a certain amount of leakage, say 1 per cent. If, therefore, the primary inductance is 15 henries, the leakage inductance will be 0.15 henry, or about equal to the equivalent inductance of the average coil. In other words, the leakage doubles the coil inductance, and therefore reduces the high-frequency current. Here we have two mutually opposed features to consider: (1) high pri-

Coil-driven Diaphragm Loud-speaker Design.—

mary inductance is essential for low frequency, (2) low primary inductance is essential for high frequency. Hence we must compromise and strike a mean, for we cannot have both high and low frequencies in full force. It often happens that diaphragm resonances in the upper register permit a larger primary inductance to be used. Moreover, a variable ratio is useful, because a lower ratio will reduce the equivalent values of the coil constants. At large intensities the value of L_1 increases owing to increased permeability of the iron due to greater current in the primary.

There are two resonant circuits in Fig. 8: (1) the circuit comprising valve resistance, primary resistance, leakage, coil inductance, and motional capacity. This resonance usually occurs in the middle register, but is inevitable and unimportant. (2) The parallel circuit of the primary and the leakage motional capacity, etc. This gives a low-frequency resonance, and will help the bass, but its magnitude and flatness are such that, in general, it is not serious.

Effect of Valve Resistance.

So far as the internal A.C. valve resistance is concerned, it can be shown that the shunting effect of L_1 at low frequencies is greater the higher the valve resistance. Hence the coil current is appreciably reduced unless the conditions are such that large currents are flowing through the circuit (large intensity and H.T. volts). So far as high tones are concerned, the reactance of L_1 is so high that the current is mainly in the coil circuit. Low valve resistance will, therefore, help the bass, but, owing to coil and leakage inductance, the upper register may be impaired due to reduced current. In general, however, there is no lack of high tones, but they are not always of the orthodox variety. A compromise can be effected by reducing the transformer ratio.

Although low valve resistance is beneficial, so far as the primary inductance is involved, there is also the motional impedance of the coil, which reduces the low-frequency output under this condition. Thus we have two contending factors, viz.: (1) by-passing by L_1, which requires a low-resistance valve; (2) motional and inductive reactance, which requires a high-resistance valve to keep up the coil current.

The constructor would do well to look after the bass register first and use a primary of fairly high inductance and moderate ratio. The leakage must be as small as possible, and this is accomplished by sectionising and sandwiching the windings. The self-capacities of the windings have been omitted, because they are of little account in comparison with other features. They make for more resonant circuits at higher frequencies. There is also loss due to the iron and the copper of the primary winding which is absent with a high-resistance coil. Finally, there is the distortion arising from hysteresis in the iron core plates of the transformer. Whether the transformer is operated in the anode circuit of the valve or with a blocking condenser, as shown in Fig. 9 (c), there will be hysteresis effects. The variation in flux density is appreciable, since we are now dealing with a power transformer, and alien tones of triple, quintuple, etc., frequency will be created. These tones will appear to give the reproduction a good upper register. With large amplitudes and a blocking condenser the iron is being worked right down to the bottom bend, and there is certainly going to be alien tones, which may be accentuated if the upper knee of the curve is reached. With moderate amplitudes a compromise could be effected by setting the iron on the middle of its B.-H. curve with the anode polarising current. But is it worth while?

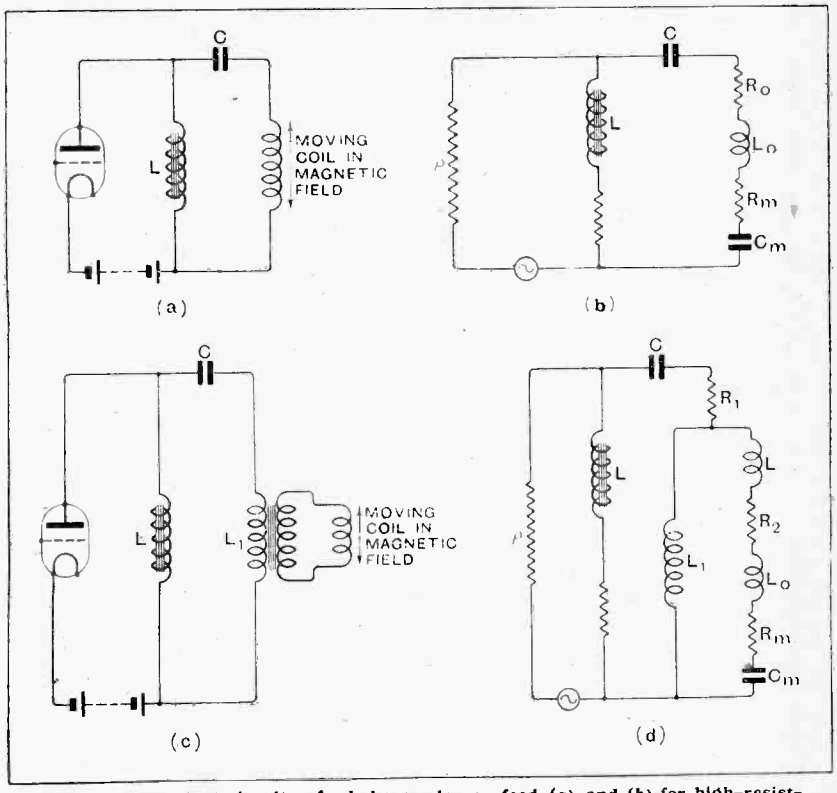


Fig. 9.—Equivalent circuits of choke-condenser feed (a) and (b) for high-resistance coil, and (c) and (d) for low-resistance coil with transformer.

The equivalent circuits in Figs. 1 and 8 are based on the assumption that the anode feed passes through the moving coil or through the transformer primary. It is, however, usual to employ a choke condenser feed, as shown in Fig. 9. Unless the values are carefully chosen, resonances will occur in the audible frequency register due to the inductance, the by-pass condenser, and the motional capacity of the moving coil. For example, in Fig. 9 (b) let $L = 15$ henries, $C = 4\mu F$, $C_m = 0.7$ mfd. Then, since C and C_m are in series, their sum is 0.6 mfd., and the resonant frequency is just over 50 cycles, but may not be serious. The same argument applies to transformer coupling where choke-condenser feed is used (see Fig. 9 (c), (d)).

AUSTRALIAN BEAM SERVICES.

Description of the Grimsby and Skegness Stations.

IT is officially announced that the short-wave beam stations which the Marconi Company have built for the General Post Office at Grimsby and Skegness for communication with Australia have successfully passed their seven days' test, having more than fulfilled the conditions required during that period. These stations will therefore be taken over from the Marconi Company by the Post Office in the near future, and will be used for direct communication between England and Australia "*via* Empiradio." The beam system has thus proved itself over the longest distance that any telegraph service can be called upon to cover.

Duplex Working at 300 Words a Minute.

The power used is only 20 kW. as compared with something like 1,000 kW. that would be required if the long-wave system were used to cover the same distance. Owing to the short wavelength employed, the speeds obtained by the beam system are also in excess of those possible by means of long waves. The guarantee called for by the Post Office provided for a speed of 100 five-letter words per minute in each direction (exclusive of any repetitions necessary to secure accuracy), for an average of seven hours per day during the period of the test. While, apparently, no attempt was made to push the speed as high as that attained during the preliminary tests, when over 300 words a minute were transmitted, it is learned that during the tests traffic was occasionally dealt with at speeds of 225 words per minute, and high-speed simultaneous two-way communication was carried out during the seven days for an average period of over 13 hours per day.

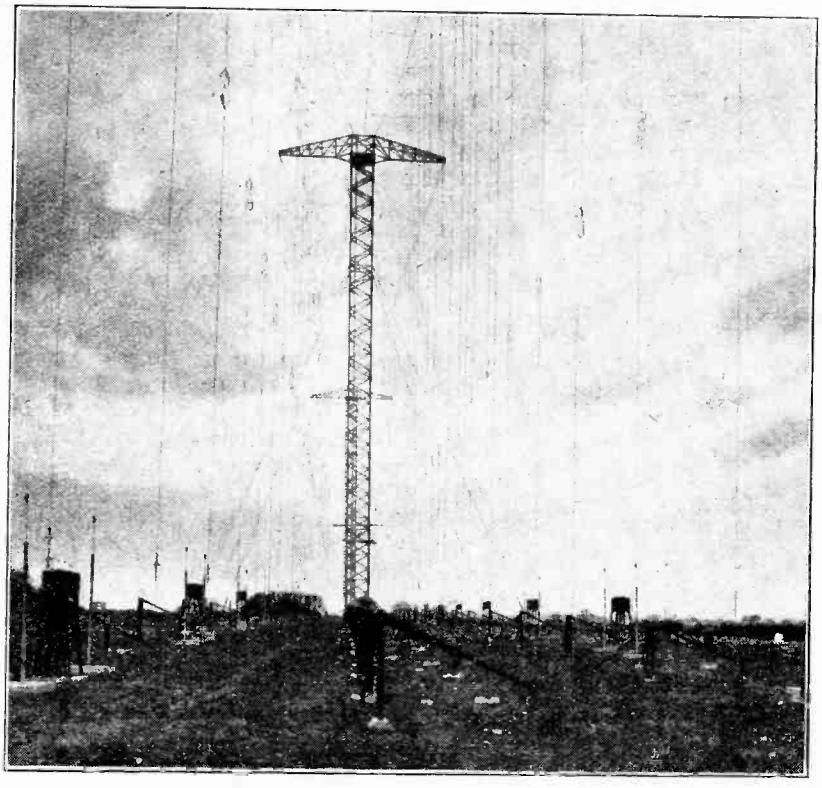
The actual speed of working for the hours during which communication was effected is estimated to have been 148 five-letter words per minute, and the total amount of traffic handled worked out to an average of well over 100 words a minute throughout the 24 hours.

The stations are similar to those at Bodmin and Bridgwater, which are used for communication with Canada, and which were described in *The Wireless World* of November 3rd last, shortly after the Canadian Service was opened. The difference is one of detail only. For instance, the masts for the Australian Service are 260ft. in height, as compared with 287ft. for the Canadian Service. Three masts only are employed for the Australian stations, because only one wavelength—approximately 26 metres—is used. The Australian service, however, is conducted round the world in two ways, eastward and westward. There is, therefore, an aerial system on either side of a central reflector, instead of a single aerial and reflector as in the Canadian stations. Either of these aerials can be energised according to the direction in which transmission is required, and the single reflector between them is effective in both cases.

The Path of the Beam.

This arrangement has been made as a result of the experience gained by Senatore Marconi when carrying out his preliminary beam tests with Australia at the beginning of 1924. It was then found that the position and altitude of the sun had an effect upon the transmission of signals, and that during the morning period the waves travel from England to Australia in a westerly direction, across the Atlantic and Pacific Oceans, following the great circle along the longest route, approximately 12,000 nautical miles. During the evening period they travel in an easterly direction, over Europe and Asia, following the great circle along the shortest route, which is about 9,000 nautical miles.

According to the requirements of the service, one or other of the aerials is energised by the transmitter, and the reflector concentrates the energy in either an easterly or

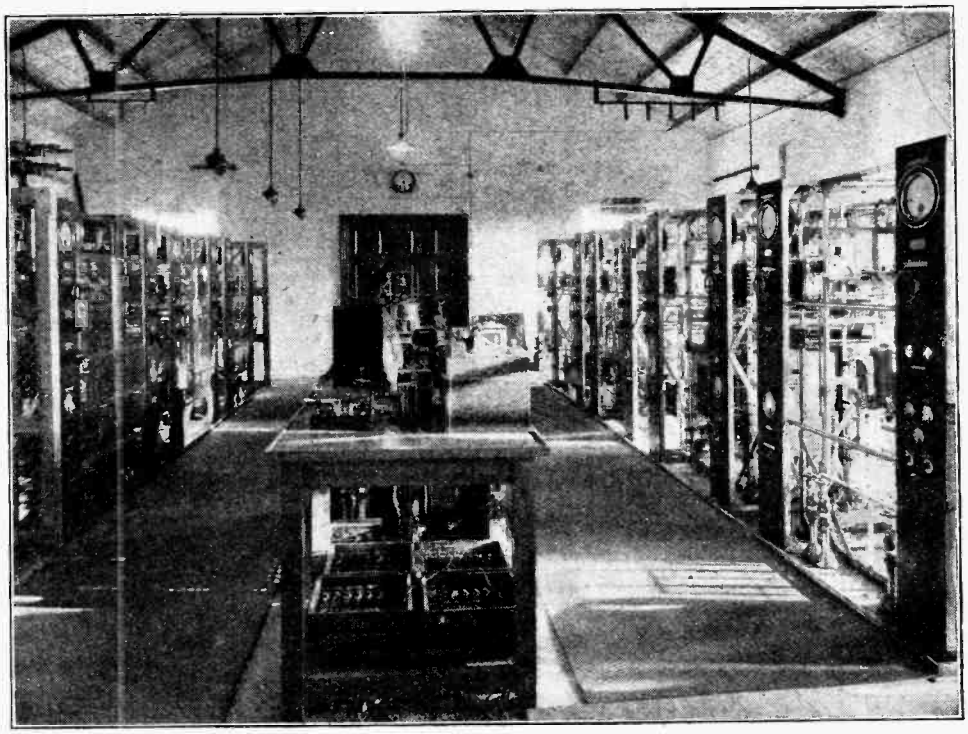


BEAM AERIAL AT GRIMSBY.—The unusual mast system is employed to support both the aerials and reflectors, the wavelength used being about 26 metres.

Australian Beam Services.—

westerly direction, depending upon which aerial system is being used. Each active aerial consists of 32 vertical wires in all, and the reflector of 64 wires. Each aerial system has its own distinct feeder system, which runs in front of the aerial and then branches out and splits up into smaller branches with a separate branch for each aerial wire. The construction of the aerial, reflector, and feeder system is exactly the same at the receiving station at Skegness, the only difference being that the operation takes place in the opposite direction, received signals being intercepted by the aerials and passed through the feeder system to the receiving apparatus.

As already stated, a power of 20 kW. is employed, which is the same as is employed at the Bodmin station for the Canadian service. Only three valve panels are fitted to the transmitter on the Australian service, as compared with four in the case of the other beam transmitters, this being due to the fact that only one wave is being used for communication with Australia, whereas arrangements have been made in the other cases to transmit on two different wavelengths.



THE GRIMSBY STATION.—The set on the left is for communication with Australia, and that on the right, which is arranged for working on two wavelengths, will shortly be used for duplex communication with India. Only one wavelength is used on the Australian service, duplex working being obtained by directing the beam in opposite directions around the earth.

Location of Transmitters and Receivers.

The actual situation of the transmitting station is in the village of Tetney, six miles south-east of Grimsby, and the receiving station is at Winthorpe, two miles north of Skegness.

Land lines connect the transmitting and receiving stations to the Central Radio Office at the General Post Office in London, from which the transmitter is automatically operated, the operator in London being in full control. In Australia the transmitting station is at Ballan, near Ballarat, Victoria, 50 miles north-west of Melbourne, and the receiving station at Rockbank, near Sydenham, 15 miles from Melbourne.

As in the case of the Canadian and South African services at Bodmin and Bridgwater, the sites at Grimsby and Skegness are utilised for the operation of two services, in this case with Australia and India. The Indian transmitter at the Grimsby station is arranged for transmission to India on two wavelengths of approximately 35 metres and 16 metres, one of these wavelengths being intended for night-time communication and the other for daylight communication. In the case of the India service, where two wavelengths are employed, there are, of course, five masts supporting two separate aerial systems, and in this case the height of the masts is 287ft.

The other details of these stations are similar to those described in connection with the Bodmin and Bridgwater stations, and therefore need no further elaboration here. It is expected that the Indian stations will be completed within the next few months. The call letters of the Grimsby transmitting station for the Australia service are GBH and for the India service GBI.

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.

Beginners' Difficulties.

Another of the series of evenings devoted to beginners' difficulties was held recently by the Golders Green and Hendon Radio Society, the subject under discussion being "Circuits." The opening speaker was Mr. J. C. Bird, B.Sc., who first took his audience back to the early days of radio. Brief reviews were then given of the "T.A.T.," Reinartz, superheterodyne, and the modern neutrodyne circuits. An interesting digression was made by Mr. Bird in dealing with H.F. transformers. He showed the progress made from the old plug-in type to the Litzen-wound transformer used in *The Wireless World* "Everyman Four." The instructive discussion which followed proved the value of an evening of this kind.

A syllabus of activities for the current session, together with full particulars of the society, 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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The "Despised Amateur."

The Radio Experimental Society of Manchester recently gave a farewell dinner to their late chairman, Mr. E. Butterworth, B.Sc., who is taking up a position in Ireland. Responding to the toast, Mr. Butterworth assured the society of his continued interest in their activities and said that he would always be pleased to collaborate with the members in their experiments. The treasurer, Mr. H. Frearson, on behalf of the society, then presented Mr. Butterworth with a clock in token of their esteem. Mr. G. Blake, of Messrs. Radions, Ltd., in paying a tribute to the work of the society, said that the so-called "despised amateur" was not so despised by the trade, as it was recognised that the amateur was doing great work.

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

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New Quarters at Hounslow.

The Hounslow Wireless Society devoted an entire evening recently to "finding its feet" in the new headquarters.

At the conclusion of a somewhat strenuous but exceedingly interesting evening much useful information had been collected. There was a general feeling of relief when it was ascertained that the negative side of the lighting mains was earthed, many members having experienced a certain amount of confusion in the past when carrying out experiments with a "live" earth. A temporary outside aerial was erected, and the new situation was found to be ideal for the reception of distant stations, many German stations being tuned in on the loud-speaker by means of a 0-v-2 resistance-coupled receiver. Only one unfortunate circumstance was found to exist, viz., it was impossible to use a microphone successfully owing to enormous echo.

The apparatus used was kindly provided by Mr. Osborne.

Hon. secretary: Mr. W. R. Collis, 7, Algar Road, Isleworth.

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Valve Making in the Club Room.

"The Trend of Valve Design" was the title of an unusually interesting lecture and demonstration given at the last meeting of the Muswell Hill and District Radio Society by a member, Mr. F. E. Henderson, A.M.I.E.E., of the General Electric Co., Ltd. One of the most interesting demonstrations occurred when Mr. Henderson took an unfinished valve and, in full view of the audience, put it through various processes, producing a modern dull emitter. The process of "gettering" was first demonstrated, and it was shown how the magnesium on the plate adhered to the glass walls, silvering the glass and combining with the gas molecules to produce a high vacuum. The valve was then "flashed," *i.e.*, run at high L.T. voltage, causing the oxide thoria in the filament to change to metallic thorium. The filament was finally "formed" for 60 seconds and run at a lower temperature.

A syllabus and membership form can be obtained by return of post from the Hon. Secretary, Mr. Gerald S. Sessions, 20, Grasmere Road, Muswell Hill, N.10.

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Mains Units *v.* Batteries.

"The Design of an A.C. Mains Unit" was the title of a lecture given by Mr. L. H. Crowther, A.M.I.E.E., to the members of the Sheffield and District Wireless Society on the 18th inst. A comparison of cost over a period of three years between dry batteries, accumulators and an H.T. unit was made which clearly showed that the use of large-capacity dry batteries was uneconomical.

After describing the functions of the step-up transformer, rectifier, filter and potential divider which comprise the complete H.T. unit, the lecturer gave details for a suitable design which has been in use for the last nine months with very successful results.

A demonstration of this particular unit was afterwards made by coupling it to a three-valve (0-v-2) receiver, the anode current of which was 20 milliamps. Good reception with no trace of hum was found to be possible even when listening with the phones.

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

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The Rice-Kellogg Demonstrated.

A successful demonstration of the possibilities of the Rice-Kellogg loud-speaker was given before a gathering of members of the Halifax Wireless Club on Wednesday, March 16th.

Mr. James R. Clay—one of the founders of the club eight years ago—who was the lecturer, preceded the demonstration by some notes on "Amplification," which were the result of his individual research in this line. Owing to local electrical disturbances, the Rice-Kellogg speaker was used to reproduce gramophone records of the instruments of an orchestra played separately, and all present were surprised to hear such faithful reproduction, which marks a decided step forward in loud-speaker amplification.

FORTHCOMING EVENTS.

WEDNESDAY, MARCH 30th.

North Middlesex Wireless Club.—At Shuttesbury Hall, Bowes Park, N.11. *Lecture:* "Broadcast Engineering and Breakdowns," by Mr. J. H. A. Whitehouse, of the B.B.C.

Muswell Hill and District Radio Society.—At 8 p.m. At Tollington School, Tetherdown, N.10. *Lecture and Demonstration* by Mr. L. Hirschfield, B.Sc. Also Loud-speaker Prize Competition.

Edinburgh and District Radio Society.—At 8 p.m. At 117, George Street. *Lecture:* "High-Frequency Measurements," by Mr. W. Winkler.

Barnsley and District Wireless Association.—At 8 p.m. At 22, Market Street. *Lecture:* "Simple Calculations and Uses of Various Measuring Instruments," by Mr. G. W. Wigglesworth.

FRIDAY, APRIL 1st.

Radio Experimental Society of Manchester.—*Lecture:* "Direction Finding," by Mr. S. Atkinson, B.Sc.

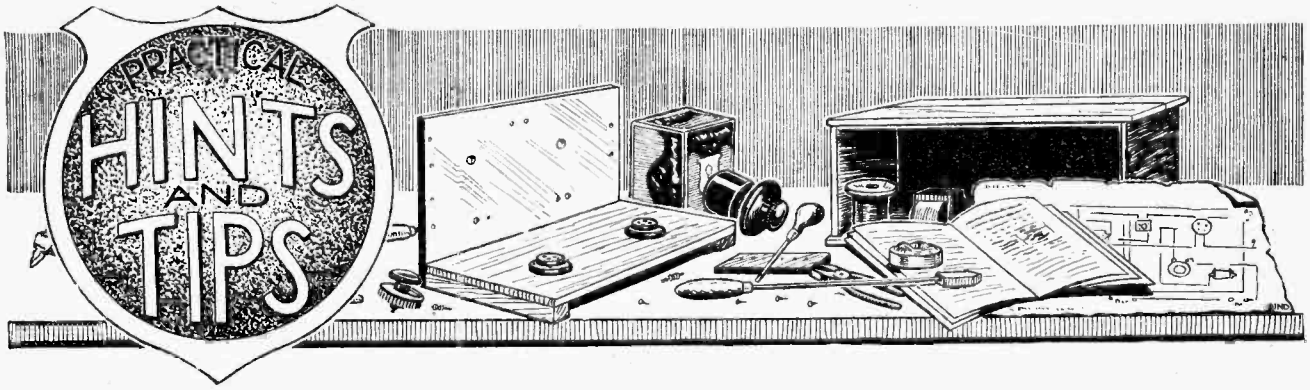
Leeds Radio Society.—At 8 p.m. At Collinson's Cafe, Leeds. *Lecture:* "Measuring Instruments," by Mr. A. F. Carter, A.M.I.E.E.

Sheffield and District Wireless Society.—At the Department of Applied Science, St. George's Square. *Lecture:* "Repeaters," by Mr. E. W. Cross.

MONDAY, APRIL 4th.

Northampton and District Amateur Radio Society.—At 8 p.m. At Cosmo Café, The Drapery. *Lecture:* "Rectilinear Propagation," by Mr. A. E. Turnillo.

Croydon Wireless and Physical Society.—At 8 p.m. At 128a, George Street. Evening of practical work.



A Section Mainly for the New Reader.

PORTABLE SETS.

A considerable amount of care must be devoted to the design and construction of portable receivers using high-frequency amplification; a circuit which will give good results with an open aerial will often be unstable when operated in conjunction with a frame. This is due, in part, to interaction between the frame and the H.F. transformer, which can be prevented only by more complete screening than is usually specified. Again, where compactness is of prime importance, there is always a tendency to reduce the spacing of components to a minimum, and, rather than risk probable trouble from instability, the less experienced amateur may well consider the adoption of a circuit without any form of high-frequency amplification other than that obtainable from reaction.

Providing that really critical control of regeneration is possible, the sensitivity of a detector-L.F. combination as shown in Fig. 1 is surprising, even when operated with a frame aerial small enough to be accommodated in an attaché case of medium size. The arrangement is a modification of the well-known "Hartley" circuit, using a centre-tapped frame.

Unless the control of reaction is really smooth, results will be disappointing from the point of view of range, and to attain this end every effort should be made to operate the detector valve to the best advantage. A potentiometer is included in order that grid voltage may be adjusted to a value giving a compromise between best detection and smoothest regeneration.

In a set of this kind, where light weight and compactness are important, the voltage of the H.T. battery may be low; about 30 volts will be sufficient. The circuit may be simplified still further by choosing valves of similar filament characteristics, so that they may both be controlled by a single rheostat or fixed resistor.

The range of the receiver is, of course, increased enormously by the connection of an aerial-earth system, as a frame is at best only a poor collector of energy. In order to provide for this addition, aerial and earth terminals may be fitted; the former will be joined to a point on the frame which is found by experiment to give best results (generally to the second or third turn on the "grid" side of the centre tap), and the latter to the negative low-tension lead.

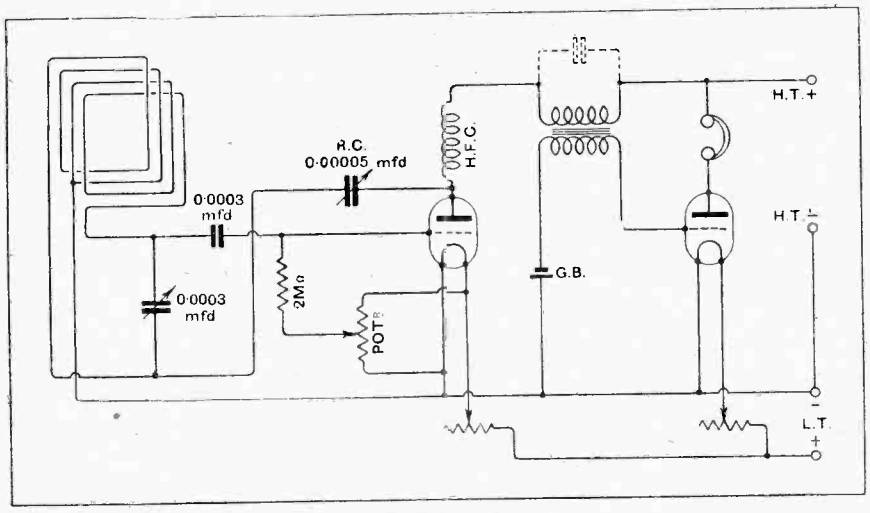


Fig. 1.—An effective portable receiver.

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BATTERY ELIMINATORS.

The effectiveness of the rectifying and smoothing devices incorporated in a battery eliminator may be checked by connecting a loud-speaker in series with a well-insulated condenser of up to 0.002 mfd. across the negative and positive output terminals. This should preferably be done while the normal current is being supplied to the valves, or otherwise results may be misleading.

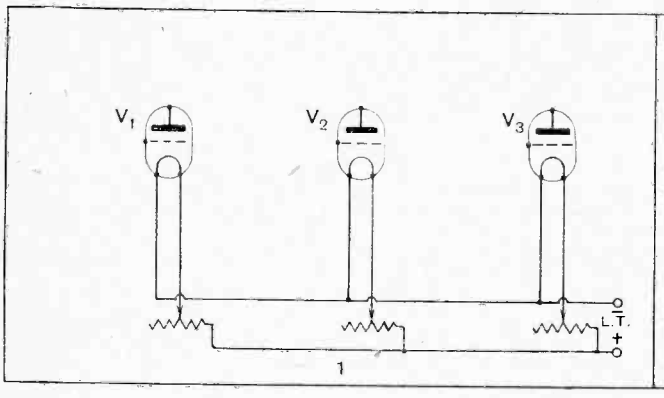
The effects of experimental alterations to the capacities of the smoothing condensers and the addition of extra chokes may be noted; the adjustment giving the least amount of "hum" in the loud-speaker is naturally the best. This method is particularly likely to be useful when alternative voltage outputs are available, as the one responsible for the greatest amount of interference may be located more easily than by connecting the eliminator direct to the set.

DISSECTED DIAGRAMS.

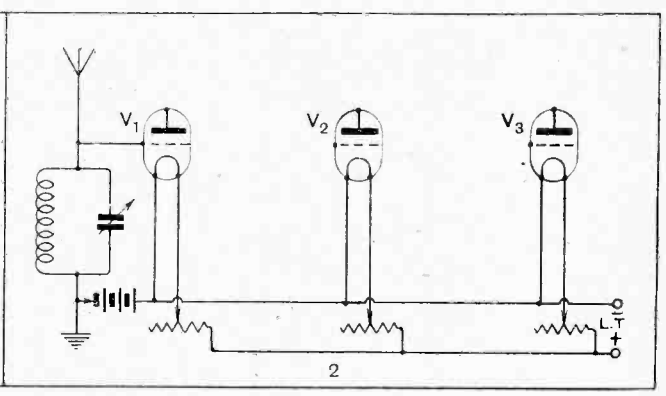
Practical Points in Design and Construction.

No. 65.—Anode Detector with Two Resistance-coupled L.F. Amplifiers.

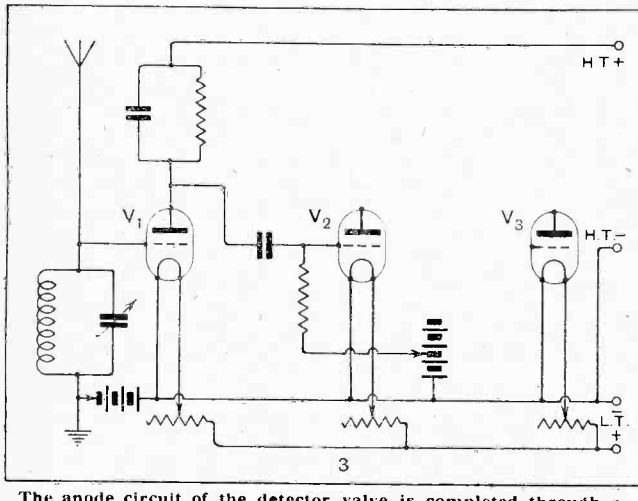
The present series of diagrams is intended to show progressively, and in an easily understandable manner, the various points to which special attention should be paid in the design of typical wireless receivers, and at the same time to assist readers in mastering the art of reading circuit diagrams. The arrangement shown below is capable of giving high quality reproduction at comparatively short ranges. Elaborations of this circuit will be discussed in next week's issue.



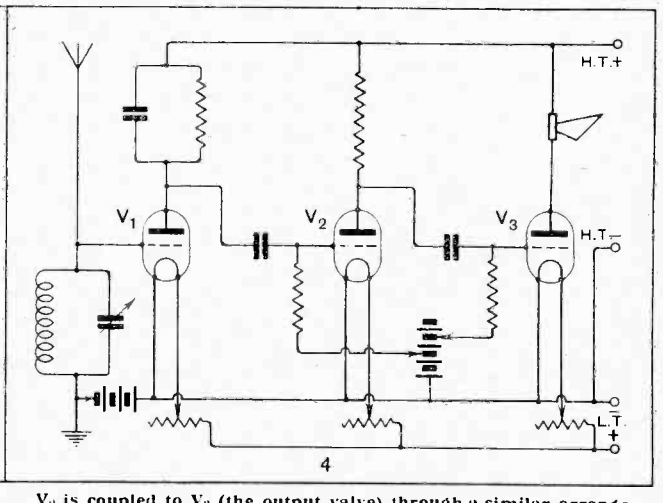
The filaments of three valves connected in parallel across an L.T. battery, with separate controlling rheostats.



A tuned aerial coil is connected across grid and filament of the detector valve, a bias battery being interposed.



The anode circuit of the detector valve is completed through a resistance (with shunting condenser) and the H.T. battery. L.F. voltages across this resistance are applied to the grid of V_2 through a condenser. The grid is biased negatively through its leak.



V_2 is coupled to V_3 (the output valve) through a similar arrangement of resistance and condenser. The anode circuit of the latter valve is completed through the loud-speaker (or a choke-filter or transformer) and the high-tension battery.

THE three valves, V_1, V_2 and V_3, function respectively as detector and first- and second-stage L.F. amplifiers. The detector valve may have an impedance of 20,000-30,000 ohms, with the highest possible amplification factor. The second valve, V_2, may be of a similar pattern; while V_3 (the second L.F. amplifier) must be a power valve or, better, one of the "super-power" variety.

In circuit 2, the tuning condenser should have a maximum capacity of about 0.0005 mfd. A plug-in coil may be used, its size depending both on the wavelength to be received and the capacity of the aerial. For the normal broadcast waveband, Nos. 35, 40 or 50 will generally be necessary, and for Daventry a No. 150 or 200. The correct value of grid bias will depend on the type of valve and H.T. voltage applied, etc.; it can only be ascertained by experiment, and will vary from $1\frac{1}{2}$ to 6 volts, the lower voltage being suitable for a high-amplification valve.

Referring to circuit 3, the external anode resistance must be several times greater than the internal impedance of the valve, and considerable latitude is permissible. For the type of valve specified above, a value of 150,000 ohms, with a shunting condenser of 0.0001 or 0.0002 is recommended. The coupling condenser between this resistance and the grid of the next valve may be of 0.1 mfd., with mica dielectric, with grid leak resistance of 0.5 megohm. These are safe values, which may be depended upon to give as nearly "straight-line" amplification as is necessary, and may be repeated in the succeeding stage.

A common H.T. voltage may be applied; about 120 volts will be suitable for the valves likely to be used.

Instead of connecting the loud-speaker directly in series with the anode of the output valve, as shown, it may be desirable to interpose a choke-condenser arrangement, more particularly when a "super-power" valve is fitted, as the heavy current passed may damage the windings.

VALVES WE HAVE TESTED

Cossor 410H and Stentor 4; Lustrolux 525 and 525B; Radion B and 525H.

A FURTHER batch of valves having been received, we deal this week with those supplied by three manufacturers. We have two Cossor 4-volt valves, two Lustrolux, and two Radion 6-volt va ves.

The first of the Cossor valves tested was type 410H (Red Band). This has a filament rated at 3.8 volts 0.1 ampere, and has a fairly high voltage factor—hence the type number 410H. In appearance this valve resembles the Cossor series of 2-volt valves reported in last week's issue, except that type 410H has a larger bulb. The usual tests were applied, the curves of Fig. 1 being taken at 80, 100, 120, and 140 volts, with the filament set at 3.8 volts.

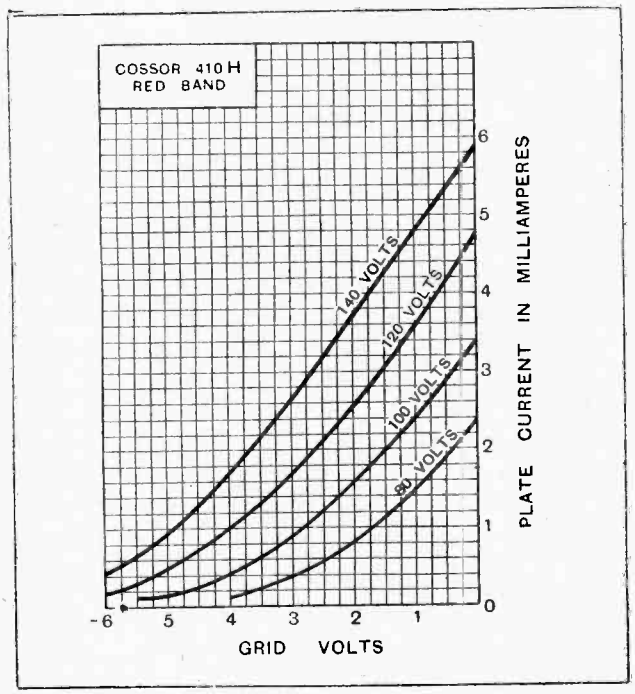


Fig. 1.—Cossor, Type 410H. Filament voltage 3.8; filament current 0.1 ampere; maximum anode voltage 150. The amplification factor and anode A.C. resistance were found to be 18.5 and 17,200 ohms respectively for an anode voltage of 120 and a grid bias of negative 1.5 volts.

Measured round an anode voltage of 120 and a grid bias of −1.5, the amplification factor was found to be 18.5 for an A.C. resistance of 17,200 ohms; the anode current, at 120 and −1.5 volts respectively, is 3 milliamperes. When a higher anode voltage was applied the A.C. resistance was reduced, as is usually the case.

This valve is quiet in operation and may be used as a detector or high-frequency amplifier. When used for H.F. amplification with an anode voltage of 120 and a grid bias of −1.5 excellent amplification will be obtained when the H.F. transformer is of the type used in the "Everyman Four" receiver. This valve can also be used in a low-frequency amplifier with transformer coupling; the transformer used should be of a type having a primary inductance of the order of 50 henries. Such a component will normally have a ratio of between 2.5 and 3.5 : 1, resulting in an amplification for the stage of 46 to 65 (according to the ratio), with good quality.

Considering that the valve is of the 4-volt type, the A.C. resistance is remarkably low for the amplification factor. This valve is, of course, not intended for the output stage of a receiver.

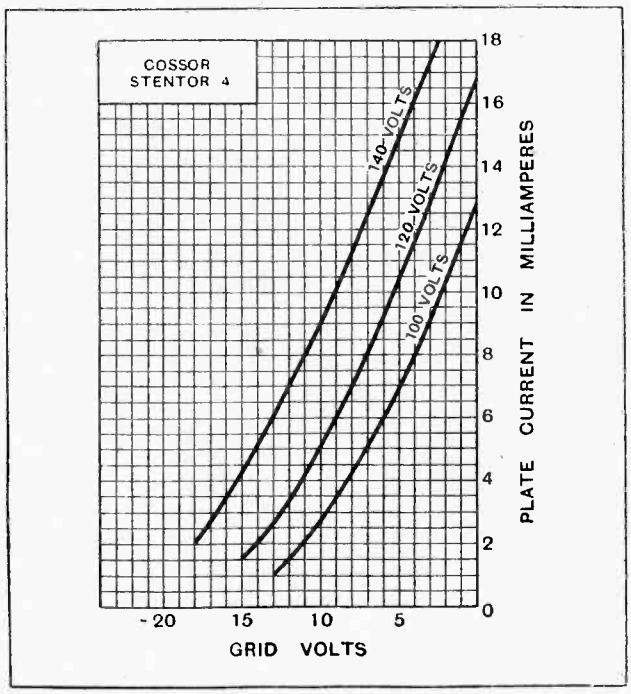


Fig. 2.—Cossor, Type 410P (Stentor Four). Filament voltage 3.8; filament current 0.1 ampere; maximum anode voltage 150. The amplification factor and anode A.C. resistance were found to be 5.4 and 4,600 ohms respectively for an anode voltage of 120 and a grid bias of negative 7.5 volts.

Valves We Have Tested.—

The second valve tested was the Cossor Stentor 4 (Type 410P). This is a power valve having an amplification factor of 5.4 for an A.C. resistance of 4,600 ohms, measured round an anode voltage of 120 and a grid bias of −7.5 volts. Curves are given in Fig. 2 for 100, 120, and 140 volts. If the higher voltage is used, a grid bias of about −12 will be about right when a normal loud-speaker is connected to it. This valve is, of course, a power valve, and as such is designed for the last stage of a receiver. It will deal with signals capable of operating a large loud-speaker at ample volume without distortion, provided, of course, that the input to the valve is suitable in amplitude. This valve is a very good one, as it has a high amplification factor for its A.C. resistance, and can be recommended for the output stage of a receiver where strong signals have to be handled.

Lustrolux Valves.

The first Lustrolux valve tested had a filament rating of 5 volts 0.25 ampere, and it is supposed to be used with an anode voltage not exceeding 120. Its anode is of rather peculiar construction, consisting of a piece of metal bent to a narrow U shape. Curves for this valve are given in Fig. 3, and were taken at 80, 100, and 120 anode volts. For an anode voltage of 120 and a grid bias of −4.5 the valve had an anode A.C. resistance of 8,300 ohms and an amplification factor of 6.7; the anode current for these voltages was 7 milliamperes. These figures show that the valve is typical of normal valves of this filament rating. It is intended for the last stage in a low-frequency amplifier, and, indeed, may be used for working a small loud-speaker with an anode voltage of 120 and a grid bias of about −6 volts. The appearance of the valve is shown in an accompanying illustration. The pins are of the split type with the connecting wires soldered to the bottom of the pins.

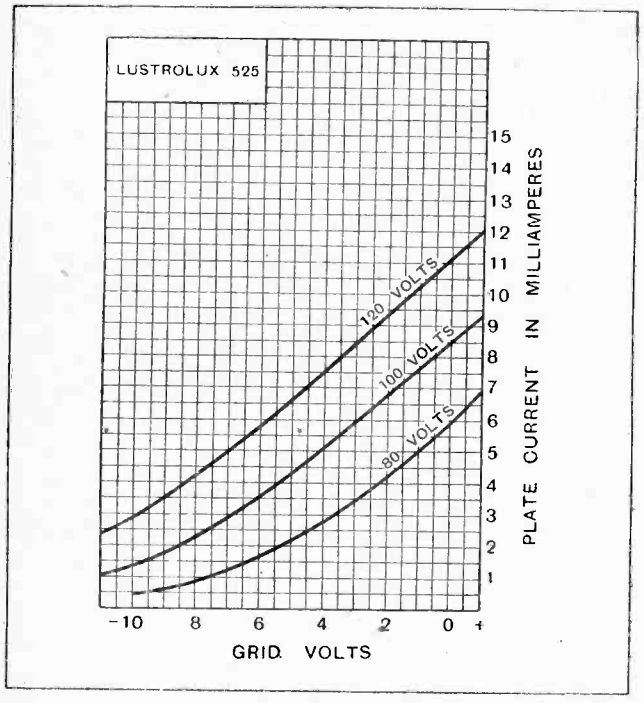


Fig. 3.—Lustrolux, Type 525. Filament voltage 5.5; filament current 0.25 ampere; maximum anode voltage 120. The amplification factor and anode A.C. resistance were found to be 6.7 and 8,300 ohms respectively for an anode voltage of 120 and a grid bias of negative 4.5 volts.

The Lustrolux and Radion six-volt valves.

Type 525B also has a filament rated at 5.5 volts 0.25 ampere, but this valve may be used with an anode voltage up to 150, as it is of the high impedance type. The curves of Fig. 4 for various anode voltages will give an idea of the probable performance of this valve in a circuit; measured at 120 anode volts, with a grid bias of −1.5, the A.C. resistance was found to be 40,000 ohms with an

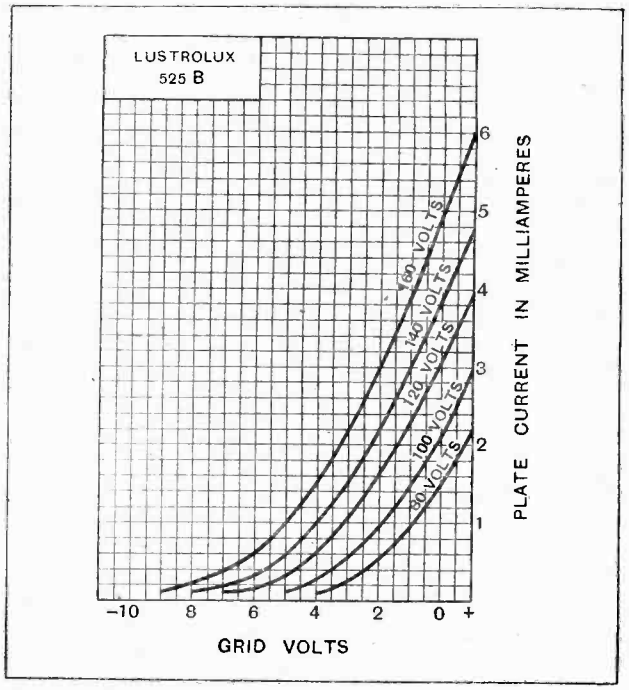


Fig. 4.—Lustrolux, Type 525B. Filament voltage 5.5; filament current, 0.25 ampere; maximum anode voltage 150. The amplification factor and anode A.C. resistance were found to be 18 and 40,000 ohms respectively measured at 120 anode volts and with the grid at negative 1.5 volts.

Valves We Have Tested.—

amplification factor of 18. The A.C. resistance is rather on the high side for a modern valve, in view of the heavy filament consumption, but nevertheless the valve can be used in many circuits; it can be used in most high frequency amplifiers and as a detector. When used in the latter position in a receiver a resistance or choke coupling should be employed; a transformer coupling would not prove satisfactory from the point of view of quality, owing to the relatively high anode A.C. resistance.

This valve was found to be quiet in operation when tried in a receiver, and in view of the robust filament should have a reasonably lengthy life.

Radion Valves.

Two types of Radion valves have been tested; one is a low-impedance valve and the other has a moderate impedance. Curves for the low-impedance valve, known as type B, are given in Fig. 5. This takes 5 volts at 0.25

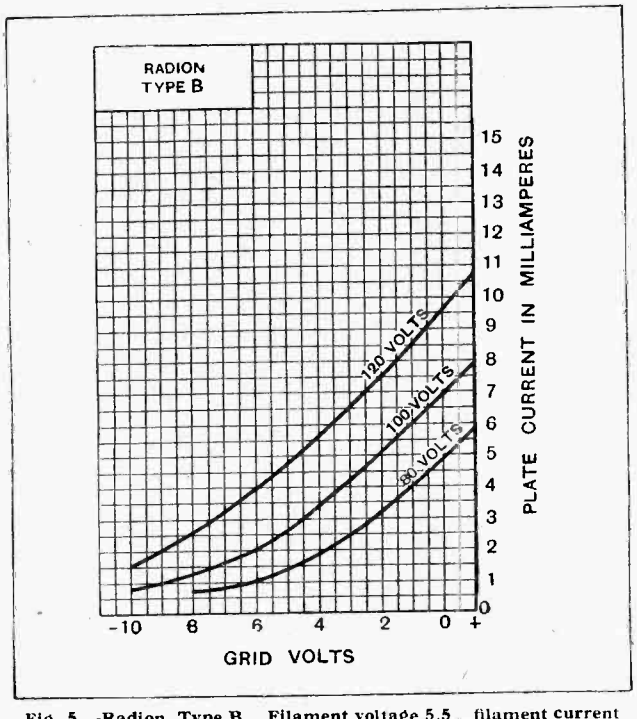


Fig. 5.—Radion, Type B. Filament voltage 5.5 filament current 0.25 ampere; maximum anode voltage 120. The amplification factor and anode A.C. resistance were found to be 7.2 and 8,900 ohms respectively for an anode voltage of 120 and a grid bias of negative 4.5 volts.

ampere and has a rated A.C. resistance of 8,000 ohms for an amplification factor of 7.2. The specimen tested was found to have an A.C. resistance of 8,900 ohms, with an amplification factor of 7.2 when measured at 120 and −4.5 volts on the anode and grid respectively.

This valve is a normal type of power valve, suitable for low-frequency transformer-coupled amplifiers. Measured with a filament voltage of 5.5, the current was 0.28 ampere.

There is nothing unusual in the construction of this valve, the electrodes being mounted in a vertical position; the anode is of the box type. Split pins are used with the connecting wires soldered to the bottom of the pins; a small amount of the insulating material of the base is cut away between the pins

The second Radion valve tested is known as type 525H. This valve takes 5.5 volts at 0.25 ampere, and can be used with an anode voltage as high as 150 or 160. The curves of Fig. 6 are for 100, 120, 140, and 160 anode volts. Measured with an anode voltage of 120 and a grid

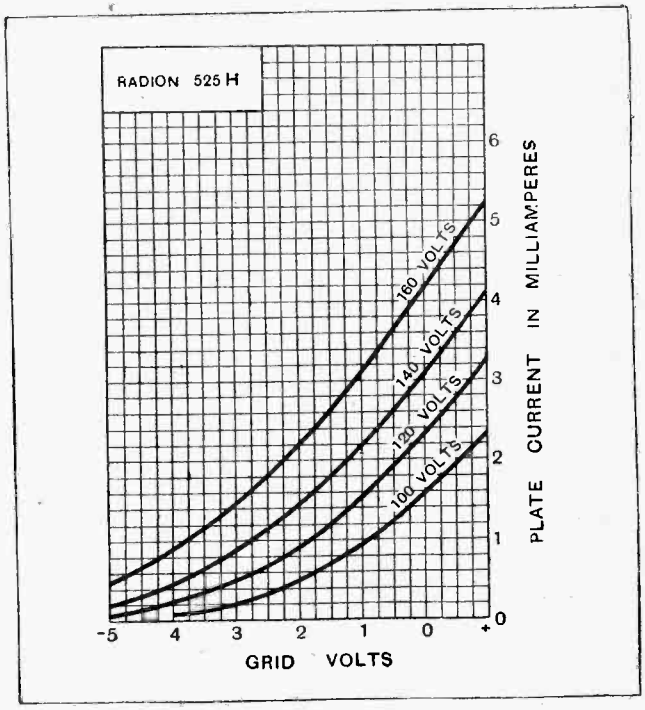
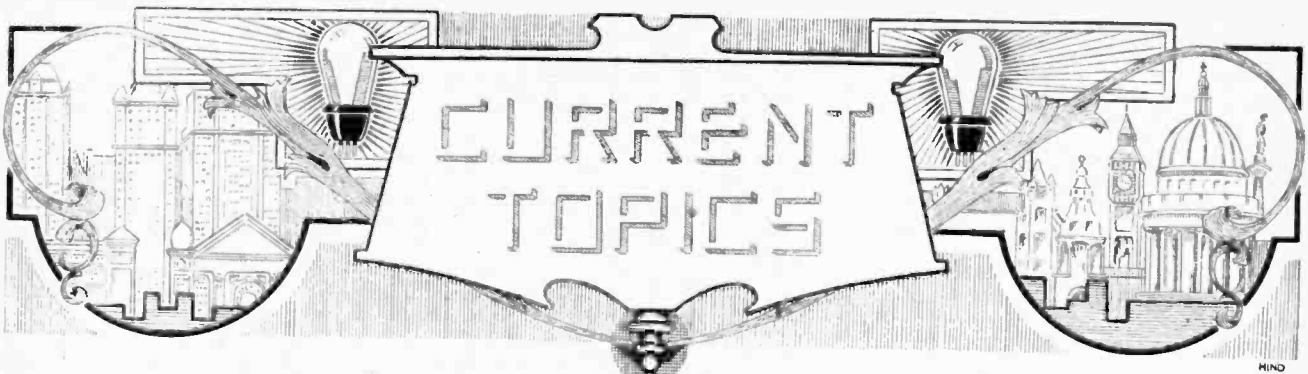


Fig. 6.—Radion, Type 525H. Filament voltage 5.5; filament current 0.25 ampere; maximum anode voltage 150. The amplification factor and anode A.C. resistance were found to be 23 and 33,500 ohms respectively for an anode voltage of 120 and a grid bias of negative 1.5 volts.

bias of −1.5, the A.C. resistance was found to be 33,500 ohms for an amplification factor of 23. These figures are satisfactory, and the valve is suitable for use in the high-frequency and detector positions of a receiver. It could also be used in the first stage of a low-frequency amplifier with a choke or resistance coupling. The valve should not be used in the output stage of a receiver, because of its high anode resistance.



News of the Week in Brief Review.

WIRELESS SERVICES.

York claims to be the first city in England in which church services by wireless are a regular feature. Canon C. C. Bell, Precentor of the Minster, has installed a four-valve receiving set in the church of St. Helens, and it is intended to tune in the Sunday night services relayed from London and the Thursday afternoon services broadcast from Westminster Abbey. Canon Bell, who is also Vicar of St. Martin's, Coney Street, hopes by this means to make more use of his second church.

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INTERCHANGE OF PROGRAMMES.

A sub-committee of the Union Interpationale met recently at Geneva and was attended by delegates from several European countries. One of the chief subjects discussed was the actual transfer of programmes between different countries by land line and the mutual exchange of lectures and talks. It was thought that this would inspire listeners with a desire to visit each other's countries.

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RADIO EXHIBITION.

At a recent ballot taken by some 3,000 wireless traders on the question of the most suitable period of the year in which to hold a London Wireless Exhibition, voting was decidedly in favour of the choice of the month of September, which won the vote by a majority of 861. Strangely enough, the second most popular month was May, which had 437 votes.

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NEW WIRELESS SERVICE.

A radio telegraph service has been inaugurated between this country and the Cape Verde Islands. The ordinary rate is 2s. 3d. per word to St. Vincent, and 3s. 1d. to St. Thiago. Deferred telegrams are at half rate, while specially urgent messages can be sent for a trifle above the ordinary amount.

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A SURPRISE FROM AMERICA.

Those who are engaged on short-wave development work are likely to experience something of a shock as a result of the publication in the United States of a patent granted on February 8th of this year to R. A. Fessenden. Briefly, the patent is granted to Fessenden for the use of wavelengths between one and fifty metres for directional wireless purposes. The claim is based on early work, when the applicant is stated to have discovered for the first time that directive wireless was more satisfactory and less affected by the usual causes of variation when wavelengths between one and fifty metres were employed. It is scarcely to be imagined that in this country a patent would be granted giving to one inventor the control of the use of a complete waveband for any particular application.

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WIRELESS HORRORS.

The ingenuity of our transatlantic cousins has discovered new and sensational directions for the use of wireless. It is reported that a building contractor in York, Pennsylvania, while listening to the evening's programme heard a voice commanding him to lock his hands together and not separate them until he received permission from a transmitter in Boston. Despite the efforts of his wife and son he was unable to separate his hands until the experimenter in Boston had given the necessary permission.

It is to be hoped that demonstrations of this nature will not become common. The community laugh is bad enough, but community hypnotism is too horrible to contemplate.

Rear-Admiral William H. G. Bullard, retired from the United States Navy, who has been appointed Chairman of the new Federal Radio Commission recently created to investigate the problem of "chaos in the air."

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AIR CADETSHIPS.

With a view to obtaining the widest field of recruitment for permanent commissions in the R.A.F. and to throwing the profession open to able boys from the public and secondary schools without respect to means, the Air Council have decided to increase the number of prize cadetships offered for competition annually from three to twelve. These prize cadetships enable boys to complete the two years' course at the R.A.F. Cadet College, Cranwell, at a cost of only £40 in all to their parents. When flight cadets are commissioned at about the age of twenty they become independent of any assistance from their parents and have before them a permanent and pensionable career.

Full particulars can be obtained from the Secretary, Air Ministry, London, W.C.2.

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THE "EVERYMAN FOUR."

Readers are reminded that if they desire to avail themselves of the opportunity of seeing a specimen of the "Everyman Four" receiver built up, arrangements have been made for receivers to be on view between the hours of 10 a.m. and 5 p.m. (Saturdays between 10 a.m. and 12 noon) at No. 24, Tudor Street, E.C.4, in London, and at *The Wireless World* Birmingham office at the Guildhall Buildings, Navigation Street, and also at the Manchester offices, 199, Deansgate. Those who desire to make up this receiver and who purchase the 1s. booklet describing its construction, will find that an inspection of the set will greatly facilitate the work of assembly.

MARCONI PICTURE TRANSMISSION.

Two interesting new photographs transmitted by the Marconi Picture Transmission system are reproduced on this page. One is a reproduction of part of an advertisement page of *The Autocar*, and the other a specimen message. These pictures were transmitted from the Marconi Works to the Marconi College in Chelmsford, a distance of approximately three-quarters of a mile, and the time taken for each picture was approximately 100 seconds, although it is stated by the Marconi Company that it is possible to transmit at the rate of 0.6 square inch per second.

An interesting application of this system, which was touched upon by Senatore Marconi in his recent address at the shareholders' meeting, is to the transmission of written messages or sections of sheets of newspaper, when it is anticipated that it will be possible to transmit by this means at a very much higher rate of speed than would be possible by utilising Morse code with an automatic sender.

Reproduction from an advertisement page of "The Autocar" transmitted by the improved Marconi Picture Transmission System.

WIRELESS AT WESTMINSTER.

By Our Parliamentary Correspondent.

Licence Prosecutions.

Lord Wolmer informed Mr. Day in the House last week that five persons had been prosecuted for using wireless apparatus without a licence. A conviction was obtained in each case and the penalties imposed ranged from a fine of £4 to a fine of £10, in addition to £5 costs. In two of the cases apparatus was confiscated.

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The "Radio Times."

Mr. Johnston enquired whether the printing contract for the *Radio Times* was fixed after competitive tenders had been received; whether the State printing works were invited to tender; if the present contract provided for a break; and how long it had yet to run. Sir W. Mitchell-Thomson, in reply, said that the British Broadcasting Corporation took over the printing contract made by the B.B.C. subject to certain modifications in the corporation's favour. The corporation informed him that they did not invite competitive tenders, but they were satisfied that the terms secured were satisfactory and the responsibility for the contract rests with them.

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Beam Wireless.

Replying to Lieut.-Commander Kenworthy, the Postmaster-General made the statement that the Beam wireless stations erected in this country for the Australian service had passed the seven-day test required by the contract and were about to be taken over by the Post Office. The sending station was at Grimsby and the receiving station at Skegness. The corresponding stations in Australia were at Ballan and Rockbank, near Melbourne. He stated that it was proposed to operate a service between London and Melbourne. Many detailed arrangements had still to be made, and he could not yet state on what date the service would be opened to the public.

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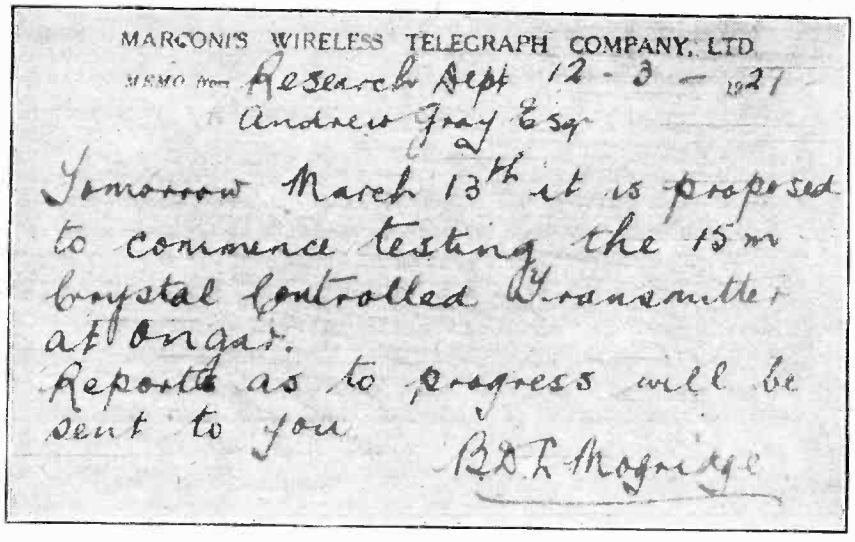
President Coolidge's Speech.

Asked by Mr. Day how many land lines were used, and from what stations in Great Britain, for the purpose of broadcasting by relay President Coolidge's speech to Congress, Lord Wolmer said that the land lines used on the occasion in question were one between the receiving station at Keston and the B.B.C. headquarters at Savoy Hill, another between Savoy Hill and the London transmitting station in Oxford Street, and a third between Savoy Hill and the Daventry broadcasting station.


MARCONI'S WIRELESS TELEGRAPH COMPANY, LTD.

MEMO from Research Dept 12-3-1927

Andrew Gray Esq

Tomorrow March 13th it is proposed to commence testing the 15m crystal controlled transmitter at Ongar.

Reports as to progress will be sent to you

B.D.T. Mogridge

A facsimile message transmitted by the Marconi Picture System.

BOOKS RECEIVED.

"Practical Radio Construction and Repairing," by James A. Moyer, S.B., A.M., and John F. Wostrel. Pp. 319, with 157 diagrams and illustrations. Published by McGraw-Hill Publishing Co., Ltd., London. Price 10s.

"Elements of Radio Communication," by Lieut.-Commr. Ellery W. Stone, U.S.N.R. Pp. 433, with 220 illustrations and diagrams. Third edition, revised and enlarged. Published by Chapman and Hall, Ltd., London. Price 10s. 6d. net.

"Cours Élémentaire de Télégraphie et Téléphonie Sans Fil," by M. Veaux. Two Volumes:—No. I. pp. 389, with 324 illustrations and diagrams. No. II, pp. 492, with 458 illustrations and diagrams. Published by Librairie de l'Enseignement Technique, Paris.

A TOUR ROUND SAVOY HILL.

Part VII.—Studio Organisation and Rehearsal of Programmes.

By H. LEA CHILMAN.

THE preceding articles have dealt chiefly with the technical and other considerations which have governed the building and technical equipment of the studios, of the control room, of the arrangements made for linking the main and relay station's transmitters to London and *vice versa;* of the studios now in course of construction and of the arrangements made for dealing, from a lines point of view, with programmes "simultaneously broadcast" from any part of the British Isles or elsewhere. It is my privilege to relate something of how we use the studios and their engineering equipment.

Until 1926 we had merely two studios, and these had to suffice for all the transmissions, rehearsals and engineering tests. In cases of emergency, announcements have made through ordinary telephone microphones in the control room, or an extra microphone was rigged up in the little "A" amplifier room behind the upper studio. When extra "effects" were required an additional microphone was placed in the passage outside the studio, and many interesting transmissions, including the first Military Tattoo and "The White Chateau," were broadcast using two microphones in this fashion.

Fully Occupied Studios.

Early in 1926 three more studios became available—Nos. 2, 4 and 5—and for a few months it seemed as if we should have ample accommodation for rehearsals and transmissions, but our constant programme development has speedily dispelled such hopes, and although two more studios—Nos. 6 and 7—have now been brought into use, we find every studio occupied almost continuously, many rehearsals have to take place in the band-rooms and waiting rooms, and it has even been found necessary, on occasions, for other rehearsals to take place in offices.

If it were possible for visitors to peep into every studio and band-room one morning at, say, noon, they would make the interesting discovery that the transmission was taking place in No. 3—that the orchestra was busy rehearsing in No. 1—that a revue was being rehearsed in No. 4—while the dance band would be found trying out new tunes in No. 7—that a play was being rehearsed in No. 2, both sections of this studio being in use: here there would possibly be an accompaniment of effects, there might be syrens wailing, a tropical thunderstorm, surf breaking on the beach, the roar of an express coming out of a tunnel, or perhaps the rattle of a machine gun—one never quite knows what is going to happen in No. 2 (B). Some difficulty was experienced in getting revolver shots "over the mic.," and not very long ago I met a comparatively new office-boy dashing round the corner of one of the passages; on enquiring as to the reason for his exceptional haste, he explained that he had been walking quietly past No. 2 (B) when suddenly the door had partly opened, and a hand appeared grasping a huge revolver which had immediately "gone off"—to the boy's astonishment.

A Startling Effect.

The effects artist had decided on a new experiment, and I can assure any readers who may visit Savoy Hill that it will not be repeated; a better method was found almost immediately—it was advisable!

Dragging themselves away from this fascinating exhibition, our visitors would find No. 5 being used for a talkers' audition, while in No. 6 we might find the larger chorus composed of seven sopranos, six contraltos, six tenors and seven basses; the smaller chorus is composed of eight singers. In one of the band-rooms they would perhaps find a new "act" being tried out, and in another a play being "read over" for the first time.

Studios are ordinarily booked several weeks ahead, but

The 2LO Wireless Symphony Orchestra under the baton of Mr. Percy Pitt.

A Tour Round Savoy Hill.—

urgent calls for "a studio with microphone in five minutes" are becoming increasingly common, and as we endeavour to fill every call on our accommodation I, for one, shall be most thankful when more accommodation is available.

Final rehearsals are arranged, whenever possible, in the studios from which the items are to be broadcast—by doing this, those responsible for "balance" are able to arrange artists, instruments, effects, etc., so that a properly-balanced broadcast may be "put over." "Balance" is a matter which receives a vast amount of consideration and experiment. Every programme is dealt with separately. Quite a lot of time may be taken up in getting the right balance for such an item as a song at the piano—when the singer plays his or her own accompaniment. A singer is normally placed between the microphone and the piano; a soprano usually stands about 8 feet from the microphone, while the piano is 13 feet away. Balance experiments are, of course, made on the "live" microphone, so that all the conditions approximate to those of the subsequent broadcast transmission.

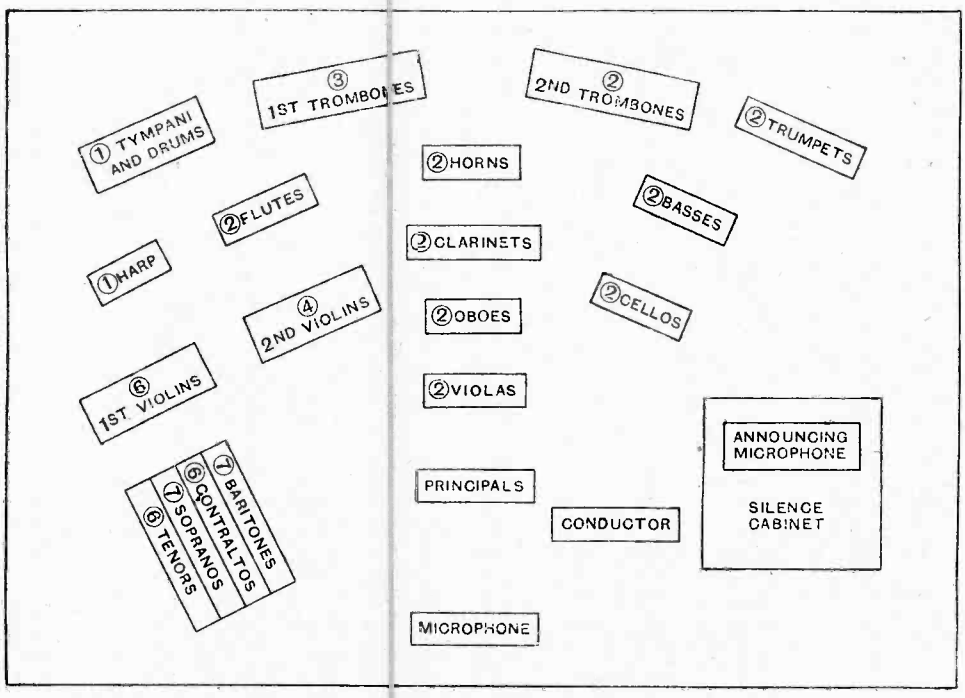


Fig. 31.—Arrangement of the London Wireless Orchestra showing positions taken up by principals and chorus in operatic and musical comedy items.

So many rehearsals would not be necessary if we only had to deal with 2LO's programme in the London studios, but they are needed when it is realised that it is becoming quite common for four programmes to be broadcast simultaneously from this building—for instance, there might be a light orchestral programme to 2LO, a chamber music hour to 5XX, a rota play to say, Belfast, and a "touring" variety turn to, possibly, Bournemouth. The need for many studios is also made apparent when it is explained that in our endeavours to cut out the "few moments, please," we switch from studio to studio during the run of even a short programme. By doing this it is unnecessary to hold up the transmission—even for a few seconds while the "orchestra takes its place"—because we can have the orchestra in No 1 studio and switch over to the solo artists in another studio. Following a representative 2LO programme from 6.30 p.m. we might find it housed as follows: 6.30 p.m., 1st General News Bulletin, No. 5; 6.45 p.m., London Radio Dance Band, No. 7; 7 p.m., Talk, No. 5; 7 15, Beethoven Sonatas, No. 3; 7.25, Talk, S.B. from Cardiff, with No. 3 in reserve (there is always a studio in reserve during a Talk or an O.B. before 10.30 p.m.; here an accompanist is sitting at a piano ready to improvise in case the Talks run short or the line breaks down); 7.45, Orchestral Programme, orchestra in No. 1, solo artists in No. 4, a short play in No. 2; 9 p.m., 2nd General News Bulletin, No. 5; 9.15, Talk on Music, with piano illustrations, No. 6 (the large talk studio equipped with pianos); 9.30, Variety Programme, No. 1 (with stage, spotlights, etc.).

Composite Programmes.

Some of the big broadcasts, such as the Radio Fantasy, need several studios simultaneously with an orchestra in No. 1, voices in No. 2 (A), effects in No. 2 (B), the dance band in No. 4, the special gramophone in No. 5, and a linking voice or voices in No. 3 keying the whole production together. Echo is applied when required, as explained in a previous article. Such a production naturally receives very careful preparation, and the cue sheet is a most interesting piece of work. It is literally followed blindly, as those taking part cannot see their colleagues in the other studios. The artists in the various studios come "on" when warned to do so by the respective announcers in charge of the studios. They are in touch with the course of the production as they wear headphones and follow their cue-sheets. In the case of the orchestra, the conductor wears headphones and by following a similar cue-sheet he brings the orchestra into the programme wherever necessary by raising his baton in silence and commencing the playing of the item required exactly at the right moment. Such a production calls for the closest co-operation between the programme and control-room staff concerned, the sounds picked up by the microphones in the various studios are blended into a composite whole in the control-room, the general balance between the various components being arranged by the Productions Director, calling for much skilful "fading in" and "fading out." This composite programme is then broadcast, picked up on the check receiver in the control room,

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amplified and passed back to the headphones worn by those concerned in the studios.

All the studios, with the exception of No. 5, are equipped with one or more pianos, which are tuned weekly —or more often when necessary. No. 3 studio sometimes resembles a very fine piano showroom, as eminent pianists often send in their special piano, and as this is the only studio containing sufficient spare space there may be as many as five different makes of grand pianos in at once.

The permanent B.B.C. combinations which are broadcast are the Wireless Orchestra, the Wireless Military Band, the London Radio Dance Band, and the Daventry Quartet. Fig. 31 shows the studio lay-out of the normal orchestra, which is augmented for special programmes. Fig. 32 shows the disposition of the players when the Military Band is broadcasting.

The Dance Band.

The London Radio Dance Band is composed of ten players, many of whom play several instruments during the course of even a short programme. They often play the following combination of instruments: piano, banjo, trombone, 1st and 2nd trumpets, sousaphone, two alto saxophones, tenor saxophone, and one drum and effects, aided and abetted by the conductor's violin.

The London Radio Dance Band conducted by Mr. Sidney Firman.

At other times the sousaphone operator plays the string bass, the banjo is exchanged for a guitar, one of the alto saxophonists plays the 'cello, clarinet, or soprano saxophone, while the other plays any of the following instruments: tenor, soprano, alto and baritone saxophones, clarinet or oboe.

The Daventry Quartet consists of piano, 1st and 2nd violins and 'cello, augmented each Wednesday morning by a viola.

Now, perhaps you would like to learn something about auditions. The postbags delivered at Savoy Hill invariably contain some applications for auditions, and these are dealt with by the sections dealing with concert artists, variety artists, and speakers respectively. In the case of variety artists an audition is normally arranged quickly, such auditions being held frequently. Concert artists are asked to fill in a form supplying details of their training, past work, etc. Speakers are, of course, asked to supply proof of their adequate qualifications to speak on the subject they have suggested. In the audition waiting rooms there have been instrumentalists of all kinds; some have brought modest violin cases, others several large cases, each containing part of a huge xylophone, or a set of bells; others a set of native (African) drums; some have produced nasty-looking saws from brown paper parcels; others have extracted tin whistles or mouth organs from the inner recesses of their clothing; some have asked for a few dozen glasses, a gallon or so of water, and a large table, so that we might hear the music with which listeners were to be charmed. Occasionally a would-be broadcasting artist has asked us to produce a full orchestra to accompany his or her trial song! Various birds, animals, and insects have come for auditions and have later broadcast from the studio.

Perhaps the outstanding "dumb" broadcasters were "Cynthia," the mosquito—and in the children's hour the guinea-pig which made a few remarks and audibly ate part of an apple in September, 1925; "Bob," the dog, which broadcast in November of that year; and the roller canaries, whose song was heard a year ago.

Audition under Broadcasting Conditions.

Now that several studios—Nos. 1, 2, 4, 6, and 7—are equipped with silence boxes or the equivalent, the would-be broadcasting artists do not see their examiners as much as they did previously; often they do not see him or her at all. The test is, in most cases, made on a "live" microphone, and the conditions approximate to those of an actual broadcast, except that the sounds never reach the transmitter.

A Tour Round Savoy Hill.—

Having been judged suitable after an audition, a singer or instrumentalist is often offered an engagement to broadcast in a Daventry morning concert. When the date arrives the artist comes to the north entrance, by appointment, about 10.30 a.m. and "runs over" his or her items with the staff accompanist on duty, then goes to Studio No. 3, where the morning and day-time transmissions usually take place (the reason being that this studio is completely isolated from the other studios, which resound from 10 a.m. to 6 p.m. with the rehearsals referred to earlier in this article). Arriving at the studio armed with a plentiful supply of songs, a singer is met by the announcer, with whom the items to be sung are discussed. The announcer needs to know the title of the song, the composer's name, and the name of the publishers. All this information is required for the official "programme as broadcast," a most important document. The artist is ushered into the studio, and after the announcer has signalled to the control room—by giving one buzz—that he is ready, the red lights over the studio doors glow, he makes an announcement, the accompanist strikes the first few notes, and another artist begins his or her first broadcast. The rest is in the competent hands of the engineers in the control room and at the transmitter.

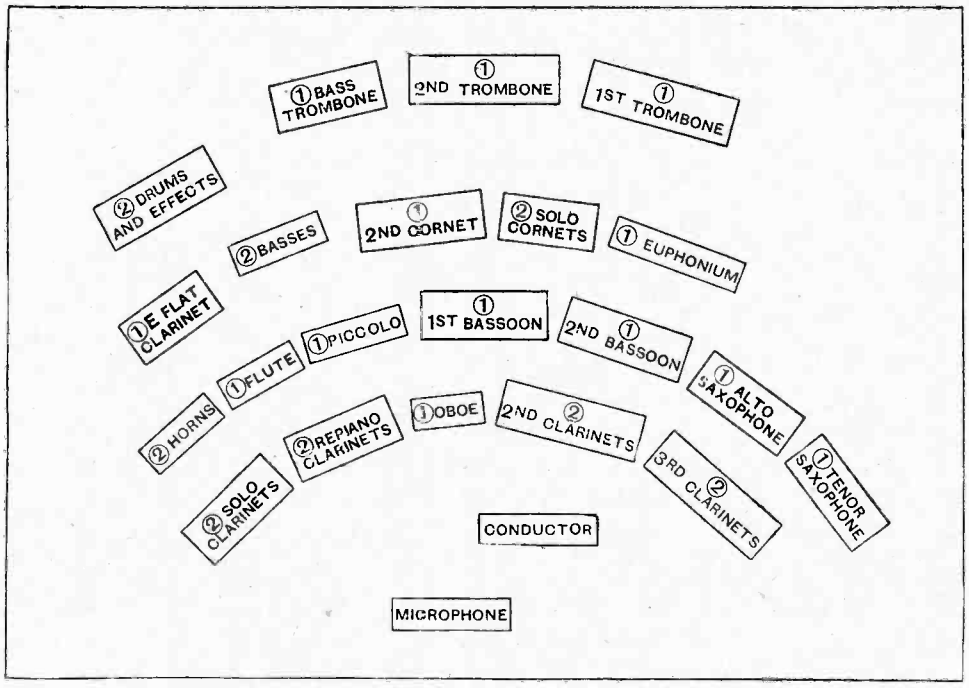

Fig. 32.—Arrangement of instruments in the Wireless Military Band.

Variety Programmes.

Special arrangements are made in the studio for many programmes, particularly variety and revue. In many revues there has been a dancing chorus, which performed its dances on a stage covered with sail-cloth and lino. Recent experiments have shown that the best effect can be obtained by using the lino and doing away with the stage. In most of the variety programmes we now use a stage about fifteen inches high and an illumination supplied by two amber-coloured spotlights. This is done in an endeavour to help variety artists by giving them an atmosphere to work in more similar to their usual working environment, and it is for this reason that we often have a small audience in the studios for variety and revue transmissions. Here it might be well to state that there is a long waiting list of listeners anxious to be members of such audiences. Many weeks must elapse before we can invite fresh applicants to see a studio transmission.

It is also possible to look over the studios and control room in non-broadcasting hours. Parties are taken round on most week-days, but here, again, there is a long waiting list, and the parties have already been arranged for many weeks still to come.

Ventilation.

When used for rehearsals or transmission, the studios are kept as nearly soundproof as is possible, and they are therefore almost sealed up, all windows being covered over and doors kept shut. The necessary fresh air is provided by large ventilating plants in the basement, which, when at full speed, blow sufficient air into the studios to fill each one seven times per hour, while ducts in the ceiling let the vitiated air out. In the latest studios two sets of fans have been provided, one blowing air in, and the other extracting it. These ventilating plants are connected with the main boiler systems so that the air may be heated when necessary.

Incidentally, it may be mentioned here that all parts of this building, including the studios, receive the constant attention of little boys armed with big sprays which diffuse a powerful germicide. Artists seldom see them at work, as the spraying is, naturally, done when the studios are empty. This has been the practice here for some years.

Also there is, and has been, a buffet maintained throughout the day and during the evening for the convenience of artists and staff, while a public telephone has recently been installed in one of the artists' waiting rooms on the ground floor for the use of artists and visitors.

With seven busy studios and so many sections in the programme department, each anxious to improve on anything it has ever previously attempted, it is necessary to give a lot of attention to the allocation of the available studios, so that everything being rehearsed may do so under those conditions which will make for the best

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possible transmission later on. It is therefore essential for the writer to keep a synoptic view of all studio arrangements constantly before him. An altered rehearsal, or an extra rehearsal called at the last moment often calls for a complete reshuffling of studio accommodation. Should the transmission studio ever break down, some rehearsal must be moved from a studio into a band room, or even be cancelled, and there is nearly always somebody asking for a room—"anywhere will do as long as there's a piano in it." The following day's bookings are worked out the previous afternoon. A list of microphone requirements for all programmes taking place in the London studio is sent to the control room so that the senior engineer may make the amplifier and charging arrangements referred to in the article dated March 9th. The announcers, accompanists, studio staff, etc., and all those connected with the programme from an engineering point of view, are supplied with detailed information regarding the studios from which the transmissions will take place, while other officials are notified of all rehearsals. The commissionaires and studio staff receive a sheet showing all the studio bookings, etc., for the day. These sheets regulate the use of the studios, and no deviation from these arrangements takes place unless there is a serious studio breakdown, or unless a programme item has to be altered, in which case everybody concerned is notified immediately.

It will thus be seen that the running of the programmes calls for the closest co-operation between the studios, the engineers in the control room, and, last but not least, the house staff.

The making of the programmes is a matter outside the scope of these articles, which have described the technical apparatus used in transmitting them, the studios in which they take place, and how those studios are used in the transmission of the programmes. It only remains to be said that certain studios are particularly suitable for particular transmissons. For instance, No. 1 transmits orchestral programmes well, No. 4 is best for revues, No. 2 for plays, No. 5 for speech, No. 7 for small orchestral combinations, such as quintets and octets, No. 3 for day-time programmes.

I can suitably conclude by explaining that in their tour round Savoy Hill our visitors would have seen many offices sandwiched among the studios, for this building houses head office as well as London station. The working of our twenty-one stations is co-ordinated here, so that the public may have the full benefit of a really efficient service working in harmony throughout the British Isles. Here questions of administration, broad policy, and of finance are settled. Broad questions of programme policy, including music, education, and drama, are discussed or settled. Finance, stores, and buying are centralised. Technical research and development is carried out. Technical correspondence is specially dealt with, including oscillation reports, etc. The B.B.C. publications, such as the *Radio Times*, *World Radio*, opera libretti, National and other B.B.C. concert programmes, all have their home in this building. An Information Department spends a busy day here. Workshops can be found in various parts of the building, each dealing with work of a particular kind calling for specialised equipment, or its alteration, repair, and assembly. The outside broadcast engineers have their own room full of equipment ready to be rushed off to any part of the country in their own van. Such things would you see and hear on your TOUR ROUND SAVOY HILL.

"Fading" Tests.

The experimental station 2XAI of the Westinghouse Co. in Newark, N.J., will conduct a series of tests on a wavelength of 43 metres, from April 18th to 30th, for the purpose of discovering its audibility, fading, etc., throughout the world. These tests will be sent out from 8 p.m. to 9 p.m. E.S.T. (0100-0200 G.M.T.) on a 20 kW. crystal-controlled transmitter; the signals for the first half-hour will be "ABC's de 2XAI," and these will be followed by ordinary test transmissions with amateurs, etc. Reports and communications should be addressed to Mr. E. Gundrum, manager WAQ-2XAI, Westinghouse Electr. and Mfg. Co., Newark, N.J.

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General Notes.

Mr. E. A. Dedman (G 2NH), 65, Kingston Road, New Malden, tells us that at 1820 G.M.T. on March 13th he was in two-way communication with OA5X, Mr. A. J. Jacobs, in Johannesburg, on 20 metres, using a power of 35 watts. A5X reported the signals as R3 steady D.C., while his signals were received by 2NH at about R3 on two valves. Mr. Dedman believes this to be the first amateur contact on 20 metres between Europe and South Africa.

TRANSMITTERS' NOTES AND QUERIES.

Mr. A. C. de Groot (EI PK1), Tegallegah West 56, Bandoeng, Java, asks British transmitters to listen for his signals on about 35 metres. He uses about 20 watts input, 500-cycle rectified A.C., which gives rather a rough note. He states that he has heard many British stations in Java, but has not yet succeeded in getting any replies to his calls.

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A Correction.

We understand that Mr. Arthur Gook is not yet transmitting from his station at Akureyi, Iceland, as stated on page 283 of our issue of March 9th, neither does the call-sign IC 3PF belong to him. Any correspondence for Mr. Gook should be sent direct to Akureyi. We regret that our previous note was based upon misinformation which at the time we believed to be correct.

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New Call-Signs Allotted and Stations Identified.

G 5PL	(ex 2AFZ) I. A. Philpot, 21, Casino Avenue, Herne Hill, S.E.24 (will welcome all reports and wishes to get into communication with DX stations interested in weather and atmospheric interference).
EI PK1	A. C. de Groot, Tegallegah West 56, Bandoeng, Java. (Change of address).
NE 8AW	James Moore, Carbonear, Newfoundland.
NE 8AF	E. F. Power, 124, Duckworth Street, St. Johns, Newfoundland.

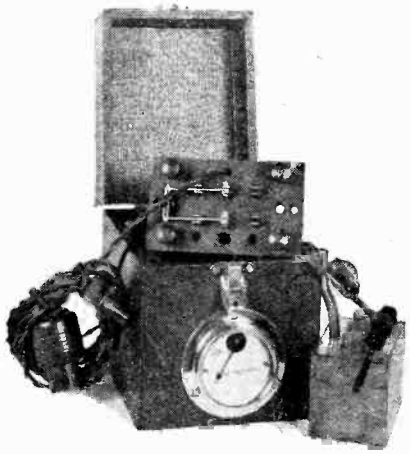
Through the courtesy of Mr. C. A. Jamblin (G 6BT) we are able to give a few more QRAs of Belgian transmitters whose stations are now officially licensed:—

B 4AH	R. Destrée, 38, Rue de Suède Brussels.
B 4AR	R. Boëll, 253, rue Francois Gay, Woluwe St. Pierre, Brussels.
B 4BB	M. Michelet, 59, rue Emm. Van Driessche, Ixelles-Brussels.
B 4GO	G. van den Eynde, 22, rue du Remorqueur, Brussels.
B 4RS	R. Pirotte, 10, rue du Parc, Verviers.
B 4SF	J. Mallinger, 15, rue de l'Athénée, Ixelles-Brussels.
B 4VU	— Diricq, rue du Progrés, Charleroi.

A Review of the Latest Products of the Manufacturers.

A.C. MAINS L.T. SUPPLY.

The recent adoption of tantalum for the construction of the electrodes of the electrolytic rectifier has to some extent re-established this form of rectifier for use in circuits where a comparatively heavy current is to be handled at a low potential. For battery charging, therefore, this form of rectifier possesses certain merits over other types as it is inexpensive to build, running costs are low, while the temperature rise of the solution is much less than in the case of the Nodon rectifier.



The Tannoy tantalum rectifier.

A simple form of tantalum rectifier has been developed by the Tulsemere Manufacturing Company, Tulsemere Road, West Norwood, London, S.E.27, and is marketed under the name of the "Tannoy" supply unit. The outfit is compact, being enclosed in a hinged box measuring $4\frac{1}{2} \times 5\frac{1}{2} \times 5\frac{1}{2}$ when the lid is closed. Contained in the case is the power transformer and electrolytic cell built in a celluloid box closely resembling in appearance a small accumulator, together with a panel carrying a change-over switch, while on the outside of the box is an ammeter reading to 500 mA. Full-wave rectification is provided, the electrolytic cell being fitted with two tantalum electrodes. This form of rectifier makes use of a solution of ferrous-sulphate in dilute sulphuric acid, and consequently care must be taken not to upset the electrolytic cell, for the external appearance does not suggest that the interior contains spillable acid. A celluloid ventilating tube is brought out through the switch panel, and except for this the electrolytic cell is completely sealed.

On test it was found that a charging rate of 0.5 ampere was obtained when the rectifier was connected up to a 6-volt battery, a 4-volt battery charged at 0.6 ampere, and a 2-volt cell at 0.75 ampere.

As an inexpensive source of L.T. supply from alternating current mains this unit will be found to give satisfactory service.

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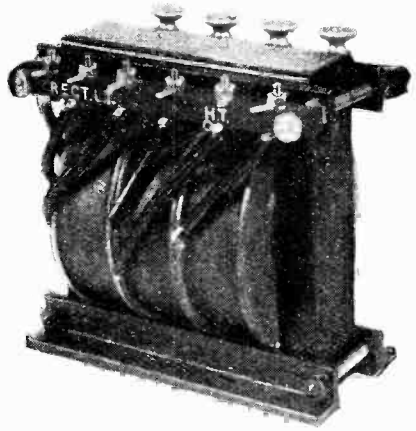
ELIMINATOR TRANSFORMER.

By making use of the new Marconi and Osram type K.L.1 valves one can now build a receiver which can be operated from alternating current mains.

To facilitate the construction of sets of this type the Marconiphone Co., Ltd., 210-212, Tottenham Court Road, London, W.1, have designed a transformer giving all the necessary outputs for the heater current supply as well as the H.T. rectifier. In addition to the input terminals and a pair of terminals giving a heavy current output at 4 volts for heating the cathodes and K.L.1 valves, are six connectors for the filaments of the rectifying valves of the eliminator and the high potential for the rectifier output.



Marconiphone transformer with outputs for cathode heating as well as H.T. supply.

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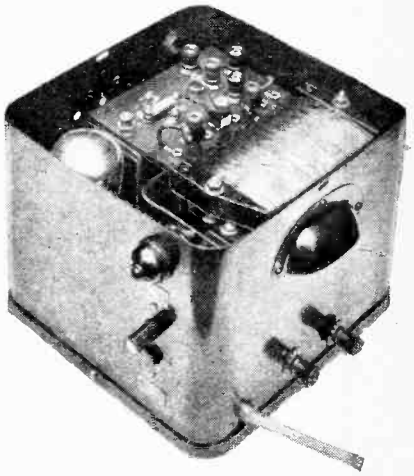
IGRANIC H.T. SUPPLY UNITS.

A series of thermionic rectifiers for H.T. supply have recently been developed by the Igranic Electric Co., Ltd., 149, Queen Victoria Street, E.C.4.

Robustness of construction and general standing merits are at once observed when examining one of these units. The substantial iron case used for screening is roughly a cube, and the four vertical edges are rounded. There are no high-voltage terminals apparent on the outside of the case, the main leads being taken through to the interior in an armoured cable, while the output connections are made to the several terminals and connected to the set by multi-wire cable. An attractive form of "on" and "off" switch is fitted consisting of a pair of plungers, while a small lamp with ebonite cover and ruby window serves to indicate when the rectifier is switched on. For economy this lamp is connected to one of the secondary windings of the power transformer.



Igranic H.T. supply unit, model V208, rated to give output potentials from 35 to 200 volts within a maximum load of 30 milliamperes.

The circuit arrangement is an orthodox one, making use of a full-wave rectifying valve of liberal output (Mullard U2), smoothing chokes and condensers of ample size, and a potential divided for obtaining the several different voltages. By means of a simple arrangement of connecting links all Igranic H.T. units can be used on supply voltages of 110 or 220.

The particular merit of any rectifier is that it should be capable of giving a high voltage output on a heavy load without the setting up of ripple. These requirements demand the adoption of a large power transformer, a low-resistance valve, smoothing chokes capable of passing a

liberal current, and a bank of large-capacity smoothing condensers suitable for withstanding high potentials. All these requirements can be found in the Igranic rectifier.

Three models are available giving maximum voltage outputs of 200, 120 and 70. The 200-volt model is stated to be capable of giving a current of 30 milliamperes at 200 volts, and the method of testing consisted of steadily increasing the load, observing the fall in voltage and at the same time listening for the point at which the ripple became audible on a four-valve receiver comprising two low-frequency stages. On a load as high as 35 mA. no ripple was discernible even when using telephone receivers and at a time when no signal was coming through, while the potential applied to the anode of the power valve was found to be 220 volts. On full load there was no mechanical hum.

The energy taken from the supply mains is exceedingly small, and the cost of running a battery eliminator of this sort is practically negligible.

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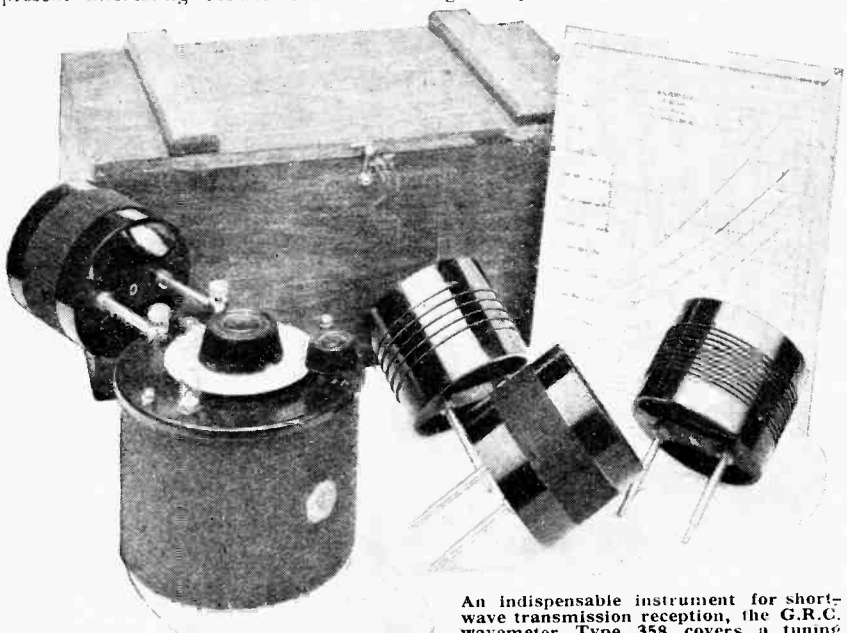
G.R.C. WAVEMETER 15/230 METRES.

It is evident that many amateurs at present interesting themselves in short-wave reception are not in possession of an accurately calibrated wavemeter. It is true, moreover, that there are several operators of amateur transmitting stations who are not in a position to accurately verify the correctness of the wavelength on which they are working, and there would therefore appear to be a considerable demand for a reliable yet inexpensive wavemeter.

Readers have enquired as to where they can obtain a wavemeter covering the present short-wave band which is in general amateur use, or if they undertake the construction of the instrument themselves where and at what cost an accurate calibration can be obtained. It is for this reason that reference is made here to the General Radio amateur wavemeter, Type 358, obtainable from Claude Lyons, 76, Old Hall Street, Liverpool. It is a simple instrument of the absorption type consisting of condenser and coil with a small series-connected lamp to indicate resonance when used for adjusting a transmitting set. It is equally useful for indicating the wavelength to which a receiving set is tuned, for if the circuit adjustment is brought to a condition of feeble self-oscillation resonance with the wavemeter can be easily detected.

Four interchangeable tuning coils are supplied, which according to the calibration chart cover a wave band of 14.4 to 234 metres, the first twenty degrees of the condenser scale as well as the last eight being ignored. The instrument was tested for accuracy and found to be thoroughly reliable. On the 23-metre amateur wavelength, for instance, one division on the scale of one hundred divisions represents 0.3 metre, and it is possible to read with accuracy to 0.1 metre. On the 200-metre range one division on the scale represents approximately 2 metres. The dial is operated through geared pinions from an auxiliary knob.



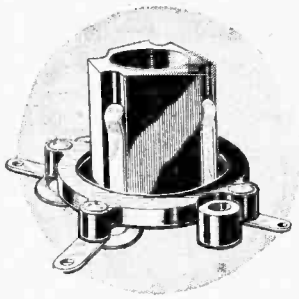
An indispensable instrument for short-wave transmission reception, the G.R.C. wavemeter Type 358 covers a tuning range of 14.4 to 234 metres.

COMPACT VALVE HOLDER.

It is often assumed that the baseboard space occupied by a valve holder may at least equal in diameter that of the valve, and for this reason valve holders are often unnecessarily of large diameter.

To accommodate as much apparatus on the face of the board as possible, particularly components such as fixed condensers, leaks and resistances, the area taken up by valve holders should be kept to a minimum, and with this object in view Cason Mouldings, 1, Lansdowne Road, Hackney, London, E.8, now manufacture a holder of exceedingly compact form.

Instead of adopting the usual tubular sockets to accommodate the valve pins a moulding is employed provided with grooves and springs over which the pins slide. Not only is reliable contact made



Very little baseboard space is occupied by the new Cason valve holder, the diameter of the mounting ring ⅜ being only 1¼ inch.

in this manner, but the valve is held securely by a moulding smaller in diameter than the actual space between the pins.

The holder is spring mounted on to a ring arranged for baseboard mounting, and of a diameter smaller than that of the moulded cap fitted to the valve. When it is desired to build a really compact set the adoption of this valve holder will be found useful, particularly if a number of valves are to be employed. The holder possesses good insulating properties, exceedingly low capacity between the connectors, and is of durable construction.

TRADE NOTES.

Scientific Research Instruments.

From Messrs. Adam Hilger, Ltd., 24, Rochester Place, Camden Road, London, N.W.1, we have received an interesting brochure describing developments in measuring instruments, including spectrometers, interferometers, photo-measuring micrometers, etc. The company now confines its activities to the manufacture of scientific instruments for research. In view of the growth in sales during the last few years the interesting inference is drawn that this is due to the intensive research work now applied in the production of British manufactures.

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A Book on the Super-het.

"The A B C of the Super-Het." is the title of a fascinating sixpenny booklet (post free 8d.) published by the Allied Newspapers, Ltd., Withy Grove, Manchester. In 88 pages, copiously illustrated, the writer gives a lucid description of the operation of the super-heterodyne receiver, and gives constructional details and useful hints on overcoming troubles. The book is designed primarily for the home constructor whose technical knowledge has been acquired by making and operating the ordinary types of receiver. Included is a half-sized drilling and wiring diagram of the eight-valve instrument described in the booklet.

SOURCES OF DISTORTION in Resistance Amplifiers.

Influence on Quality of Anode Resistance, Grid Leak, and Coupling Condenser Values.

By MANFRED VON ARDENNE.

DISTORTION of broadcast transmission is caused when the amplitudes of the oscillations sent out are not transmitted with exact proportionality or when the various frequencies are not transmitted equally. In the interests of good reproduction it is, therefore, necessary for all units responsible for the transmission, especially for receiving amplifiers, to have an amplification characteristic, which is, within certain limits, independent of frequency.

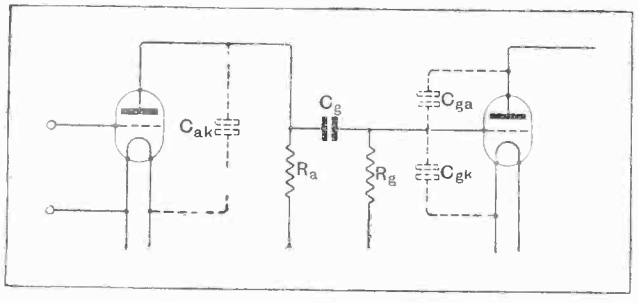


Fig. 1.—Schematic diagram of a single-stage resistance-capacity coupled amplifier showing inter-electrode capacities.

The thermionic valve used in all modern amplifiers functions independently of frequency by virtue of the freedom from inertia of electrons. Dependence upon frequency in amplifiers is first introduced with the coupling unit employed.

Of the various methods of coupling only that obtained through pure ohmic resistances offers theoretically a constant coupling over a very wide frequency range. Unfortunately, coupling through ohmic resistances is not entirely practicable. To begin with, the capacities formed between the electrodes themselves and the capacities of the unavoidable connecting leads constitute at the upper limit of audio frequencies a certain capacitative impedance which, as a rule, cannot be neglected if the ohmic resistances used for coupling are of the order of a million ohms. But at low frequencies also, the application of pure resistance coupling offers practical difficulties. If it were desired to convey the potential drop in the anode circuit of one valve *directly* on to the grid of the next, it would be essential to provide either a separate filament battery or a separate anode current supply for each stage. Further, since the grids of amplifying valves must be biased negatively with respect to the filaments (to avoid undesirable loading and distortion through grid current), it would be necessary to compensate for the D.C. potential drop on the anode resistances with special batteries. Apart from the fact that the setting up of such a pure resistance amplifier, especially when employing several stages, is attended by extraordinary practical difficulties, and apart from the necessity of several filament and anode batteries, pure resistance coupling possesses the further drawback of demanding battery potentials of a constancy which is difficult to attain.

Limitations of Pure Resistance Coupling.

All these disadvantages must be regarded as the reason why pure resistance coupling plays an unimportant part in amplifier technique. The objections mentioned are traceable to the fact that direct-current amplification takes place. Except for certain measurement purposes and, for instance, in arrangements in connection with recording

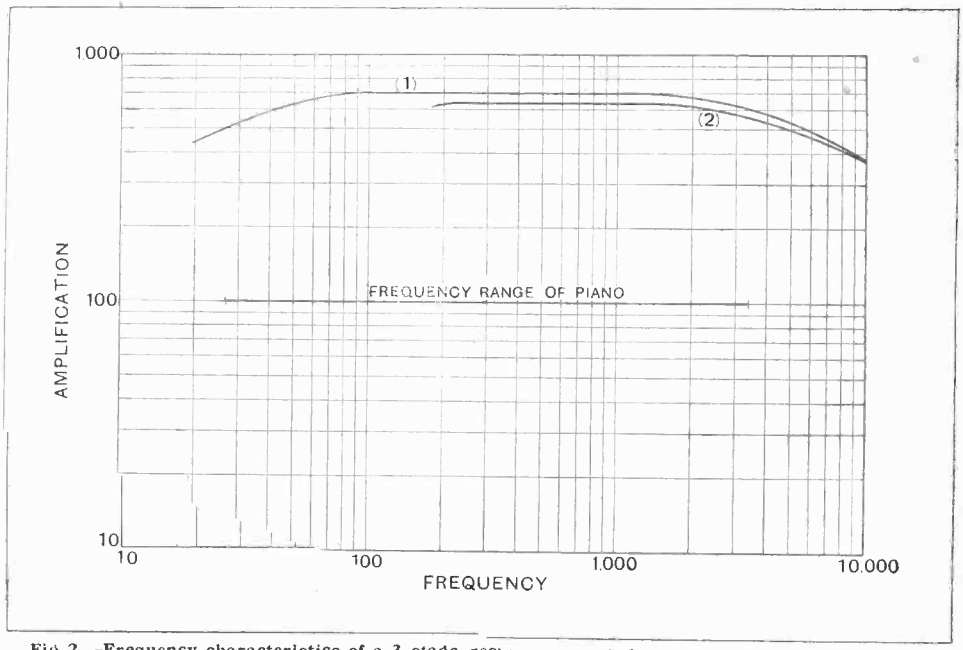


Fig 2.—Frequency characteristics of a 3-stage resistance-coupled amplifier showing the effect of changing the value of grid leaks (curve (1), 8.5 megohms; curve (2), 5.5 megohms). Anode resistances, 3 megohms; coupling condensers, 0.001 mfd.; internal resistance of valves, 700,000 ohms; amplification factor, 31.

Sources of Distortion.—

receivers, it is quite unnecessary that slow D.C. variations or oscillations below audibility should be amplified as well. Matters can here be assisted by conveying the varying but not the direct potentials of the anode resistance on to the grid of the next valve through a sufficiently large condenser.

The fundamental circuit diagram of such an amplifier with resistance-capacity coupling is reproduced in Fig. 1. In order to enable a negative potential to be imparted to the grid of the next valve with this type of coupling, a second resistance, the grid leak Rg, is necessary, which must be small compared with the insulation resistance of the valve and the internal resistance formed by the grid current of the valve. When using good coupling condensers it is quite possible to maintain their insulation resistance at an order of 1,000 megohms. Even the in-

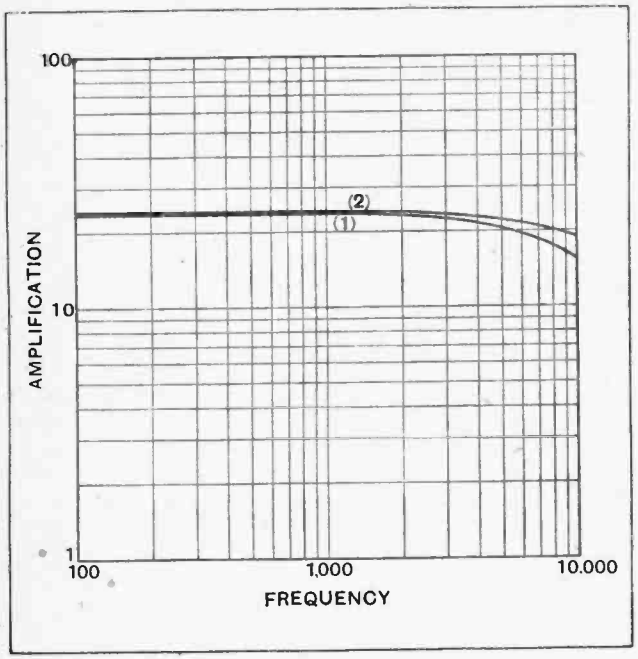


Fig. 3.—Calculated curves for the first and second stages of the 3-stage amplifier. In curve (1) (1st stage) the detrimental capacity is fixed at 0.00003 mfd., and in curve (2) (2nd stage) at 0.00002 mfd.

ternal grid resistance of the valve assumes a value of over 100 megohms on the application of a grid potential of minus 1 to 2 volts. It is then possible to use grid leaks of 5 to 15 megohms without fear of irregularities appearing in the amplifier. If grid leaks of 8 to 10 megohms are used, the oscillations at the lower limit of audibility of the human ear (about sixteen cycles) are still well reproduced if coupling condensers of 0.001 mfd. are used.

Fig. 2 curve (1) shows measurements[1] which, with the subsequent ones, were carried out in the writer's laboratory upon a three-stage resistance amplifier, and which confirm this statement. At frequencies around twenty

[1] For a description of the method of measurement see M. v. Ardenne, "Ueber die Dimensionierung von Niederfrequenzverstärkern unter besondere Berücksichtigung der Verzerrungen." *E.T.Z.*, Berlin, January, 1927.

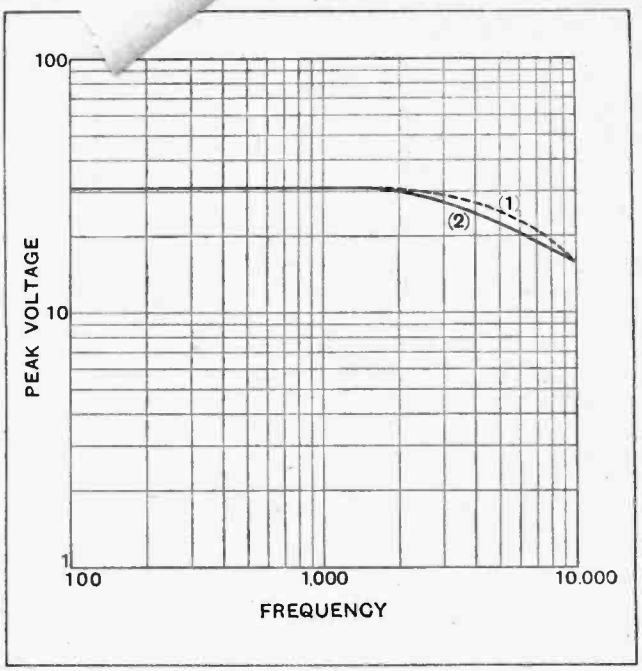


Fig. 4.—Calculated curve (1) and measured curve (2) for the two stages treated separately in Fig. 3.

cycles, which occur only in the lowest organ notes, the over-all amplification does not fall as low as half the amplification in the middle of the audible range. With the use of higher grid leak resistances or larger coupling condensers there are no difficulties preventing the notes at the lower limit of audibility being amplified to the same extent as the higher notes.

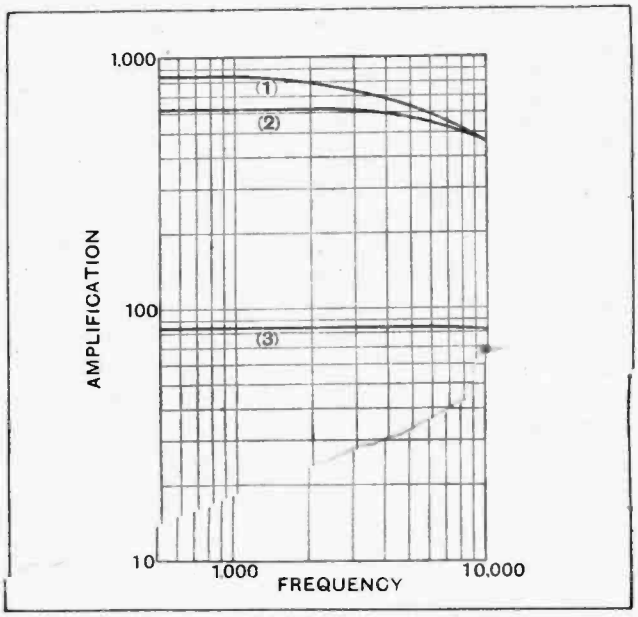


Fig. 5.—Curves showing effect on frequency characteristic of reducing the value of anode resistances Curve (1) R_a = 3 megohms; curve (2) R_a = 1 megohm; curve (3) R_a = 0.3 megohm. Grid leaks of 8 megohms were employed throughout, but in the case of curve (3) valves with an amplification factor of 10 were used as compared with 36 in the case of curves (1) and (2).

Sources of Distortion.—

In practice, however, this procedure would have two drawbacks. In the first place, if the very low frequencies are fully transferred without any diminution, distortion readily takes place through overloading of the valves. It is known that the low notes at a given physical loudness have much greater amplitudes than the higher notes. Further, if, in order to attain complete independence of frequency in the lower ranges, high-resistance grid leaks and large coupling condensers are used, large charges (such as might be caused by atmospherics) take too long to leak away. In the meantime reception is entirely stopped until after a certain interval the charge has leaked away through the grid leak and a grid potential suitable for amplification has once again been established. For the above two reasons it is as a rule inadvisable, when grid leaks of 8 to 10 megohms are used, to employ coupling condensers greater than 0.002 mfd.

With the usual electromagnetic headphones and horn-type loud-speakers, which, according to measurements by

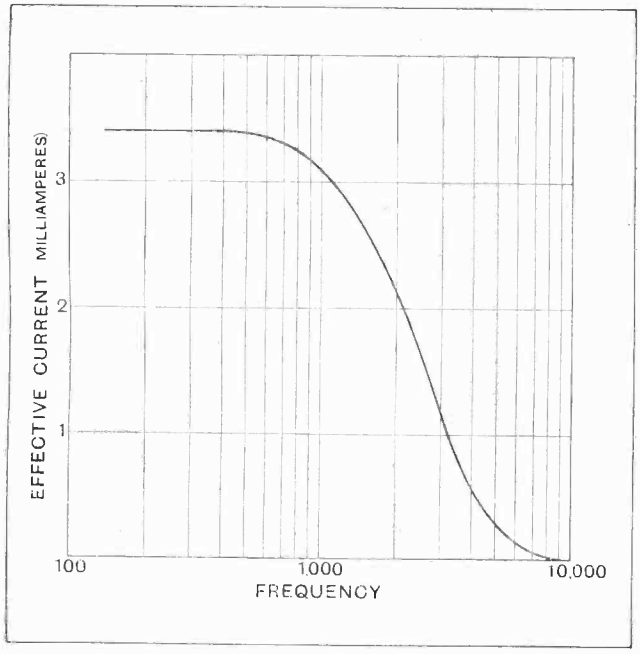


Fig. 6.—Effective current in a good electromagnetic type loud-speaker of inductance 2.35 H. with 0.0044 mfd. in parallel. Power valve: R_i = 10,000; amplification factor = 5; steady anode current 5 mA.

E. Meyer and E. Mallet, reproduce notes from below 100 to 200 per second extraordinarily badly, the use of still smaller coupling condensers (as low as 0.0005 mfd.) is suggested by the foregoing arguments.

The effect of choosing a lower value of grid-leak resistance on the A.C. voltage in the anode circuit of the last valve of a three-stage amplifier, other magnitudes being given, is shown in curve (2), Fig. 2. As measurement of curve (2) shows, apart from the greater variation with frequency in the lower audible range, the output voltage, *i.e.*, the amplification with lower resistance grid-leaks, is somewhat reduced. In a sense the reduction of the grid-leak resistances acts as though lower coupling resistances had been employed. At the same time the variation with frequency in the upper audible range, already mentioned above, due to unavoidable capacities, is somewhat less with lower grid-leak resistances. With frequencies up to 2,000 or 3,000 cycles the degree of amplification of the three-stage amplifier can be regarded for quantitative work as independent of frequency. At higher frequencies than this the amplification falls off, the amplification at 10,000 cycles near the upper limit of audibility becoming about 50 per cent. of the amplification in the middle of the audible range.

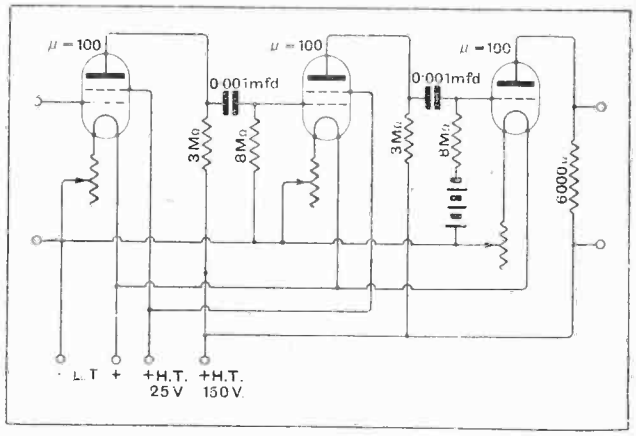


Fig. 7(a).—Resistance amplifier with four-electrode valves.

Without entering further into theoretical details here, we reproduce in Fig. 3 amplification curves calculated on the basis of the stated values for frequencies from 100 to 10,000 cycles. The two curves show the variation with frequency of the first and second stages of a three-valve resistance amplifier. Since the last amplifying stage has in itself nothing to cause a further variation with frequency, the resulting frequency characteristic of a three-stage amplifier is given actually by the product of the two curves. On examination of the two curves in Fig. 3 it will be noticed that for the last voltage-amplifying stage but one a value of 0.00002 mfd. is taken for the detrimental capacity in the calculation. This small value of capacity was assumed, on theoretical grounds which cannot be gone into further here, from the low amplification of the last valve.

The frequency variation resulting from the above-mentioned curves in Fig. 3 is reproduced in Fig. 4. From comparison of the measured with the calculated curves it is apparent that the values for the detrimental capacity in the normal[2] arrangement of valves and components considered here were approximately correctly assumed.

Fig. 5 gives some further measurements from which can be obtained the frequency relation of the amplification for the value of anode resistances employed. Just as with transformer-coupled amplifiers with a lower step-up ratio, where the amplification though somewhat lower is more uniform with frequency, there is also a smaller frequency variation and lower amplification in resistance amplifiers (where the value of the anode resistances governs the step-up ratio) attending the use of lower anode

[2] In contradistinction to the capacitative "multiple valve" arrangement.

Sources of Distortion.—

resistances. At the same time a further measurement is reproduced in Fig. 5 showing the degree of amplification of a three-stage amplifier with the constants that used to be employed (R_a = 0.3 megohm, valves with a magnification of 10). The degree of amplification of such an amplifier reached 84. The degree of amplification is here taken as the ratio of the amplitudes of the output alternating voltage (measured across a pure ohmic anode resistance of 6,000 ohms) to the input voltage. As against the 84-fold amplification of the original amplifier, an amplifier based upon the writer's researches with anode resistances of 3 megohms and valves with an amplification factor of about 31 yield just about ten times the amplification.[3] With the use of anode resistances of only one million ohms the amplification falls from 840 down to 620. In order to decide which of the two curves is most advantageous in practice for broadcast reception, various other factors outside the amplifier itself have to be considered.

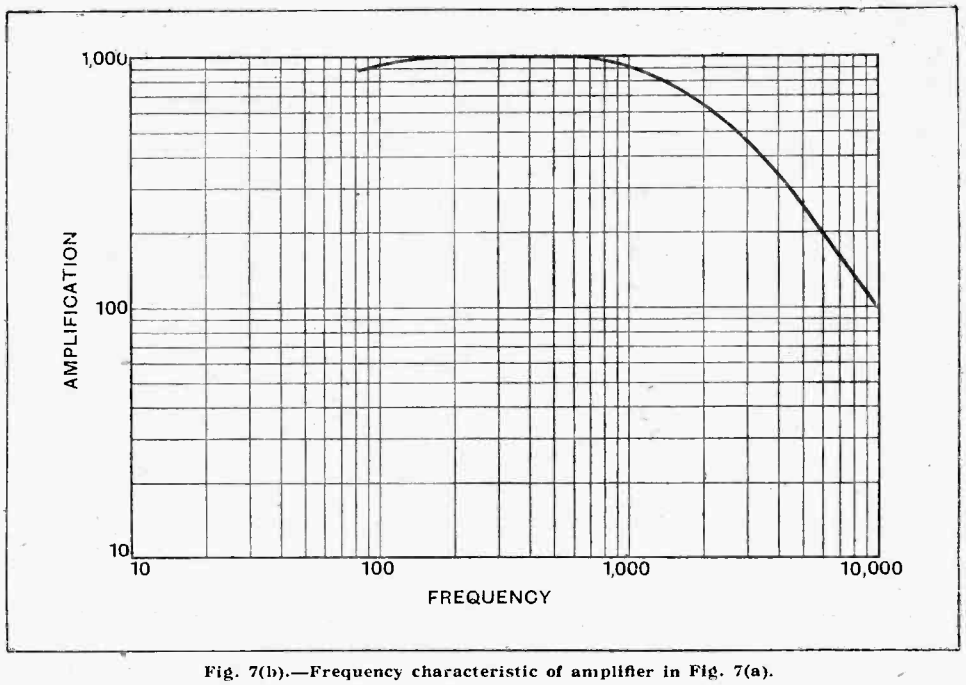


Fig. 7(b).—Frequency characteristic of amplifier in Fig. 7(a).

When the amplifier is used for distant reception the existing slight sacrifice of notes above about 3,000 cycles can be completely ignored in comparison with the frequency-response characteristic necessary in this case for selectivity. A slight suppression of the very high frequencies is, in fact, to a certain extent desirable with otherwise ideal reproducing instruments in order to reduce the interference from "mush," the average frequency of which is high.

[3] Further details on this subject will be found in the author's book, "Der Bau der Widerstandsverstärkern" (The Construction of Resistance Amplifiers), published by R. C. Schmidt, Berlin.

Loud-speaker Characteristics.

With the common horn loud-speakers, the deficiencies of which are of a different order, the afore-mentioned frequency dependence in amplifiers with the suggested values is in any case immaterial. With many loud-speakers and receiving equipments a condenser of about 0.005 mfd. is connected across the loud-speaker further to suppress the higher frequencies, as has been mentioned to be sometimes desirable. In Fig. 6 the currents through the loud-speaker windings at various frequencies are measured when a condenser of 0.0044 mfd. is connected in parallel. Measurement was carried out on the loud-speaker just as marketed. The value mentioned for the parallel capacity is that of the condenser incorporated in the loud-speaker by its manufacturers.

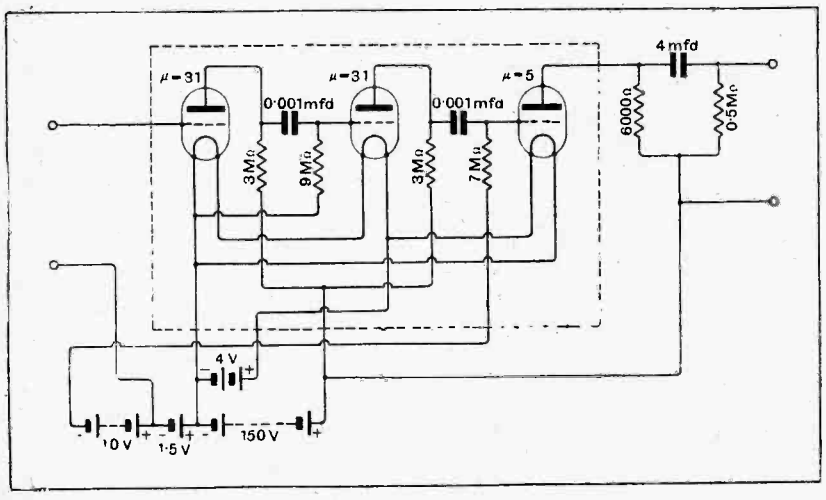


Fig. 8(a).—Circuit diagram of "multiple-valve" resistance-capacity coupled amplifier arranged for frequency measurements.

This measurement, which naturally throws light on the electrical side only, shows that the effective current falls off rapidly with frequencies above 1,000 cycles. At 5,000 cycles the effective currents become only about a tenth of those below 1,000 cycles. This determination, taken for a model so manifestly dependent upon frequency, shows clearly that the frequency-variation hitherto considered in resistance amplifiers is altogether unimportant.

Matters would be different if one were to employ suitable double-grid valves

Sources of Distortion.—with the screen-grid connection instead of special single-grid valves (the latter always possessing considerable capacities). These double-grid valves certainly permit high amplification, and might be developed and put on the market if their internal resistance were not so high.

Advantage of Multiple Valves.

The curve in Fig. 7(b) enables us to compare the amplification and frequency characteristic yielded by the normal amplifier circuit with that of a three-stage amplifier having double-grid valves. At a frequency of 10,000 the amplification here falls to about one-tenth. Even with this amplifier the frequency-variation is substantially less than with the usual loud-speakers. With the double-grid valve amplifier the output voltage has been measured across an ohmic resistance of only 6,000 ohms, as has also been done in the case of the multiple valve amplifier in Fig. 8(a). The degree of amplification was taken in the usual way as the ratio of output to input voltage. The unusually small capacities used in the multiple-stage set of S. Loewe ensure that a nearly ideal independence in amplification of frequency is obtained in the upper audible range. The amplification of such an amplifier averages about 700 with the output resistance mentioned above. In cases where higher anode resistances are connected in circuit with the last valve in order to measure the pure voltage amplification, the figure for the amplification increases to about 2,000 with most models.

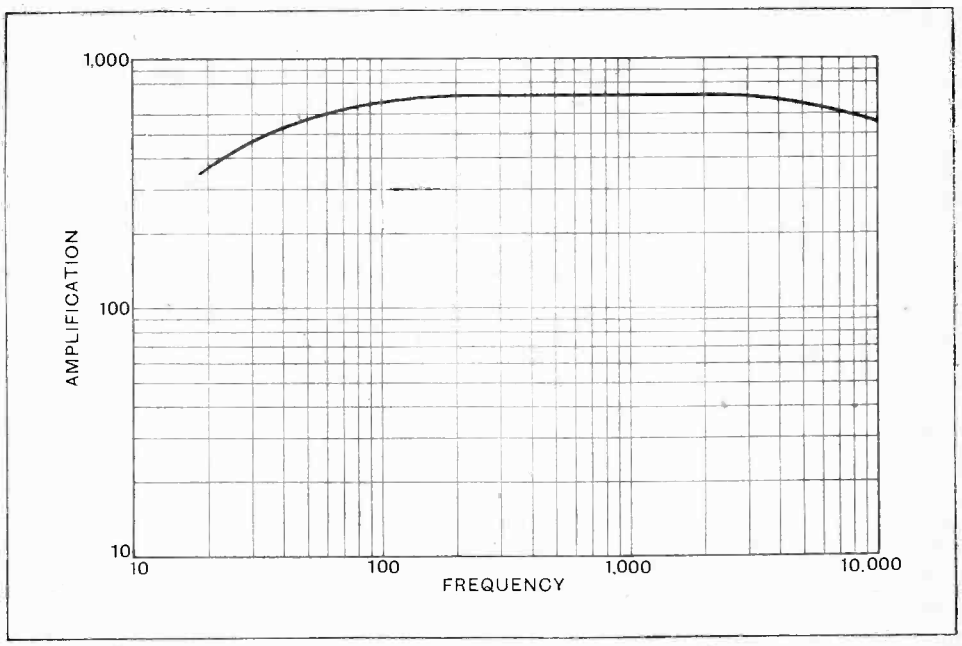
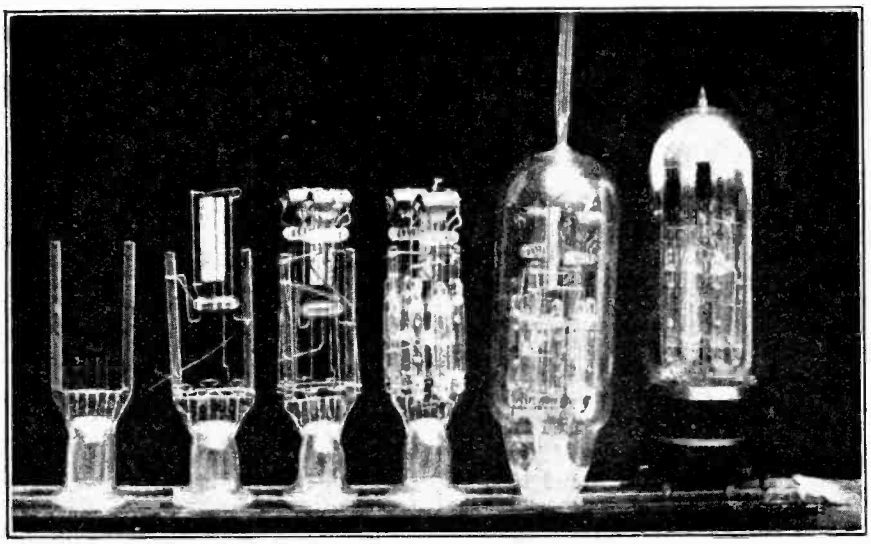


Fig. 8(b).—Frequency characteristic of "multiple valve" amplifier in Fig. 8(a).

Having clearly established with the measurements given that a sufficient freedom from frequency-variation is to be had in resistance amplifiers with a high degree of amplification, it is still necessary, in order to estimate the freedom of the amplifier from distortion, to know whether any variation with amplitude is present. In the voltage-amplifying stages such variation with amplitude is not likely to occur, since the operating characteristic is particularly linear, especially when very high anode resistances are used. On the other hand, it very easily arises that distortion is set up in the final valve through unduly high alternating potentials being applied to the grid and the valve not working on the straight portion of its operating anode current characteristic. Unless these details are carefully attended to the output valve will run into grid current and the normal grid bias will be temporarily upset through the coupling condenser acquiring a permanent charge. To avoid the latter form of distortion one must, with a given arrangement of amplifier coupling, be satisfied with sufficiently moderate output strength. With most final amplifying valves the danger of over-loading may be diminished by the use of a high anode voltage, suitably large grid bias, and by the use of valves with the lowest possible internal resistance. Valves operating under these conditions have a characteristic with a considerable straight portion on the negative side of zero grid volts.



Successive stages in the manufacture of a three-stage, resistance-capacity coupled multiple valve amplifier.

News from All Quarters: By Our Special Correspondent.

Broadcasting in Algiers.—Summer Tests from Daventry Junior.—Boat Race Broadcast Plans.—Glasgow Night for Railwaymen.

Brightening the Arabian Nights.

British listeners may not be entirely satisfied with the broadcast service in this country, but they can console themselves with the thought that, in broadcasting as in other matters, it is better to be a Britisher than an Arab. At any rate, this is the impression I gain from an interesting communication from a correspondent in Algiers, where the Algerian Post Office have astonished the locality by erecting a 100-watt transmitter on their building in that town.

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The Redoubtable Monsieur Colin.

No beneficent corporation exists for providing Algiers with a continuous flow of broadcast entertainment, consequently the service is rather irregular, not to say inadequate. The bulk of the programmes are provided by Monsieur P. Colin, a local music dealer, who also keeps a limited amount of wireless gear.

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Strange Official Attitude.

Among the more enthusiastic listeners complaints are made that the French Posts and Telegraphs Department do not encourage broadcasting in Algeria. This seems a pity, in view of the extreme interest which the Arabs are reported to be showing in the innovation. An efficient broadcasting system would appear to be a particularly useful medium for propaganda and calculated to assist the French in their laudable efforts to provide "the noble Arab" with education.

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"Gay Paree" in the Desert.

The Algiers station transmits as a rule between 9.45 and 11 p.m. (G.M.T.) on 310 metres. A proposal is afoot to relay programmes from the Eiffel Tower.

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Beneath Criticism?

In Tunis broadcasting flourishes to an even lesser degree than in Algiers. It appears that perfunctory and half-hearted programmes are broadcast occasionally by a station under French military control situated between Tunis and Carthage. The transmissions come in for but little criticism, probably because they are not worth criticism.

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Picking Up Europe.

A phase of wireless in Tunisia which wears a brighter complexion is the reception of European stations. Many enthusiastic listeners are to be found in the district, and the majority report the reception of Radio-Paris, Vienna, Toulouse, Prague, Breslau, and even Moscow. Strangely enough, the British and German stations are not being picked up so well this year as last.

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Daventry Junior.

Our anticipative notes on the subject of the short-wave station about to be brought into operation at Daventry have perhaps given readers the impression that this will at once be used for regular broadcasting service. This is not the case. The station is purely experimental, and there is no evidence at present that the Post Office will license it for broadcasting. Some time during the next month tests will be commenced extending over several weeks. The station will then close down for a further week or so for the adjustment of the apparatus and, probably in July, a fresh start will be made with rather more elaborate equipment. At the end of two or three months the Post Office authorities will decide whether "Daventry Junior" shall be used as a regular broadcasting station. The power used during the tests will be about 20 kW., as predicted by *The Wireless World*, and the wavelength will probably be about 400 metres.

o o o o

Un-Corked!

A true Hibernian fragrance surrounds the present activities of the Cork broadcasting station, in view of the fact that it is not yet "officially opened." Unofficially it is crowing quite lustily on 400 metres, but officially . . . it is as silent as the grave.

The long-awaited ceremony will probably be conducted by Mr. J. J. Walsh, Minister of Posts and Telegraphs.

FUTURE FEATURES.

Sunday, April 3rd.

LONDON.—Popular Ballad Concert.
GLASGOW.—Mendelssohn's "Hymn of Praise."
BELFAST.—Carillon from St. Patrick's Cathedral, Armagh.

Monday, April 4th.

LONDON.—"The Long Arm of Co-incidence," by Dion Titheradge.
BOURNEMOUTH.—Orchestral Concert relayed from the Winter Gardens.
BELFAST.—"My Programme," by Joe Devlin, M.P.

Tuesday, April 5th.

LONDON, MANCHESTER.—Concert of Sir Hamilton Harty's Works, conducted by the composer.
CARDIFF.—"The Height of the Brow," a musical programme.

Wednesday, April 6th.

BIRMINGHAM.—"By Virtue of a Broadcast," by Frank H. Shaw.
MANCHESTER.—Overtures, Marches and Waltzes.
BELFAST.—English Memories.
GLASGOW.—Scottish Programme.

Thursday, April 7th.

LONDON.—B.B.C. National Concert at the Albert Hall, conducted by Siegfried Wagner.

Friday, April 8th.

LONDON.—Band of the Royal Regiment of Artillery.
ABERDEEN.—Dramatic Excerpts and Songs from Shakespeare.

Saturday, April 9th.

LONDON.—An Hour of Edward German's Music.
BIRMINGHAM.—Organ Recital by Frank Newman.
Popular Celebrity Concert relayed from the Central Hall.
CARDIFF.—"Our Programme," by the Barry Island Radio Club.
BELFAST.—Comic Opera "The Rose of Auvergne."

Broadcasting the Boat Race.

All arrangements are now completed for broadcasting the progress of the boat race, and the plans foreshadowed in our issue of March 16th will be carried out. Mr. Guy Nickalls will follow the race in the launch *Magician*, and will be accompanied by the well-known writer Mr. J. C. Squire, so that nothing should be lacking either in the description of the scene or in an authoritative commentary on the race. The signals received at Mr. W. Secretan's station in Castelnau will be relayed to Savoy Hill by land line.

Death of a Broadcasting Pianist.

Cardiff station has suffered a great loss in the sudden death of Vera McComb Thomas, pianist and accompanist at the station since the early days in Castle Street. Nearly a year ago she was able to claim that she had played for broadcasting over a thousand pianoforte solos, fourteen piano concertos, accompanied fifteen hundred songs and numerous instrumental items, and on four occasions broadcast to America in the early hours of the morning. Madame Thomas was the wife of Mr. A. T. Thomas, of the Welsh Board of Health.

A Railwaymen's Programme.

The Glasgow evening programme on April 12th will be a railwaymen's night. Artistes provided by the L.M.S. and the L.N.E.R. will include a general superintendent, a station-master, an engine-driver and a passenger: the last, barring accidents, I understand will be John Henry himself. Listeners may, therefore, look forward to an edifying time.

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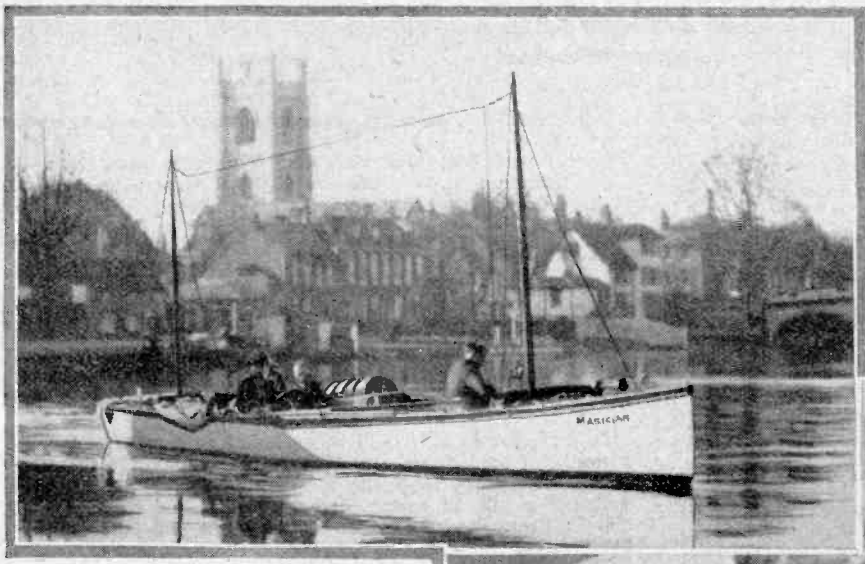
Dodging Tramway Interference.

A commendable attempt to reduce broadcast interference caused by electric trams is being carried out in Vienna.

The trolley on each car is now fitted with an extension which carries a second contact set back about 3ft. from the main contact. When the normal contact is passing over a triatic and tending to spark, the second contact has not reached the triatic, but serves to take the current temporarily until the main contact has resumed proper touch. By this method sparking is avoided, and much of the interference is reported to have ceased.

It has also been found that a great improvement can be effected by the use of carbon-to-copper contacts instead of metal-to-metal.



THE MOTOR LAUNCH "MAGICIAN," fitted with a portable transmitter, that will be used on Saturday to broadcast a commentary of the Boat Race. The progress of the race will be described before a microphone located on the bows.

Owing to the height of the aerial the launch will have to pass through the highest arch of Hammersmith Bridge, and special permission for this has been obtained from the Port of London Authorities.

The transmission will occupy about three-quarters of an hour in all. From 1.30 to 1.45 there will be introductory remarks on the crew, weather conditions, the course, the crowds and other items of interest; from 1.45 to 2.5 (approximately) there will be a running description of the race, and the last ten minutes will probably be occupied by a general summary of the event.

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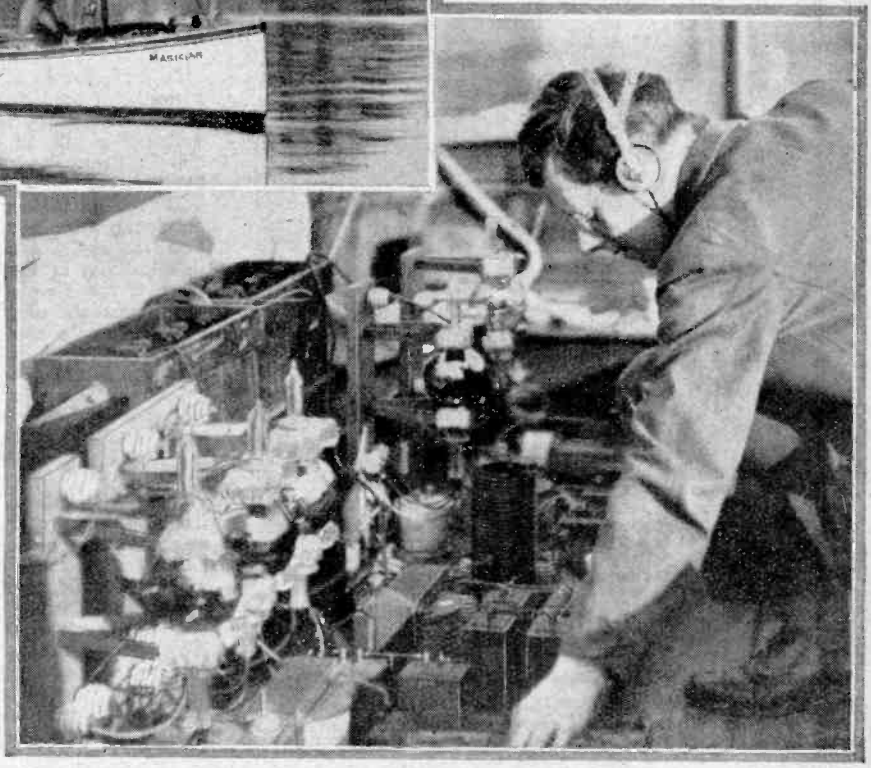
Checking "Pirates" in S.A.

The Johannesburg broadcasting station, which owns the distinction of being the first important station to close down for financial reasons, will shortly resume regular programmes under the control of a new South African broadcasting company.

An unusually interesting method of checking "piracy" is to be adopted. Under the scheme the sale of wireless apparatus to non-licence holders will be prohibited.



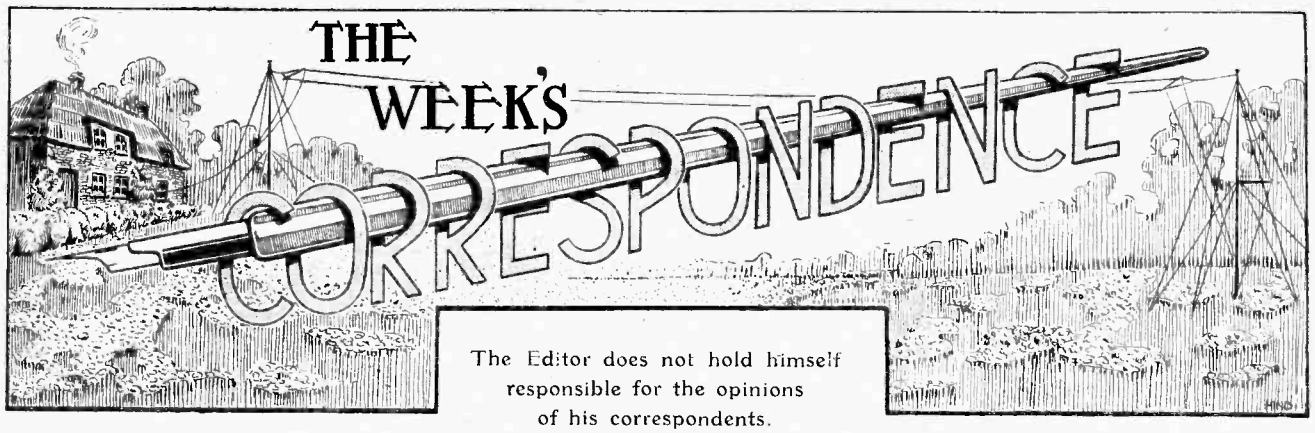
The short-wave transmitting gear which will maintain communication with a receiving station at Castelnau from where a land line will connect with Savoy Hill.

The "Variety" War.

I understand that the B.B.C. has received a statement from Mr. Charles Gulliver in which he categorically dissociates himself from the alleged hostilities against broadcasting of which he has been represented as the sponsor.

More Power at Copenhagen.

The Copenhagen station will soon be heard in this country at greater strength than at present. A new 5-kilowatt transmitter of British make is to replace the 2-kilowatt plant now in use. Copenhagen works on 337 metres.



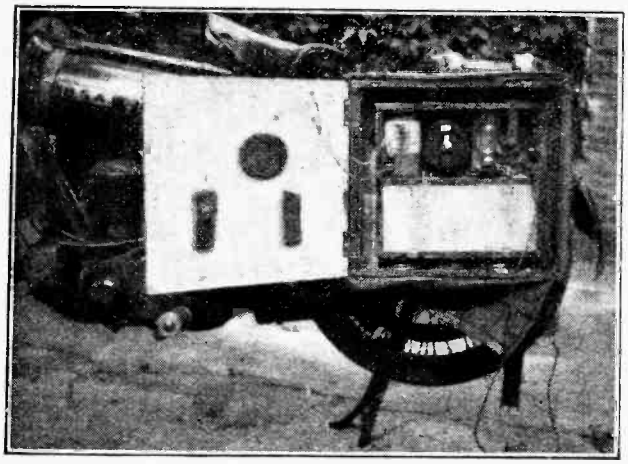
The Editor does not hold himself responsible for the opinions of his correspondents.

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.

A MOTOR CYCLIST'S PORTABLE SET.

Sir,—I am sending a photograph of my portable set which I think might be of interest to some of your readers.

The set is a single-valve Armstrong "Super." The frame is mounted on the outside of the door which can be seen on the left-hand side. The tuning coils are on the left-hand side, the reaction sliding inside the grid coil on a special type of mounting. The quenching coils are on the right-hand side. The distance between these coils can be varied at will. The condenser and telephone plug are on the extreme right.



Portable Armstrong super-regenerative receiver mounted on the carrier of a 2¼ h.p. B.S.A. motor cycle.

H.T. and L.T. batteries and phones are housed in the bottom compartment. The set is sprung in an oak case measuring 15in. × 16in. × 5in., this outside case being covered with a waterproof case, and slung on the side of the machine by means of brackets.

The photo was taken after a 700-mile tour in Devon and Cornwall. Except for about 100 miles, the valve, a 1-volt "Ora," was carried in a small pouch on the other side of the carrier for safety.

L. W. PETTITT.

Orpington.
March 8th, 1927.

VALVES FOR THE "EVERYMAN FOUR."

Sir,—In further reference to valves for the "Everyman Four," it may be of interest to your readers to know my results with the new "Cossor" 6-volt series.

I have tried practically all the well-known makes of English valves, as well as one or two American, and the new Cossors (particulars of which are given in the accompanying table) easily give the most satisfactory results. They also have the added advantage that there is not the slightest trace of microphonic noise, however roughly the set may be handled.

TABLE.

	V_1	V_2	V_3	V_4
Type	610 H.F.	610 H.F.	610 H.F.	Stentor 6
H.T. voltage	90	85	120	120
G.B. voltage	1½	1½ to 3	1½	18
H.T. consumption in mA.	1	0.5	2.5	6

Since these valves function at considerably below 6 volts it will be necessary to use a resistance of at least 60 ohms for V_1; this can conveniently be made up of a fixed resistor of 15 ohms and a variable resistance of 50 ohms.

In reference to V_2 it will be necessary to short-circuit one of the resistor holders and employ a 15 ohm resistor in the other; it is also necessary to employ a separate G.B. battery of 1½ or 3 volts; this will, of course, necessitate the lead to between R_3 and R_1 being disconnected from that point and taken up by a flexible lead to a suitable tapping on the G.B. battery.

It will be noticed that the anode voltages are below those previously recommended for certain other combinations of valves, but even so the volume will be found to be greater without loss in selectivity or tone. Increasing the anode voltage of V_1 will increase the volume still further, but it will also bring in a certain amount of mush, which is obviously undesirable.

It is hardly necessary for me to compliment you on this receiver; there is not the slightest doubt that it is "the" set of the 1926-1927 season

I have no interest in Cossors other than being a very satisfied user of their products.

H. GOODWIN.

Elstree.
March 9th, 1927.

Sir,—With reference to the short article on "Wood Stain and Polish," on page 284 of your issue of March 9th, as these are processes that come under my control in my daily life may I suggest some modifications that I have found easier for most amateurs to do, and which give excellent results?

Purchase, instead of potassium permanganate, a small quantity of dry mahogany or walnut water stain, sold as granules. Add about a tablespoonful to half a pint of water, and allow to stand over night.

Next day heat it and stir until just too hot to put the hands into. Now apply a liberal dose with a brush to the article to be stained, doing only *one* side at a time; so long as the surface is all covered, lines and marks do not matter, as, as soon as you have completely covered one side, and while it is *still wet*, get a large duster of loose texture—old lace curtain washed free from starch is ideal—and wipe off all the stain you can get to come off, using long, firm strokes in the same direction as the grain of the wood. Then proceed to carry out the same process on the other side. If done with just ordinary care this will give a surface quite even in colour and free from brush marks and patches.

After staining apply a coat of french polish (not naphtha varnish) with a large soft brush; put it on freely and evenly, and let dry; after it is quite dry, carefully clean down with fine

glasspaper, using the paper with strokes in the same direction as the grain of the wood.

NOTE.—Do *not* glasspaper before applying the polish.

After this, a liberal coat of boot polish or more french polish can be used, according to taste, but the boot polish makes quite a nice finish. CHAS. W. STONE.

Birmingham, March 13th, 1927.

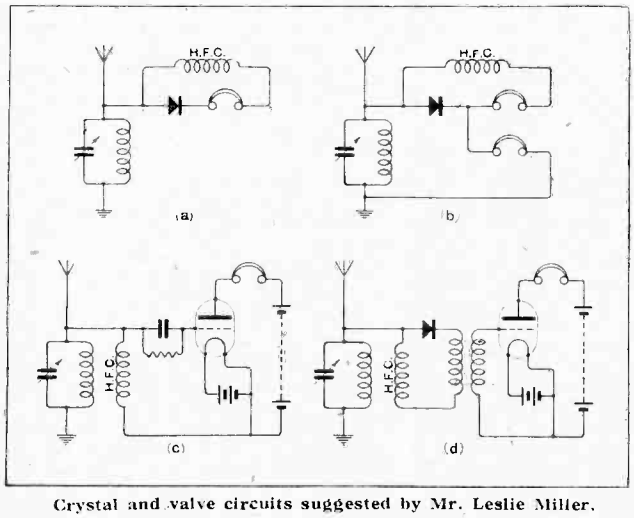
AERIAL CIRCUIT CONNECTIONS.

Sir,—When the connection from the end of the telephones in an ordinary crystal receiver is taken back to the aerial terminal instead of being joined to earth, broadcasting from such a station as 2LO can still be heard without difficulty at least as far as 6 miles away. The reason is that the telephones act partly as an H.F. choke that prevents the high-frequency currents going round the loop one way while allowing the rectified L.F. to pass along the other. A microammeter in the circuit shows this, but the current registered is only about a quarter of what a good earth would give. The unidirectional current serves, however, to show the effect is not due to capacity, for this would give alternating current that could not actuate a moving-coil, permanent-magnet meter.

To make the circuit a really efficient one, all that is needed is a good high-frequency choking coil, interposed between the telephones and the aerial terminal, as shown at (*a*) in the diagram. The choke should be of the low-loss type, but its chief purpose is to stop H.F. and let L.F. pass. A well-made basket coil will answer quite well, but it is essential that the self-capacity must be very small or the H.F. will get through.

The choking coil must, of course, be wound to suit the wavelength for which it will be used. For broadcasting, below 400 metres, inductance coils with 150 to 200 turns (1,200 to 2,300 microhenries) will be about right. Therefore the tuning coil for Daventry can be used as a choke for 2LO; while the choke for Daventry itself should have about 600 turns.

With a good choke no difference at all can be perceived in the loudness of reception between the new circuit and one with the telephones connected to earth; nor is there any difference in the reading on the microammeter. What little increased loss there must be in the choke over the tuner can be more than counter-



Crystal and valve circuits suggested by Mr. Leslie Miller.

balanced by closer tuning, and in any case it is insignificant compared with the other losses. The choke connection to an aerial terminal may therefore be regarded as the electrical equivalent of a connection to earth. This is most easily demonstrated by means of the multiple circuit (*b*), for which a common rectifier is employed (in order to avoid using two crystals, which can never be alike) as well as a common tuning point.

Although it is advisable to attach the loop circuit close up to the top of the tuner, a single insulated wire may be used as an extension, and the writer was rather surprised to find he could still hear 2LO comfortably, though much reduced in loudness, with 60 feet of single cable lying on the floor between him and the tuner. There is, however, no novelty in the use of a single wire extension, and it is better to employ the usual twin flexible.

As regards the load thrown on the aerial by the closed loop, it must be practically the same as with an earth.

It might reasonably be thought that anything done inside the closed ring would not affect the aerial of a neighbour, but this remains to be proved. The writer finds that two circuits of his own, which are only a few yards apart, react on one another; but apparently not easily.

It should clearly be understood that the current that actuates the telephones flows round the ring, and is not a capacity current to earth. Capacity effects are, however, present, the chief being due to the telephones and their cords to earth. This is not a disadvantage, but the contrary, as it affords a path by which any H.F. that has passed unchanged through the rectifier is drained off to earth. This can be demonstrated by removing the telephones from the circuit and touching the back terminal of the rectifier with one finger, or connecting to earth through an adjustable 0.001 mfd. condenser. This will often double the reading on the microammeter.

Finally, the application of the circuit to valves must be briefly touched upon. Owing to the large capacity of the H.T. and L.T. batteries to earth, the new circuit does not seem likely to be so useful as with crystals. The diagrams (*c*) and (*d*) show two of the simplest applications, but it is quite possible there are others where it can be used to more advantage. Also, it seems as if this no-earth system might be applied to the aerial itself. LESLIE MILLER.

London, S.W.16.

February, 1927.

HIGH POWER STATIONS.—B.B.C. STATEMENT OF POLICY.

Sir,—Appreciating both the public-spirited motive and the independence of your attitude in dealing with broadcasting matters, I am sure you would wish me to join issue with you on the few occasions when I believe your conclusions are definitely wrong.

With regard to the leading article in your issue of March 2nd, I am sorry to note an undercurrent of innuendo. This, I believe, is best answered by a clear statement of the fundamental facts of our present policy.

You suggest first of all that we have left the crystal user out of account, and that those listeners who are close to the new high power transmitters will be at a disadvantage. Now our plan is quite definitely to place the new high power transmitters well away from the large centres of population at present served by broadcasting, and to give in general the same field strength over large towns as we do to-day, thereby not altering conditions in this important respect.

Secondly, as the alternative programmes are proposed to be each of the same strength, i.e., radiated from the same point, the need for ultra selectivity in receiving sets does not exist. Any set not being able to select between two equal strength programmes with considerable wavelength separation will be unable to cut out the Continental station of the future, working with only 10 to 20 kilocycles separation, and must be extremely out of date and badly designed. In some experiments we found that a reasonably well-manufactured set, crystal or valve, gave the owner a choice between two programmes of equal field strength without interference one with the other.

Thirdly, on the question of competition in power and your, perhaps, unfortunate suggestion of an international struggle in the ether. I am sure that you underestimate the significance and the authority of the International Committee of Broadcasters which is now engaged in examining this very question, and is fully alive to the implications of the sane development of international broadcasting conditions.

Fourthly, the basic reason why high power is essential to any adequate new scheme of distribution is that it is a prerequisite to an uninterrupted service for every wireless user in the country. A lot of low power stations cannot fulfil this condition.

THE BRITISH BROADCASTING CORPORATION,
P. P. Eckersley, Chief Engineer

London, W.C.2.

March 14th, 1927.

READERS' PROBLEMS ANSWERED

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

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

Three-valve Frame Aerial Set.

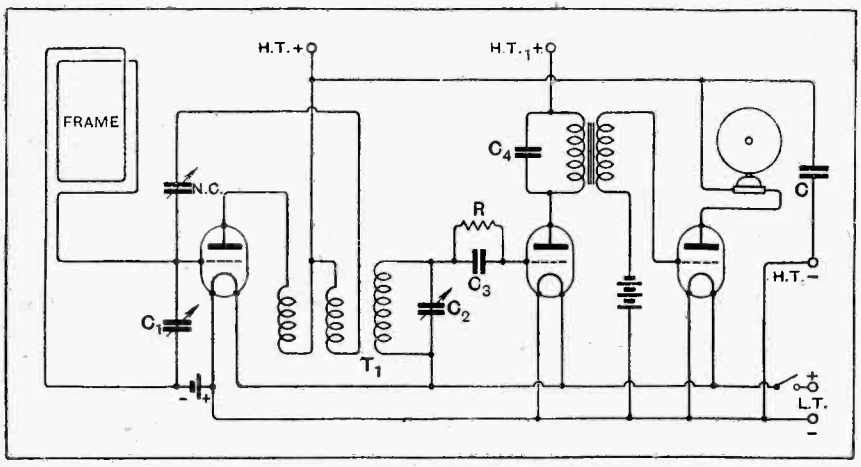
Would you please give me details of a three-valve receiver suitable for use with a frame aerial? I wish to receive the local station at good strength and to have reasonable quality of reproduction and yet be able on occasions to hear distant stations at fair telephone strength. The valves used should be of the 2-volt type taking about 0.1 ampere each. F. L.

A circuit diagram of a three-valve receiver having one stage of tuned high-frequency amplification, a valve detector and one low-frequency stage is given here. A frame aerial tuned by condenser C_1 of 0.0003 mfd. is connected to the input of the first valve, the grid being biased negatively to 1.5 volts. The coupling between the high-frequency and detector valves is of the type developed by Mr. W. James for the "Everyman Four" and other receivers; it has a primary and balancing windings of 14 turns each of No. 40 D.S.C. wire and a secondary of 68 turns of No. 27/42 silk-covered Litzendraht wound on a former 3in. in diameter and 3½in. long. Condenser C_2 of 0.0003 mfd. tunes the transformer. Grid condenser C_3 has a capacity of 0.0002 mfd., and the grid leak R a resistance of 1 megohm.

A transformer coupling is used between the detector and the low-frequency valve. This is provided with a by-pass condenser C_4 of 0.0003 mfd. if one is not already included in the transformer itself. Naturally, this transformer must be a good one to ensure good quality. Condenser C of at least 2 mfds. shunts the H.T. battery.

It will be noticed that no filament rheostats are used, but that a switch is included in the filament circuit. In a circuit of this sort it is important to use valves having suitable characteristics. For the H.F. position one with an A.C. resistance of between 20,000 and 30,000 ohms should be used with a similar valve in the detector position; for the output stage a valve with an A.C. resistance of not over 10,000 ohms should be used. Normally, an anode voltage of 120 will be required for the H.F. and L.F. stages with about 60 for the detector.

This receiver will tune from 200 to nearly 600 metres and be perfectly stable; the setting of the balancing condenser, however, determines to some extent the characteristics of the receiver, and for this reason should be carefully adjusted. As a frame aerial is used it is not necessary to set this condenser in the position to give a more or less perfect balance; it should be set a little above or below this position so that a certain amount of reaction is introduced into the frame aerial; at the same time care should be taken that the receiver is not worked too near the oscillating point. If the receiver is practically oscillating the quality will very likely be poor.



A three-valve frame aerial receiver suitable for loud-speaker reproduction of the local station and for the telephone reception of distant stations.

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Resistance-coupled Amplifiers.

I often hear it said that a resistance amplifier using anode resistances of a high value amplifies without distortion, but it seems to me that this cannot be true and that there is not very much to choose between a resistance amplifier of this type and a carefully made transformer-coupled amplifier. Am I correct, please? J. McD.

Resistance amplifiers using an anode resistance of the order of 2 megohms and a grid leak of, say, 5 megohms, with a very small coupling condenser such as 0.0001 mfd., certainly distort very badly. In the first place, the lower notes are suppressed owing to the small value of coupling condenser used, and, secondly, the higher notes are not amplified to any great extent because of the circuit capacities, which have a relatively low impedance as compared with the ohmic resistance of the grid and anode resistances. If a curve were drawn showing the amplification at various frequencies the curve would start at a low value at, say, 25 cycles, rise to a maximum at between 500 and 1,000 cycles, and then fall off rapidly at the higher frequencies. Anyone possessing a good loud-speaker can verify these facts for himself.

So far as transformer amplification is concerned, a good transformer used with a low-impedance valve will give better quality as a rule than the type of resistance amplifier discussed above. The transformer must, of course, be a good one and be used with a low-impedance valve, but such transformers are easily obtained, and, even though a valve having a low A.C. resistance is used, a voltage step-up of about 35 per stage is easily obtained. This compares very favourably with the amplification given by one stage of resistance coupling when anode resistances of the grid leak type are used. Stray capacities are naturally not so serious when an anode resistance of, say, ½ megohm is employed, and the lower frequencies can be brought up in strength by using a coupling condenser and grid leak of suitable proportions.